ISEA2019
Gwangju, Korea
Lux Aeterna

25TH INTERNATIONAL SYMPOSIUM ON ELECTRONIC ART

June 22 (Sat) – June 28 (Fri), 2019
Asia Culture Center
Gwangju, Korea

PROCEEDINGS

ISEA2019

Juyong Park
Juhan Nam
Jin Wan Park *Editors*

ISEA2019 Gwangju LUX AETERNA

Proceedings of the 25th International Symposium on Electronic Art

Editors: Juyong Park, Juhan Nam, Jin Wan Park

Cover Design: Page Communications

Art Center Nabi
4th Floor, SK Building, 26 Jong-ro, Jongno-gu, Seoul, Korea

Printed in Gwangju
ISBN: 979-11-87275-06-0

CREDITS

General Chair

Soh Yeong Roh, Director, Art Center Nabi

Honorary Chair

Kwangyun Wohn, Chairperson, National Research Council of Science and Technology

Academic Directors

Juyong Park, Associate Professor, Graduate School of Culture Technology, KAIST

Juhan Nam, Assistant Professor, Graduate School of Culture Technology, KAIST

Jin Wan Park, Professor, School of Computer Science and Engineering, Chung-Ang University

Artistic Director

Namhee Park, Team Leader, ACT Festival Team, Asia Culture Institute

Poster / Demos Chairs

Yongsoon Choi, Associate Professor, Department of Art & Technology, Sogang University

Jiyoon Chun, Associate Professor, Department of New Media, Seoul Media Institute of Technology

Workshop / Tutorial Chairs

Hyun Ju Kim, Associate Professor, Department of New Media, Seoul Media Institute of Technology

Byungjoo Lee, Assistant Professor, Graduate School of Culture Technology, KAIST

Artist Talks Chair

Su Hyun Nam, Assistant Professor, Department of Transmedia, Syracuse University

Institutional Presentation Chair

Boa Rhee, Professor, Department of Computer Art, Chung-Ang University

Special Session Chairs

Won Kon Yi, Professor, School of Fine Arts, Dankook University

Soo Hee Lee, Professor, Organisation Studies, University of Kent

Jina Kim, Ph.D, Nabi Future Studies, Art Center Nabi

YoungJae Oh, Professor, College of Art and Design, Seoul National University of Science and Technology

Exhibition, Performance, and Event Chairs and Co-Organisers

Art Center Nabi:

HyeIn Jeon, Team Leader, Curatorial Team

Hee-Eun Kim, Suhun Lee, Yoojin Chung, Soyoung Lim, and Heeyoon Choi

Asia Culture Institute:

Hyehyun Kim, Mihyun Jang, NamKyoon Kim, Jeongseok Lee, and Sangon Wi

Yang Hyun Kim, Professor, Department of Philosophy, Chonnam National University

Gwangju Cultural Foundation,

Gwangju Traditional Culture Center

Chosun University

Gwangju Convention & Visitors Bureau

Artistic Program Management and Supervision

Art Center Nabi:

HyeIn Jeon, Hee-Eun Kim, Suhun Lee, Heeyoon Choi, Yoojin Chung, Yeajin Cho, Yukyung Chung,

Hahlra Kim, Soyoung Lim, SangWook Han, Junho Choi, SoHyeong Lee, Homan Kwon, and JaeYoung Kim

Opening Performance <Drunken Drone>

LEE LeeNam, Robolink, Pablo Air, GongMyoung and Art Center Nabi

Closing Performance <Fiat Lux>

Jayoung Chung, Art Center Nabi, and Gwangju Traditional Culture Center

Local Engaged Workshop <Searching Darkness>

Marcus Neustetter, Ji-Eun Lee, Art Center Nabi, and Gwangju Cultural Foundation

Administrative

Art Center Nabi:

A-Young Cho

Gwangju Metropolitan City:

Yongsup Lee (Mayor), Hyang Park, Byungjae Moon, Minsuk Shin, and Myeongju Jo

Asia Culture Center:

Jinsik Lee (Acting President) and Seongkwon Jang

Asia Culture Institute:

Gipyo Lee (President) and Jeongseok Lee

Gwangju Cultural Foundation:

YoungSoon Kim, JinKyoung Jeong, HwanHee Suh, HanKyoung Kim, and Jinsil Choi

Gwangju Traditional Culture Center:

Gang Bae Park (Head), Kyung Dong Park, and Jun Woo Park

Gwangju Convention & Visitors Bureau:

Yongheon Lee (CEO), Wongi No, Jeongsuk Jeong, and Aeseon Lee

Design

Claire Choi, Pansydaisy Corporation, Label1571, and DAADA Graphics

Operations and Tech Partners

miceone

Gana Enterprise

PREFACE

In these Proceedings you can find the successful academic submissions towards ISEA2019, comprising 143 submissions in full and short papers, posters, and panels. Each one underwent a rigorous double-blind peer-review process involving the tireless work of multiple reviewers from all over the world, whom we thank deeply.

When in the spring of 2016 the plan to win the hosting rights to ISEA2019 in Gwangju, Korea was taking shape, it did not take long until it dawned upon us that there was one clear theme that touches upon the essence of the place: Light. Gwangju means “land of light”, and soon the unlikely theoretical physicist (Juyong Park) was busy at work, together with the rest of the original group from equally unlikely backgrounds, compiling the many fascinating—oftentimes paradoxical—natures of light such as its permanence in the universe and its ephemerality in time, each one confirming our belief that the choice is the right one for ISEA2019.

Three years later, here we are presenting the diverse ways in which *Lux Aeterna* — stunningly eternalised in the late great Stanley Kubrick’s *A Space Odyssey* via György Ligeti’s composition of the same name — has been imagined and materialised in the minds of the leading researchers of our time. With its long history as the centre of Korea’s traditional culture, Gwangju is now ready to assert its role in the future landscape of art by embracing ISEA2019 and catapult itself into the future. The contributions collected in these Proceedings will provide the way forward, by highlighting how Light, the very identity of Gwangju, intersects the past and the future, from the timeless, fundamental question of human existence to applications of bleeding-edge technologies that have yet to show us their full capabilities. The quality and diversity of the submissions prove that the months-long review process has been undeniably worthwhile; Therefore congratulations to all our authors, and let us now celebrate and bask in the glorious *Lux Aeterna*.

Seoul, Korea
2019

Juyong Park, Korea Advanced Institute of Science & Technology
Juhan Nam, Korea Advanced Institute of Science & Technology
Jin Wan Park, Chung-Ang University

THEME

Lux Aeterna: Eternal Light

Inspired by the meaning of the name of the host city Gwangju (City of Light), Lux Aeterna raises issues open to complex interpretations in culture, science, and history with equal fervor and significance. In religion, for instance, light signifies divinity and immortality; In science, on the other hand, it is an energetic particle-wave; In the humanities, enlightenment and rationality. The presence of light also creates Umbra, its own antithesis, with Penumbra between the two. Such multi-faceted nature of light will lead to the free cohesion of procedural logic based on human sensibilities and technology of artistic inspirations, which is the ultimate goal of ISEA.

SUBTHEMES

Aeternitas: Eternity and the Mortal

Various perspectives are presented on the eternity of humankind and the mortality of the individual human. While finite in physicality, humankind's achievements can transcend time. Scientific knowledge, however, is denied absolute eternity because it is in principle subject to modification. In the near future technological advances may bring on a singularity where humankind decides to gain physical eternity or bestow transcendence upon its past. Works under this subtheme are inspired by religious, scientific, humanistic, and artistic aspects.

Symphonia: Harmony of Noise

Sound and light are both wave phenomena, with deep ties to vision and signal processing research in engineering. An emerging opinion in Vision Insight claims that machines can be more accurate than humans when detecting the essence of things. In science and other fields, however, a raw, unrefined signal can open up various possibilities in the interpretation of data. This is expressed, for example, in Phaidon where Simmias mentions the attunement referring to the remaining sound even after the destruction of Lyre. Works under this subtheme This topic, involving the two different types of waves, includes a wide range of works on light and sound in Data Analysis and Data Visualization that extract meaningful signals from noise to achieve and harmony.

Illuminatio: Enlightenment of AI (Artificial Intelligence) & AE (Artificial Emotion)

Eighteenth-century Europe embraced Enlightenment ideals in order to advance culture and civilization by the power of the human intellect and rationale. The influence of the Enlightenment movement in the society is similar to that of Artificial Intelligence (AI) which could happen in the near future-breaking down the old customs and discovering and spreading the universal truth through objective observation. AI has been a controversial topic because it is uncertain how SNN (Spiking Neural Network) that mimics the thinking process of human's social and artistic brain activity will be able to solve problems. Even if SNN gains the problem-solving ability, various kinds of questions still remain. For example,

SNN's decision-making process and the purpose for solving problems is vague. This topic seeks a type of projects and researches that explores AI's ability to configure human's creativity and emotion. In addition, assuming the feasibility of Artificial Emotion (A.E), this topic invites works and research that deal with the essence of a man in the near future.

As the significance of redefining human creativity and ingenuity is emphasized with the advent of AI, 'education' in the regard of incubating the talents the contemporary society needs is also being highlighted. The role of education in the era of the machinery is not only restricted to nurturing the capability to stay abreast of the latest innovations and implement science and technology to the today's everchanging turmoil of interests. There are active discussions on the education reflecting the transitions and transformations of the contemporary society from programming, code literacy, to STEAM, aiming to further present how the essence of humanity could be innovated. We await various researches and opinions on the importance and role of media art, focusing toward the direction of education for the present and the future.

Penumbra: In-between

We look for various topics for research that are not mentioned above. Light and shadow are relative concepts. A research that might be deemed a failure for some researchers could be seen as the process of the search for the truth from the perspective of another research field. The topics of the paper mentioned so far are the signposts for guidance and inspiration. However, beyond our narrow point of

view, we would like to hear your very own stories. We hope to encounter works and research that are full of imagination and creativity, beyond our limited frame.

Under this theme, a special session on art, technology, and money will take place. This session will explore new ecosystem(s) among art, technology, and money. Most of us in art and technology field have had to rely on governmental funds or private charity. But with the rise of social impact investment, there may be a new horizon opening up for creating new values, where artists and technologists find new ways of communicating with the public. In this special session, we want to explore new opportunities as well as possible risks.

TABLE OF CONTENTS

SHORT PAPERS

POSTER

Heavy Metal and the Oratorio for a Million Souls

Dr Nigel Helyer
Sonic Objects: Sonic Architecture
Senior Research Fellow, Macquarie University
Sydney, Australia
sonique1@icloud.com

Dr Jon Drummond
The University of Newcastle
Newcastle, Australia
jon.drummond@newcastle.edu.au

Abstract

This paper explores different approaches to the sonification and visualisation of two environmental projects:- "Heavy Metal" is focussed upon the real-time analysis and sonification of the chemical elements in a painting via a camera vision system, whilst "Oratorio for a Million Souls" concerns the behaviour and acoustic properties of live bee colonies manifest in the creation of real-time multi-channel sound compositions and associated sound architectures. Whilst these two projects differ in terms of methodology, aesthetics and technical approach they both share a direct concern with a deep analysis of the underlying environmental structures and perceptual frameworks that emerge in direct 'live' encounters — on one hand the discovery of what lies behind the surface of a painted image in terms of chemical and colour structures — and in the case of Oratorio, a compelling immersion into the acoustic environment of Bees.

Keywords

Art and Science, Data Sonification, Environmental Soundart, Art and Biology.

Introduction and context for Heavy Metal

Heavy Metal[1] (2016) is an art installation with interactive camera vision system and digital audio by artist Nigel Helyer in collaboration with composer Jon Drummond and Environmental Scientist Mark Taylor. *Heavy Metal* was conceived and realised as part of a three-year Australian Research Council Linkage Grant project, *When Science Meets Art: an environmental portrait of the Shoalhaven River Valley*. A creative research collaboration between artist Nigel Helyer, environmental scientist Mark Taylor, and media theorist John Potts.

The aim of the overall project is to create a complete environmental portrait of Bundanon[2], a region of 1100 hectares (2700 acres) in rural NSW bequeathed to the Australian people by the modernist painter Arthur Boyd[3] in 1993. The project uses techniques of environmental science, artistic practice, information technology, media technology and cultural history. Data representing environmental quality at Bundanon is digitally transformed into visual information and sound, and communicated by various means: in numerous artworks; on a website devoted to the project; through GPS onto smartphones for mobile users on site at the Bundanon property.

The environmental portrait of Bundanon also incorporates the social and cultural history of the region, as it pertains to its environmental condition. Science meets art in the communication of environmental data through artworks and media technology. Heavy Metal has been created as part of this process and invites us to interact with one of Arthur Boyd's paintings to discover a hidden world of elements and minerals in an experience that is simultaneously chemical, visual and musical.

The initial concept for *Heavy Metal* arose after spending time on-site with Professor Mark Taylor. Mark and his students had been surveying the mineral composition of Bundanon, looking for traces of human activity that, for example, derived from farm and workshop activities, but also looking for the effects of upstream mining for gold and other heavy metals.

Elements and minerals lay buried in the landscape tracing diagrams of human activity. Specks of alluvial gold washed down to the floodplain from worked-out mountain mine shafts; existing as mineral auras that reveal the long-vanished outlines of farm buildings and the telltale chemical fallout from workplaces. Arthur Boyd painted this (mineralised) landscape with colours that were themselves formulated from earthy compounds and exotic metals, milled to a fine paste in linseed oil and turpentine.[4]

Our intention was to create a map of human activity based upon this forensic evidence. While we were taking environmental samples, Nigel invited Mark to visit Boyd's painting studio and bring along his portable mineral analysis machine[5] as it struck him that we may have a great opportunity for rethinking Boyd's works. The starting point was that Boyd was situated in this landscape, painting the physical features, and using (or making himself) colours that were substantially minerals (originally extracted from the earth), thus forming a metaphorical circuit. Mark was surprised by the massive levels of heavy metals in the materials used by painters and was keen to collaborate — so we proceeded to analyse the mineral composition of the entire colour range that Boyd used and came up with a massive database of minerals that corresponded to his palette.

Figure 1. Chemical sampling of studio paints. Image Nigel Helyer.

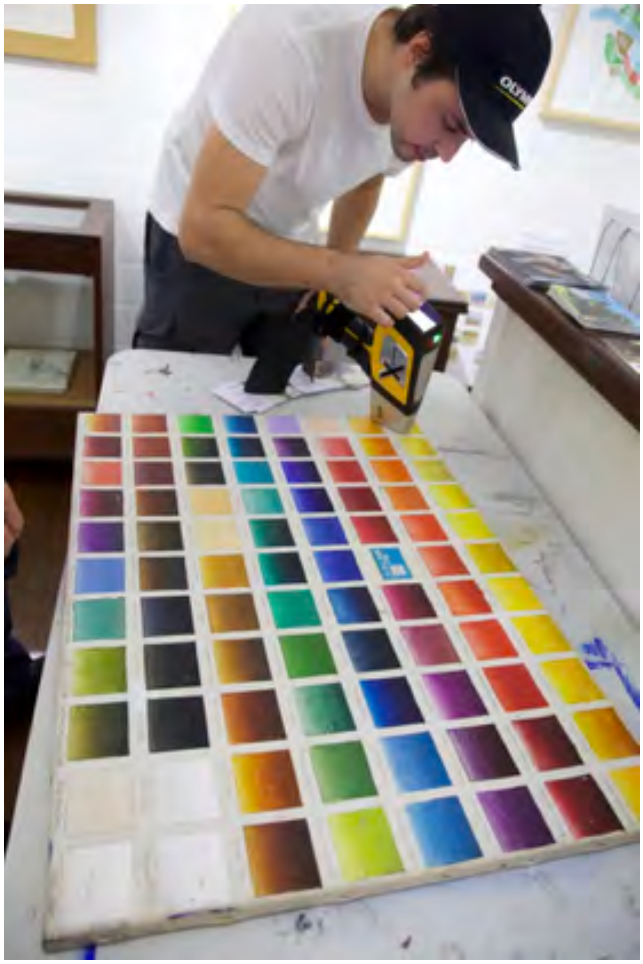


Figure 2. Chemical sampling of studio paints. Image Nigel Helyer.

The second stage was to sample the Steinway piano at the Bundanon homestead, note by note. Firstly, we recorded regular keystrokes; secondly, we recorded the reverberance of the sounding board resulting in one to two minute sound files per note. Working with another colleague, Jon Drummond, who is an expert in data sonification, we created a computer-driven audio-visual system able to read the video stream from a camera facing Boyd's unfinished painting *Return of the Prodigal Son* (c1997). The screen interface displays a highly magnified colour 'target' area from the painting along with the RGB values and the predominant minerals present, which are shown as elements of the periodic table. The system then translates the stream of mineral data into sound, which is layered in two components: a generalised harmonic chord structure that corresponds to the colour, overlaid by individual note highlights that illustrate the distribution of the most prominent minerals. The computer monitor gives feedback on the area of interest, colour ratios and a graphical display of the minerals detected.

FIGURE 3. Jon Drummond sampling the Steinway Piano. Image Nigel Helyer.

The Cultural Theorist Cecelia Cmielewski invokes the presence of Heavy Metal during its debut in the following lyrical extract from the catalogue to the Landscape/Portrait exhibition that documented the *When Science meets Art* research project.

Winding toward Boyd's studio through the beautiful garden at Bundanon, with flowering azaleas and orange clivias, under the shade of bright-green deciduous amber trees, the chord-like sounds of a piano become increasingly distinguishable. The sounds do not make a discernible melody but, once in the studio, they exert an immediate calming and almost meditative effect. Visitors are intrigued and delighted by this work. Occasionally a high note pops into the space that jolts the listener into attentiveness. The sound of a painting - Artists have responded to paintings by playing music to them, but not until Heavy Metal have they composed music from their material composition.

This work is a genuine collaboration between scientist and artist. It is rare for such a collaboration to actually be a creative conjuncture of both disciplines. Usually one is at the behest of the other. Either the art is used to explain or 'communicate' the science or the science is made too simple by the art. Helyer has a good grasp of many scientific

principles and has worked with scientists for over thirty years, the results of which we see in this collaboration.

Heavy Metal is interactive at a complex and conceptual level. The composition of chord-like sounds (recorded from the homestead Steinway) is created by a real-time analysis of the minerals in the colours of an unfinished Boyd painting, Return of the Prodigal Son (c1997). As a video camera is trained onto a section of the canvas, the screen displays the mineral content of the selected colours, in the form of the periodic table. The image and corresponding sound change each time someone selects a new section of the canvas on which to train the camera. Heavy Metal also brings together two kinds of science: environmental and computational.

FIGURE 4. In the studio with Elders from the Wreck Bay community. Image Nigel Helyer.

The creative leap of the artist is matched with the precise methodology of the scientist. Heavy Metal could have been quite a cold work — simply a digital archaeology of a painting. Instead, it is a lively work that uses the warm sounds of the piano and finely calibrated composition to bring the painting into a new space for contemplation. Heavy Metal provides participants with different ways to animate a 'static' painting. It takes some time for viewers/listeners to put together what it is that they are experiencing. The sound is dynamic, based on the elements used in a particular area of Boyd's oil painting.

One little boy of about seven years old knows the periodic table. He is thrilled to be able to 'read' this painting because each sequence on the screen includes a representation of the elements from a particular section of the painting. All of a sudden he is able to correlate his knowledge of the periodic table with the materials used by the artist. For another visitor, a writer, who does not usually 'get' art, the layers of sound and data provide a way for her to consider the work beyond that of colour and texture. For some of the men visiting from the Wreck Bay community, the data resonates with their use of naturally occurring materials used to paint their bodies for ceremony. Everyone who comes to Siteworks (and there is a large audience) spends time with Heavy Metal. The studio stays open for several hours longer than scheduled, and many visitors come back more than once. As the sounds from the studio close down, the chorus of the frogs in the nearby lake take over in the dark of evening at Bundanon.

FIGURE 5. The camera vision system, screen and target painting. Image Nigel Helyer.

Conclusion - Art Science and the Environment

Heavy Metal, draws upon recent research that has sought to develop collaboration between art and science, particularly in the context of technology and the environment. Siân Ede has proposed that there is 'much in contemporary science that can stimulate art's flexible, intuitive and visceral response to the world'. Ede also argues that 'the fragile environment' might well become 'the most crucial matter for the future concerns of both artists and scientists'. Concern for the environment has become a central political and artistic issue in the contemporary world.

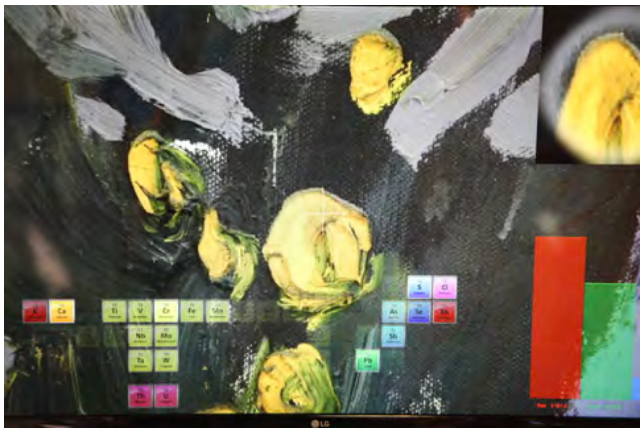


FIGURE 6. Detail of the Screen showing target area and Periodic Table. Image Nigel Helyer.

Recent publications have emphasised the heightened regard for the environment in 'eco-aesthetics', in 'eco art in pursuit of a sustainable planet', in 'art and ecology now' as manifest in 'land art' incorporating landscape, earthworks, environmental art, sculpture, and nature-based installation art. Sean

Cubitt has argued that eco-politics is indeed 'the single largest unifying political discourse of the early 21st century' Cubitt suggests that artworks can voice the contradictions of their period, including the role of technology. It may be demonstrated that 'not all technologies are instrumental, that is, used as instruments for domination over nature'. Media forms and art works may rely on certain technologies to communicate an ecological sensitivity.

Oratorio for a Million Souls

Introduction and context: Oratorio for a Million Souls - why Bees?

Why Bees? — There are two main reasons for such interest — firstly Bees, along with other colonial insects (such as termites and ants) display striking social organisation — that since ancient times they have provided powerful metaphors for human social structures. Secondly Bees have become a focus species in the public debate about the environment. Unfortunately the focus upon the threat to Bees; on Colony collapse and the subsequent effect on food production frequently masks the even wider issues of diminishing Bio-diversity in the face of industrial culture; agribusiness and climate change.

FIGURE 7. A Bombus Terrestris nest. Image Nigel Helyer.

But to return to metaphor — historically the Bee has been and remains a symbol of good (hierarchical) government — with a vast population of obedient workers ruled over by a Queen. In English we still use the terms *As busy as a Bee* and *A hive of industry* as phrases that affirm diligence and application to a task. Until quite recently the reproductive cycle of the Bee was a mystery and the Queen was long regarded by the Christian Church as analogous to the Virgin Mary; until it was discovered that she made a single but prolonged nuptial flight mating with up to eighty males, retaining their sperm for the duration of her long productive life — not such a chaste Lady after all!

The workers who make up the vast majority of the hive population, have stood for loyalty, obedience, courage and selflessness ~ and much of their behaviour would seem to support these anthropomorphic metaphors we attach to them — perfect role models for Nineteenth Century industrial capital, which like the Monarchy is based upon an autocratic power pyramid.

However, recent research turns this pyramid image upon its head. Consider for a moment the behaviour of bees in Swarming mode. The hive has grown and the colony divides. The outgoing group muster, hanging from a branch somewhere, seeking a new location. The swarm sends out a stream of scouts, often over a period of days, who report back, using methods similar to the bee dance to relay complex qualitative information. Somehow a collective process is engaged, the swarm considers this growing matrix of spatial data and eventually they fly to the most favoured location to begin a new colony. This is not the work of an individual mind, it is a product of parallel processing, a natural neural network, if you like, that has evolved over a 100 million years, the hive as *super-organism*.

FIGURE 8. The Oratorio at Buitenpost Gardens. Image Nigel Helyer.

European Capital of Culture Leeuwarden 2018

The *Oratorio for a Million Souls*[6] was commissioned by the European Capital of Culture, Leeuwarden 2018 (Netherlands). Funded by a European Union Inter-Regional programme the project has been realised in three botanical gardens; Dr Kruidhof in Buitenpost (Netherlands) and in Emden and Oldenburg (Germany). Each site consists of a 'green-architectural' listening space that houses two intelligent bee-hives to produce a four channel immersive soundscape in realtime.

The *Oratorio for a Million Souls* was developed in conjunction with a citizen science project in which one hundred sensor equipped beehives were distributed to schools in the Netherlands and Germany with the aim of mapping and assessing the pollen load (or floral productivity) of local ecologies. This research is taking place in a context which is commonly referred to as the European "Green Desert" a landscape which at first glance appears to be verdant and

productive, but which in reality is the product of high-intensity industrial agriculture that is effectively eliminating biodiversity and causing significant reductions in native species of birds and insects.

The concept behind *Oratorio* is to create a network of bio-acoustic listening spaces that allow visitors to immerse themselves in a world of insect sounds. By entering into the sonic heart of a Bee-city a visitor can for a moment become a fellow citizen — meditating at the centre of a sonic metropolis; all working; all buzzing — and taking an empathetic leap that we hope permits some serious thoughts about our collective effects on the natural environment.

Physically each *Oratorio* is constructed in traditional wattle and daub, intricately hand woven willow branches plastered with a thick layer of Leem[7] with a form based upon the shape of a traditional woven straw beehive (a Skepp in English). The structures have a thatched roof reminiscent of the traditional farming buildings of the region, and this in turn supports a green-roof — sown with Bee attracting flowers — a sort of Bee-Helipad! The hemispherical interior of the Oratorios provide a special acoustic, similar to that found in the domed roofs of Cathedrals and Mosques where sound looses its directionality and forms an omni-directional *soundcloud*.

FIGURE 09. The Oratorio concert. Image de Kruidhof Buitenpost.

Each of these green architectures contains two sensor hives furnished with colonies of *Bombus Terrestris* the common Bumble Bee[8]. We employ high definition miniature DPA microphones[9] in the Bee entry ports that are capable of recording the sounds of individuals as they arrive or depart the nest; as well as a set of large scale piezo contact microphones in the nest area that record the collective activity of the hive. These two streams of live audio are mixed with sonifications of Bee entry and exit data which are rendered as short arpeggios of piano notes; rising upon exit and descending upon arrival, and which become more complex with the frequency of Bee activity. The arpeggios provide visitors with a direct sonic index of the intensity of Bee flight activity as this can only be seen from the exterior or the Oratorio. Hive temperature is rendered as a series of sustained tones that rise or fall as the temperature in the hive varies. The outputs of the two hives are combined into a four channel live soundscape which is augmented by a screen displaying realtime data of bee activity and data sonification.

The province of Fryslân in the Netherlands and the adjacent area of OstFriesland in Germany boast many talented town Brass Ensembles and we were also commissioned to create a series of musical scores derived from the sounds and data sets recorded in the Oratorios, that could link each of the sites. By analysing the harmonic range of hive recordings we derived a tonal palette that we quantised into an equal tempered scale. Likewise by analysing the Bee entry and exit data from a range of the citizen science hives we established a temporal or rhythmic framework as well as developing an overall compositional structure based upon the diurnal activity of a hive (which is related to light and temperature).

FIGURE 10. B_Rhapsodie in performance. Image Nigel Helyer.

We created a musical event in which three the Brass ensembles located in Buitenpost, Emden and Oldenburg, collaborated to play a multi-part score via a satellite Video and Audio link-up — a task not without technical or aesthetic challenges.

Creative Challenges - The Oratorios

Working with living biological systems is always complex and unpredictable - Bees especially so in terms of handling nests of flying (and potentially stinging) insects who do not like being disturbed! This made the work of testing and mounting microphones inside the hives a physical challenge. Acoustically the project also had to develop solutions to prevent feedback within the sound architecture, which contained the two hives as live acoustic sources. The highly sensitive DPA microphones embedded in the Bee entry/exit ports provide an extremely detailed audio stream of flight and crawling sounds and as they are located on the building exterior are not affected by the interior soundscape. In contrast our early experiments with conventional microphones placed inside the hive boxes were a complete failure due to persistent feedback. The interior of the nests produce a range of relatively quiet, crawling, peeping and contact events which when employing conventional studio microphones require too much amplification; the hive boxes themselves

resonating with the sound energy from the four channel speaker array. The solution was provided by wiring together two large format Piezo discs and mounting them onto a small sounding board placed onto the upper surface of the nest enclosure. This extremely low-tech approximation of a contact microphone delivered good sound fidelity without the problems of feedback.

FIGURE 11. A BumbleBee about to enter the Oratorio. Image Nigel Helyer.

Creative Challenges - The Musical Scores

From the perspective of traditional musical aesthetics both the temporal and pitch structures of the Bee audio and data derived composition are unconventional. Whilst the three Brass Ensembles are musically extremely competent but as our scores do not resemble their normal repertoire this generated some initial resistance — the score is certainly not an imagistic representation of the life of a hive (a la *Flight of the BumbleBee*) but rather an indexical translation of that life and activity.

The debut of the composition *B-Rhapsodie* took place during June 2018 across the three sites. The collaborative rendition of the score by three geographically distant Brass Ensembles was a logistically difficult operation. We had to carefully synchronise the musicians and deal with the inevitable time lag in satellite transmission. Each site could see and hear the other two distant ensembles — and somehow, despite cloudbreaks of cold European summer rain trickling into Tubas and English Horns the concert was a success!

Legacy

In line with the objectives of the European Capital of Culture, works included in the programme are designed to have a legacy that benefits and extends the cultural life of the region. The Oratorio for a Million Souls project and its linked citizen science collaboration have an ongoing life in terms of research; public advocacy (for the preservation and growth of Bio-diversity) and in the very palpable form of the three Oratorios in their respective botanical gardens which are designed to function for at least three years. Each botanical garden is free to incorporate the Oratorio into its visitor and education programme giving a new and extended meaning to the authors original intentions.

Endnotes

[1] Heavy Metal archive http://www.sonicobjects.com/index.php/projects/more/heavy_metal
[2] The Bundanon Trust NSW Australia https://bundanon.com
[3] Arthur Boyd; One of the first Australian painters to be widely recognised internationally, specifically in the United Kingdom as one of the Antipodeans.
[4] Helyer quote from the Landscape/Portrait catalogue 2017. Pub Macquarie University.
[5] To generate the data programmed into Heavy Metal, we used a hand-held X-ray fluorescence spectrometer.
[6] Oratorio for a Million Souls archive http://www.sonicobjects.com/index.php/projects/more/oratorio_for_a_million_souls
[7] Leem - a mixture of clay, sand and chopped straw.
[8] The bee nests we used were supplied commercially. In Holland much of the agriculture takes place in vast green-houses and the pollination is carried out by Bumble bees who are 'buzz' pollinators — using their wing muscles to vibrate pollen from the flower.
[9] DPA 4060 omnidirectional lavalier microphones

Authors Biographies

Dr Nigel Helyer (aka DrSonique) is a contemporary polymath whose work links Art and Science to embrace the environment; identity and cultural history. He has an international reputation as a sculptor and sound-artist who creates large scale sound-sculptures, environmental artworks and interactive bio-art projects that prompt the community to engage with their cultural histories, identity and sense of place; inviting us to examine the abstract conditions of our world and our complex relationships to it. Nigel is the director of SonicObjects; Sonic Architecture and an Adjunct Professor in the school of Media, Music, Communications and Cultural Studies at Macquarie University, Australia. <http://sonicobjects.com>

Dr Jon Drummond is an academic, composer and sound artist whose work explores interactive electroacoustics, robotics, sonification of natural phenomena, acoustic ecology, and real-time interactive performance systems for acoustic instruments. His works have been presented at many festivals and conferences, including The Adelaide Festival, the International Symposium of Electronic Arts (ISEA), the International Computer Music Conferences (ICMC), New Interfaces for Musical Expression (NIME), and the World Forum for Acoustic Ecology (WFAE). His research interests include human-computer interaction design, new interfaces for musical expression, gesture analysis, improvisation, sound spatialisation and data sonification. Jon is an Associate Professor at the School of Creative Industries, the University of Newcastle, Australia.

In the Spotlight: Searchlights, Art, Surveillance and Spectacle

Claudia Arozqueta
PhD Candidate, Art History and Theory
University of New South Wales, Australia
info@modelab.info

Abstract

Searchlights have been used historically for artistic, military, commemoration and promotion purposes. This essay begins with an outline of the historical uses of searchlights in international fairs and its deployment in political and commemorative events on the first half of the twentieth century. The second part tracks and analyzes the use of searchlights by contemporary artists who have explored the use of this medium to create spatial, personal and community results. Some artists draw lines in the sky exploring sculptural possibilities; not a few continue the traditional uses of searchlights for national celebrations; while others manage to reveal in their installations the paradoxical nature of reflectors that oscillate between being a tool of vigilance and spectacle.

Keywords

Searchlights; Artificial Light; Surveillance; Installation Art; Memorial Art; War; Spectacle; Media Art History.

Introduction

The night is the space of obscurity and the unseen, a space of tensions and vulnerability that with the invention of electric light somehow dissipated, diminishing the risks people face in non-illuminated spaces. During the nineteenth century, the development of electric technologies resulted in the gradual illumination of public spaces. This illumination of entire cities gave visibility to the activities and relations of individuals, expanding notions of the act of observation and the phenomenon of being observed, fostering the notion of natural surveillance. With the development of electric technologies, such as computer and recording systems, monitoring became common in daily life. [1]

Searchlights are one of the oldest electric lighting surveillance systems, which initially were manual carbon-arc lamps, but now work with robotic Xenon or LED lamps. These powerful outdoor lights have found multiple and paradoxical uses. Since the late 19th century and the beginning of the 20th century these have been employed to illuminate movements of persons in the theater of war and in prisons to overwhelm the eyesight of inmates or adversaries, to detect warships from the distance, for anti-aircraft surveillance and aircraft landing assistance, and in some places like the US, for detecting migrants at the border. While they have been used for the aforementioned military uses to "light up the enemy", they have also been implemented for artistic creative purposes and commercial effects: for international fairs such as the Paris Universal Exposition of 1889 or the Panama–Pacific International Exposition in San Francisco of 1915, where more than 50 searchlights were used to illuminate the sky at night. Other implementations include theatre, music, dance spectacles to illuminate bodies on stage or more recently with consumer and advertising purposes such as the promotion of cinema premiers, sales, festivals and other special events, such as memorials and national festivities.

Figure 1. Panama-Pacific International Exposition, 1915, San Francisco, USA.

Searchlights dance across the sky, illuminating dark nights, transforming the sky in a scenario. Their paradoxical nature, at once intimidating, and at the same time visually attractive, has meant they are often used for artistic purposes. One of the most controversial historical utilizations of searchlights for aesthetical purposes is the *Licht-Dom* or *Cathedral of Light.* Created in November the 11th of 1937 when Albert Speer, the architect of the Third Reich, displayed for the Nuremberg Rallies the most imposing sky projection of those times. Commissioned by Adolf Hitler, the spectacle consisted in 150 searchlight columns, separated at intervals of 12 meters, surrounding a zeppelin field, all making a rectangle enclosure of light. As Erkki Huhtamo states, this theatrical and massive event

was transformed in an "strangely attractive 'dark fantasy', and perhaps even into a distorted manifestation of the 'technological sublime'."[2] Even the current British ambassador declared: "the effect was both solemn and beautiful, it was like being in a cathedral of ice."[3] This event of persuasive power served Nazi ideology to impose an image of infinite mastery that could reach beyond the skies. A power that was eclipsed years later by invading allied forces.

Paradoxically, eight years later, this victory was visually celebrated with the memorial *Tribute to Victory* (1945) in Los Angeles, with an act reminiscent of Speer's spectacle. 50 searchlights covered the Memorial Coliseum creating a multicolored crown, which was accompanied by detonations referring to the atomic bombings. [4] Searchlights since World War II became a tool for celebrating power and victory, and their rays a political message in the sky to be seen by many, as a sign of control.

Figure 2. *Tribute to Victory*, 1945, Memorial Coliseum, Los Angeles, USA. ©Bettmann/CORBIS.

Drawing lines in the sky in the vastness of the night, searchlights attract and spot attention. Artists have exploited their condition of being visually attractive and have used them in celebrations, festivals, and exhibitions with various connotations. Below, I discuss the work of some artists who have utilized searchlights' unique and powerful capacity to lend an eye on specific things, persons and issues, using aesthetic, social and historical discourses: Forrest Myers, uses beams capability to built space in the sky; Ryoji Ikeda continues the tradition of using lights for political conmemorations; Rafael-Lozano Hemmer and Krzysztof Wodiczko use reflectors to draw attention on memory and social issues; and Marie Sester effectively highlights the dual nature of light beams between spectacle and vigilance.

Lighting Drawings: Forrest Myers

Some artists have used searchlights to create public art installations that intend to transform their intimidating function into an aesthetical and connective one. Antithetical to Speer's intentions was the *Searchlight Sculpture* (1966), by Forrest Myers, an American sculptor that was member of E.A.T. (Experiments in Art and Technology), a New York based group that during the 1960s and 70s explored collaborative and innovative forms of work between artists and engineers. [5] Myers' colossal nighttime sculpture which was presented at Tompkins Square Park in New York in 1966, at Union Square in 1969, at a park in Fort Worth in 1979 consisted of four searchlights sited at four different corners of a public space. The projected rays converged at a point, drawing a colossal pyramid over the sky, a geometrical composition exploring the formal sculptural possibilities of light beams, and its possibilities for constructing alternative space in the sky. In 1967, Myers proposed a searchlight sculpture to David Rockefeller, consisting of four searchlights surrounding the footprints of the two World Trade Center towers, creating a light frame while the buildings were under construction. At the end this project, which melted art and advertisement, was not concluded because of its high costs, but coincidentally years later in the 9/11 Tribute of Light memorial, searchlights illuminated that same space, echoing the footprints of the lost towers.

Figure 3. Forrest Myers, *Searchlight Sculpture*, 1966, Tompkins Square Park, New York ©Forrest Myers.

National Memorials: Ryoji Ikeda

Exploring light as an sculptural material for creating aesthetic memorials is Ryoji Ikeda's *Spectra* (2000-14), a series of public art installations that the artist has presented in different cities of the world (Buenos Aires, Hobart, Sharjah, Paris), all using light to create spectacular or, in words of the artist, "unearthly" environments. [6] The Mayor of London, commissioned the latest in 2014, for the remembrance of the First World War. The installation located at the Victoria Tower Gardens was similar in form and shape to the aforementioned *Tribute to Victory* (1945). It consisted of 49 xenon searchlights, arranged in seven rows of seven lights, beaming 15 miles upwards to the sky during seven days. Ikeda also composed a soundtrack to accompany the installation, with waves of sound mixed with soft beeps. The lights were visible from different parts of the city. From the distance the installation functioned as an imposing column that illuminated the night sky, but once inside, following conventional memorial aesthetics, it turned into a contemplative space. *Spectra* in London, used searchlights for the expansion of the senses in public open spaces, but also worked as a space in which art, politics and media fusion for civic and national boosterism, resulting in art produced and used as spectacle with a sensational and massive impact.

Figure 4. Ryoji Ikeda, *Spectra*, 2014, London, Victoria Tower Gardens ©Tom Thorpe.

Voices of Light: Rafael Lozano-Hemmer and Krzysztof Wodiczko

Many artists have used searchlights for lighting up social issues, and for giving voice to people. The use of artificial light for police and military purposes has always fascinated Rafael Lozano-Hemmer and his enthusiasm is articulated via the deployment of searchlights in many of his works but for using them in another form of fighting. Inserted into the artistic strategies based in participation, communication and exchange, giving voice to people, are many of Lozano-Hemmer's works. Particularly effective was *Vectorial Elevation* (1999), a celebratory piece commissioned for celebrating the year 2000 in Mexico City, in which people controlled the searchlights and send messages in an uncensored way. Commissioned by the Centro Cultural Universitario Tlatelolco of the National University of Mexico (UNAM) for the historical commemoration of the 40th anniversary of the student massacre in Tlatelolco [7], *Voz Alta. Relational Architecture 15* (2008) consisted of a public art installation and performance where the artist placed a megaphone in the public square where the bloodshed occurred. Survivors' testimonies and participants' thoughts were transmitted live through speakers. Three 10kW searchlights that were installed at the top of the Centro Cultural Universitario Tlatelolco transmitted and translated their voices into light beams while they talked. The searchlights pointed to different directions, covering the greater part of the city on a clear night. When no one was participating, the megaphone played both past recorded memories, as well as interviews with some intellectuals and politicians analyzing or reflecting on the event. Any person in the city interested could listen live to what the lights were saying by tuning the University's radio station. So for those informed about the project the lightings would have some meaning, but for others it probably was perceived as a distant lighting related with a promotional event.

Figure 5. Rafael Lozano-Hemmer, *Voz Alta. Relational Architecture,* 2008, Mexico City, Centro Cultural Universitario Tlatelolco ©Antimodular Research.

Voz Alta can be connected to Krzysztof Wodiczko's project titled *The Tijuana Projection* (2001) realized in the eponymous city located at the Mexico-United States Border with women workers at *maquiladoras* or assembly factories spoke up about a variety of issues of which they were victims, including domestic violence, misogyny, sexual abuses or work exploitation. To narrate these stories, participants used a specially designed headset with a microphone and a camera that was connected to loudspeakers and two projectors that transmitted both their testimonies and their images on the circular façade of the Centro Cultural Tijuana. Wodiczko's site-specific work, and therefore Lozano-Hemmer's echo, uses light as a very suggestive and malleable material that offers many possibilities and forms, enabling the expansion of body limits

into the public sphere, giving them a sense of visibility through projection onto the city's buildings and the skyline. The works also illuminate people's voices by opening a space for participants to express freely, in a completely uncensored way, their opinions and issues that concerned them, functioning as a contingent space for social catharsis and resistance to unlock abuses in the darkness of silence.

Between Vigilance and Spectacle: Marie Sester

If there is a work that intentionally and effectively plays with the paradoxical nature of reflectors is Marie Sester's *Access* (2003). Her installation consists of web, computer, sound and lighting technologies that allow web site users to track persons in public spaces with a robotic searchlight. The people cast by the searchlight-like eye can move from one side to another of a room and the light will follow their path. The reactions of the people are varied: some run, dance, move backwards or forward unsuccessfully trying to avoid the beam or attract it. While this happens an acoustic beam, projects audio that can only be heard by the person: it gives instructions to people on how to move, and informs them that thousands of people are watching them online. The web users do not know that their actions trigger sound towards the target, and the individual tracked doesn't know who or why they are tracked creating an ambiguous communication. *Access* reveals how visibility, vigilance and control can be really ambiguous, and exalts the clear lines dividing observer from observed. But overall, the piece shows searchlights as a playful and intimidating material, which connotations are dependent not only on their implementation but also on personal perception.

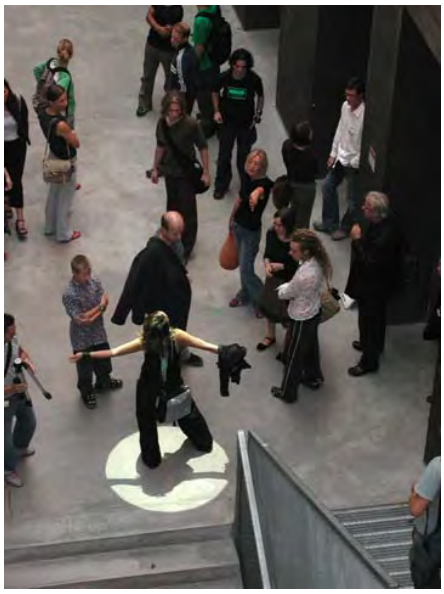


Figure 6. Marie Sester, *Access,* 2003. ©Marie Sester

Conclusion

If light was used in the early nineteenth century to maximize the visibility of private activities of individuals, and in the first half of the twentieth century to display political power in political events, today searchlights are a polysemic tool that illuminates people, objects, buildings, institutions and history itself. Originally created for control, political and military purposes, searchlights have been subverted by artists, who have managed since the 1960s to use them as tools of resistance or as a democratizing element. This is because light has an effective and affective power that can reveal things; and reflectors have become a recursive element to address things that because it's everyday condition can become invisible. Artists or activists have extended the use of reflectors, transforming them into a valuable resource that fosters community experiences or that draws attention to social discomforts, thus proposing a new ontology of these objects, currently associated with war, vanity and spectacle.

However there are works, although interesting aesthetically and formally, that continue to be aligned with commemorations and government organizations of nationalist dyes, and become simple spectacle, an attractive merchandise for the masses that more than interrogate accommodate themselves in the institutional mechanisms of control and power that foster them. The visibility of reflectors is always attractive and they will be always used for nationalistic purposes, but it is only by converging in an open and congruent way with social and political concerns that artworks using searchlight become not only attractive but critically engaging, and this is the only way in which they can somewhat mitigate the policies of seduction, control and vigilance that reign in today's society.

References

[1] Arozqueta, Claudia, "Polysemous Light: Light as a contradictory material in Rafael Lozano-Hemmer's work". In "Media Archeology", *Artnodes*, No. 21: 146-153. UOC [Accessed 17/03/19] http://dx.doi.org/10.7238/a.v0i21.3185

[2] Michel Foucault, *Discipline and Punish: The Birth of the Prison*, trans. Alan Sharing (New York: Vintage Books, 1978) 208.

[2] Erkki Huhtamo, "Gigantological Investigations, or an Archaeology of Public Media Displays," manuscript, 2009, 30.

[3] Albert Speer. *Architecture 1932-1942*, Bruxelles, Archives d'Architecture Modern, 1985.

[4] Douglas Kahn, *Earth Sound Earth Signal* (Los Angeles: University of California Press, 2013) 142.

[5] The engineers Billy Klüver and Fred Waldhauer, and the artists Robert Rauschenberg and Robert Whitman founded the E.A.T. in 1967 with the intention of expand the role of artists in society and explore technological changes. E.A.T. aimed to develop collaboration between artists and engineers to explore the intersections between art and technology. Christian Paul, *Digital Art* (London: Thames & Hudson Ltd, 2003) 16.

[6] From Ryoji Ikeda's official website: http://www.ryojiikeda.com/project/spectra/ [25.06.2016]

[7] The Tlatelolco Massacre occurred in October 2, 1968, ten days before the celebration of the 1968 Olympic Games in Mexico City. What started as a peaceful demonstration in the Plaza de las Tres Culturas (Three Cultures Square) in Tlatelolco to make social demands, ended up in a storm of bullets guided by gov-

ernment security forces. This brutal act of oppression resulted in hundreds of people dead, mostly university students, and more than a thousand people incarcerated. The Massacre of Tlatelolco has grown large in Mexican memory.
[8] Anna Seaman, **"**Artist Rafael Lozano-Hemmer talks about interactive exhibit on display at East Plaza on the Corniche," *The National*, January 6, 2015, accessed Jun 25, 2016, http://www.thenational.ae/arts-lifestyle/art/artist-rafael-lozano-hemmer-talks-about-interactive-exhibit-on-display-at-east-plaza-on-the-corniche

Author Biography

Claudia Arozqueta is an arts historian, curator and writer currently based in Sydney. She is a PhD candidate in art history and theory at the University of New South Wales, Australia. Her areas of interest are the history of media, art theory and criticism, public space and experimental history. Her research has been published in various international magazines and journals, including *Leonardo, Artnodes, Art 21, Artforum, and the Journal of Science and Technologies of the Arts*.

Invisible Animals

Donna Szoke
Brock University
St. Catharines, ON, Canada
dszoke@brocku.ca

Abstract

My research-creation on invisible animals explores what is invisible in the visual realm in order to explore immanence, power, and non-visual knowledge. Utilizing digital technologies, I create media artworks that I think about as being transformational objects, objects that can shift us into new ways of perceiving. The leap of perception through these media art experiences changes our understanding of the world, challenging notions of the utility of animals and the function of technology. My work offers an ethics of care as liberation from instrumental rationalism.

Keywords

Invisible animals, non-human animals, hallucinations, fabulations, ghosts, media art, video art, geolocation, immanence, artist-research.

Introduction

My art practice (or research-creation) plumbs what is invisible in the visual realm in order to explore immanence and non-visual knowledge. Utilizing digital technologies, I create transformational objects that shift us into new ways of perceiving. The art objects, or interfaces, confront the user with new experiences that crystallize new perceptions. This leap of perception through an art experience changes the viewer's understanding of the world. To accomplish these ends, I engage research-creation methodologies in video, media art, animation, writing, installation, sculpture, and drawing.

I have been drawn towards expanded animation for its inherent ability to suggest the flight of the imagination, and to irritate the rupture between what is actual and what can be represented. [Figure 1] Technology offers platforms, interfaces, and experimental tools that can exceed a single channel video experience; moving images in expanded animation further complicate, destabilize, multiply, and perforate the boundaries of a single screen. My recent expanded animation explores the unseen-yet-apparent through site-specific media art in public venues. I create digital interfaces, installations, and situations in which the public can engage with new media that addresses their place in the world. This way of working allows me to create an art experience through emergent technologies that connect to our very localized, specific, sensory ways of being in the world. People, animals, technology, and the landscape combine in magical surprises.

Figure 1. Donna Szoke *Invisible Histories* Installation. 2012

Recently, nonhuman animals, or more accurately, invisible more-than-human animals have been emerging in my practice. What is the invisible animal in contemporary Canadian art? Having grown up partly in the remote wilderness of northern Manitoba, my childhood was filled with very real animal presences. At this contemporary moment, an unprecedented destruction of animal species and animal habitats is taking place globally under the twin engines of political indifference and unfolding ecological disaster. This ecological disaster is largely the direct result of the endless consumption of the "capitalocene". [1] In Donna Haraway's instructive wordplay, capitalocene critiques the concept of anthropocene as a continuation of white supremacist, heteropatriarchal, European enlightenment values in its universalizing language. As Zoe Todd notes, the concept of anthropocene eclipses key differences in who is actively driving planetary ecological demise, and furthermore, who is engaged in its privileged discourse. [2]

What are the inspirations, currents, and political undertows in imaginary, invented, fabulated, hallucinatory, or

ghostly animal presences? Do these presences evoke an ethics of the virtual? How do invisible animals, as immanent forces, exert new perspectives into the discourse of animals in art?

What's the use of an invisible animal? If we imagine ourselves as just rational cogs in a rational order, then we are merely the living entrails of a mechanistic imagination, locked within a meaningless machinic phylum. Digital culture can follow this mindset, interpolating users into a binary vision of leisure or work. [3] In this system what we understand as our self-definition through leisure or work is in fact a loss of lived, personal time, in an impersonal enactment of the system's predefined actions of its general users. [4] Following only the logic of program rationality at the exclusion of the rest of our abilities, we become abstract, disembodied from what makes us each uniquely distinctive. [5] We become ever obedient nodes in an infinitely addressable universe. This type of so-called digital interactivity can only further our servitude in the self-reporting loop of consuming-as-surveilling in the attention economy. Fabulations and spectres promise extra-nodal liberation from this digital servitude. How does a ghost, séance, or hallucination promise emancipation from the rational world of modernist vision? Invisible animals and other hallucinatory beings offer a leap of the imagination out of the systematic impoverishment of the machinic/digital phylum.

In *24/7 Late Capitalism and the Ends of Sleep*, Jonathan Crary gives a brief analysis of Andrei Tarkovsky's 1972 film *Solaris*. Scientists inhabiting a spacecraft, locked into an illuminated 24/7 world suffer from chronic insomnia, and this constant light exposure leads to cognitive breakdown. Hallucinations and ghosts become their companions in a world whose sensory impoverishment leads to a blurring between dreaming and waking. It is precisely the hallucinations and ghosts that have made their impossible situation bearable. Once acknowledging these ghosts after repeated denials of perceiving them, the acknowledgment of one's hallucinatory perceptions becomes a gateway itself towards liberation or freedom. [6]

In my work with invisible animals, I'm particularly struck by Derrida's concept of *hauntology*. Hauntology deals with a central paradox in which a spectre exists but is also neither being or non-being. [7] As another type of assault on instrumental rationalism, that which haunts is paradoxically both a return from the past and yet, is also a spectre, a possible vision of the future, of what has not yet existed but yet still could return to haunt us. [8]

My invisible animal work began in 2011, when I was invited to a collaborative design charrette at University of Buffalo integrating my Brock University undergraduate visual arts students with theatre design students from the University of Buffalo. Thematically, the collaboration sessions dealt with our mutual terrain of Niagara Falls and our work was to research and explore this shared landscape then respond in design.

During the research phase, I came across the astonishing fact that 270,000 radioactive mice are buried at the Niagara Falls Storage Site near Lewiston, NY, as a result of atomic weapons research. The Niagara Falls Storage Site houses nuclear waste from the Manhattan Project and is sited 32 kilometers north east of Brock University where I teach. The irradiated remains of 270,000 mice are interred in lead and concrete, accompanied by scores of other irradiated animals including cats, dogs, and monkeys. Most Canadians are oblivious to the proximity of the Niagara Falls Storage Site because it is over an invisible political border, housed in the nearby United States. Like the Underground Railroad, which features greatly in our local history, these interred radioactive mice operate as a secret and hidden history of the area. I created the video installation by 3D animating a green glowing mouse running back and forth, and then installed this animation in a single channel video loop. Using a tiny Qumi projector, the video is rear projected onto rice paper at approximately mouse scale. The diminutive mouse haunts the gallery floorboards. [Figure 1, 2]

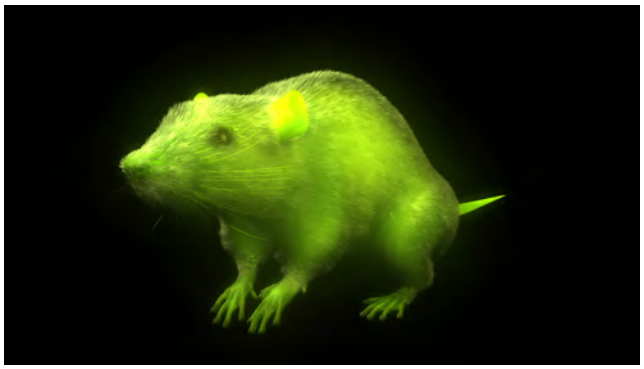


Figure 2. Donna Szoke *Invisible Histories* (installation) 2012

In 2015 I turned *Invisible Histories* into a mobile phone app. The app uses my original concept drawing as its icon, and multiple iterations of the 3D mouse animation, rendered so we look down upon the running mice from an overhead perspective. [Figure 3] The app is geo-locative so as the user gets closer to the epicenter of the Niagara Falls Storage Site, more and more glowing animated mice flood the mobile, running toward their grave. Like the Pied Piper gone wrong, the haunting mice lead us directly toward their toxic radioactive remains. Viewers immediately respond to the app's affront to the general logic and utility of mobile apps: it takes us towards what we desperately wish to avoid. Generally, once introduced to the app, most people choose not to download and install it, instead relegating awareness of nearby nuclear waste to the fringes of their consciousness. Its inverted, repulsive logic plays against the utility promised by mobile functionality. Knowing about the app is the app's largest function, and in this way the project is more of a conceptual artwork.

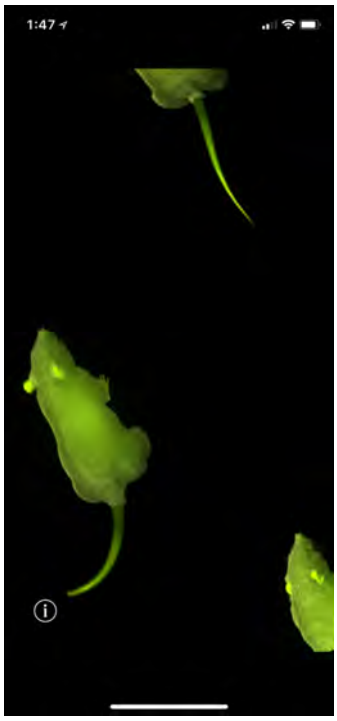


Figure 3. Donna Szoke *Invisible Histories* (Mobile app) 2015

The work exists as a type of anti-monument or "nonument." [9] It engages the mice as a missing spectacle in the Niagara Falls Region—a landscape of otherwise extravagant sites. New media becomes an avenue for marking, memorializing, and re-activating history. As activist art, it nods to critical animal studies, and questions the ways in which we engage, abuse, and memorialize nonhuman animals. It invites the viewer to visualize hidden historical outcomes, and hopefully by extension, to imagine other presents, and other futures.

Throughout creating this project I kept thinking about how the irradiated mice of nuclear weapons research occupy multiple invisibilities in a Marxist sense: the mice are the dispossessed material outcomes that are containers of their own alienated labour; as alienated workers, the mice continue to work, through their radioactive remains that outlast the bomb product they helped create; the mice are unwitting consumers of nuclear war, consuming their own alienated labour through their own alienated worker-body remains. How does the material waste of animal bodies haunt consumer objects? If we think of George Bataille's reading of Marx, the mice are an unproductive expenditure. [10] The narratives of utility, guided by instrumental rationalism, produce these by-products or unproductive expenditures such as war, pollution, and these irradiated mice. In Sontag's reading of Bataille, there are no purely unproductive expenditures. [11] These mice are productive-non-productive expenditures, as they petition our empathy. Therefore, the mobile app's true utility is that it gives us the opportunity to respond to these mice with a community of mourning, a politics of care, that has real lived outcomes. This is an ethics of the virtual. If we critically engage with mobile app functionality, we can create opportunities to newly perceive and enact an aesthetics of care.

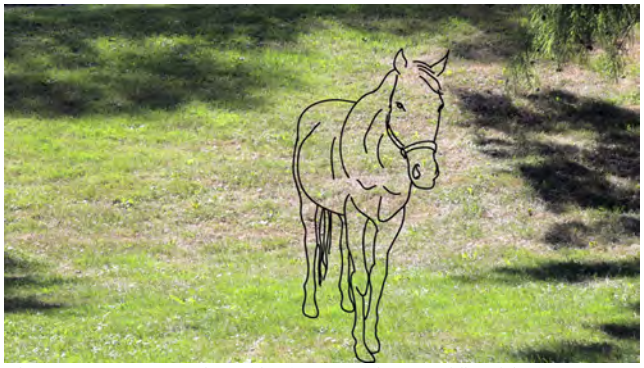


Figure 4. Donna Szoke *Alfred Waits* (site specific video) 2012

Many of the world's spiritual traditions posit that what we see of the world rests on an unseen and meaningful order. Besides the invisible as the realm of the mystical, the invisible is also the realm of power in contemporary life. The degree to which one is able to make one's self and actions visible or invisible is in direct correlation to one's power. The most important global events are relatively invisible and difficult to capture into images. The current scale of animal atrocities is difficult to envision as a whole but can be intimated through individual instances.

Alfred waits is a site-specific video commissioned by HERE 2012, a public media art project. [Figure 4] HERE 2012 located work by 40 artists via QR codes installed at 40 historic sites in the Niagara Region of Canada. I chose the historic battlefield of 1812 where General Brock died as I was appalled by pro-military accolades on the local, provincial, and national level as we neared the 200th anniversary of the War of 1812. During my research, I learned that General Brock rode his horse Alfred into battle, and while Brock was killed, Alfred fled the scene alive. Another soldier then mounted Alfred, rode him back into battle, and Alfred was killed. I was fascinated by the cruel irony of Alfred's plight, and imagined his disorientation at having to navigate a battle while being ridden by a stranger. I imagined a small moment in which we just witness an imaginary Alfred, and Alfred is simply given the equal footing of watching the viewer back. I went to "The Last Chance Horse and Pony Rescue" in Fort Erie, ON and videoed their first rescue, and still pack-dominant horse, Floyd. I then rotoscoped each frame to animate the footage and placed the animation overtop of an image of the historic battlefield. These frames are individually hand drawn, in simple line drawing, recreating Alfred as both historical fact and as an artist's rendering. This work is sited using QR codes, so that one can simply go to the historic Queenston battle spot, encounter the QR marker, and

launch the video on a mobile device while one stands on the spot where Alfred would have died. In this work I use digital technologies as magical and irrational mediums, to conduct an imaginary glimpse of Alfred, who glimpses us, bending time and space. Viewers often remark on the uncanny nature of this work, as the simplicity of the line drawing seems at odds with the accuracy of gestures, such as the tiny ear flicks. I continue to explore rotoscoping for the uncanny valley it resides in, a strange conjoining of live action, animated images, and inanimate images.

The atrocities enacted upon animals in the course of warfare are often elided in war histories. I think of Franz Marc and his visionary paintings of horses created on the eve of, and during, World War I. Initially his horse paintings suggest bucolic spaces and idealized forms, such as in *The Large Blue Horses* from 1911. [12] Conversely, Marc's painting *Tierschicksale* (*Animal Destinies* or *Fate of the Animals*) was completed in 1913 when war was impending in European. [13] On the rear of the canvas, Marc wrote "Und Alles Sein ist flammend Leid" ("And all being is flaming agony"). [14] While serving in World War I, Marc wrote to his wife that he could hardly believe he had created the painting and its premonition of the destruction to come. [15] *Fighting Forms* from 1914 is perhaps my favourite of these visionary works as the animals have been abstracted into the pure forces. [16]

Horses have always loomed large in my imagination. As a Mongolian-Hungarian Canadian, I'm the first generation to not know horse-handling techniques that have been handed down for centuries. These horse-handling skills allowed my family to immigrate from Hungary to the US, and then to Canada. In a sense, it was the horses that allowed my grandmother, a Hungarian Jew, to live in Canada, spared from World War II in Europe and the Shoah that claimed her entire extended family, save for one cousin hidden in Odessa. It is an amazing experience for me to bicycle in rural Hungary on the same ancient pathways that would have borne my ancestors on horseback.

I use digital technologies to create moving images of things that cannot be simply captured by a camera; I use projection-based and screen-based technologies, not to show an image of what was once before the camera, but to create a space for co-presence. [17] Hannah Arendt proposes a concept of natality: New beginning is inherent in birth therefore the newcomer can begin anew, that is, they embody an inherent capacity for new action. [18] Arendt places natality as potential in all human activities. She centres these actions of the radically new as the political par excellence, and therefore casts natality as the central category of politics, not metaphysical thought. [19] This idea echoes the notion that in projection we might be dealing not with vanishing, but with the moment of becoming. In this shared space we can newly consider our shared embodiment and empathy through projection as a medium of co-presence. Co-presence allows us a way to inhabit a shared space of the aesthetics of care.

Media art can create pathways for making non-linear associative leaps beyond physical reality. Like cinema, media art can be poetry's agent. [20] Rather than only mediation, media art offers the possibility of an experience or encounter. The nature of experience cannot be fully articulated, it is lived, embodied, and it sings out in our silence. The unseen, the silent unsaid, gives rise to the very impulse to make art, to articulate, to push up against the limits of representational systems.

I work with time-based media because our primary relationship to perception is not to measured time, but to lived, irreversible time. As Laura Marks notes, lived irreversible time is truly a re-enchantment of the world, as we live in a present where we can bring about actions that create previously unforeseen outcomes. [21]

Figure 5. Donna Szoke *Midst* (Video installation) 2019

The video installation *Midst* creates a mysterious image, meant to invite the viewer to experience non-human animal presences--or rather, their urban absences. [Figure 5] The image suggests that large shadowy bison pass through fog, visible momentarily. Bison that once would have been populous across much of Canada seem to have temporarily reappeared. To create *Midst*, I constructed a 2.5-meter fog wall comprised of eighty computer fans, aeronautic honeycomb, custom electronics, a fog machine, a projector, and a 4K animation loop. Again, uncanny rotoscoping conveys both accuracy and abstraction in the ghostly animal bodies. The fog manifests the bison's ethereal presence at life size. Ethereal, abstract, and somehow real, the fog bison enact a magical moment of their manifestation. Most viewers respond to this work with words like "magic" and "wonder."

As site-specific media art, new technologies are employed to destabilize the familiarity of public space. How does the presence of the non-human animal transform public space in the experience of the viewer? *Midst* questions our relationship to natural spaces, inviting our imaginations to repopulate those spaces. It prompts the viewer to engage in questions of embodied perception and the fluidity of lived experience.

Issues of encroachment of cities into rural spaces raise questions of animal rights. Do animals own the wild spaces

that they depend upon for life and sustenance? Within systems of property rights through capitalism, animals have no land rights. How does the reality of the disposability of animals fit within the mainstream Canadian psyche, one in which mythical ideas of nature predominate? How do we rethink what it is to be an animal beyond being another disposable body for the interests of advanced capitalism? How does a celebration of an animal shift the values of a global, technological world? Media art allows a unique phenomenological experience to address encroachment of urban dwellings into wild spaces, disappearance of large animal populations, and animal land rights. In an international context this work speaks to the urgency to recognize animal rights in our current eco-crisis of habitat and species loss.

Figure 6. Donna Szoke *Shot / Counter Shot: Self Portrait as a Mother* (Editioned print) 2018

Shot / Counter Shot: Self-portrait as a Mother was commissioned by the Grimsby Art Gallery for the project *Ripple Effect* in which the gallery invited 5 artists to create new work in response to a piece in their collection. [Figure 6] This print was made in response to Lupe Rodriguez's wonderful painting, *The Arrival of Liam* (1985). [22] I was struck by Lupe's sense of colour in the painting and her choice to use the image of a bull to represent herself as a mother. She made the work after the birth of her second child, and I pondered her painting 3 ½ years after the birth of my second child. After spending some time with the painting, I continued to ponder the work. What does it mean to select a bull, obviously male, to represent a mother? I loved the idea of the force of motherhood as being something beyond gender. When I think of Lupe's image, I feel it does work as a representation of motherhood as I too feel like I am massive, barely tamed, a more-than-human-animal able to erupt into sheer force at any second. Suddenly it seemed obvious that my image needed to be an almost filmic response to Lupe's image. In narrative film we see the shot / counter shot strategy where the camera peers over the shoulder of a character toward a second character. In the next shot the camera looks back at the first character in an almost perfect 180-degree axis. This suture is magical: we transcend time and space, pinning two characters into a fictional exchange. My bison is looking back at her bull.

At the outset of this project, I searched online for bison subjects to rotoscope and found image after image of dull eyed farmed bison. At last an image popped up of a bison intensely alive. It was a portrait of a bison reintroduced to wild herd in Jasper National Park. I like to imagine the print in Europe where the image of a newly re-wilded bison can rest on the soil of the extinct European bison, hopefully inspiring its invisible and long-lost kin.

I have lived with both real and imaginary animals my entire life. In my approach to the invisible, ghost, or fabulated animal, I try to create a space that doesn't demand optics. Invisible animals retain the ability to not be completely knowable, to not be fully divulged. Freed from constant material identification, they are free to inhabit the immaterial values historically assigned only to humans. They are able to haunt, to appear and reappear at will, to manifest as a hallucination or ghost, and to have a privileged interiority. Invisibility is not a dismissive relegation, as if a subject or object can only *exist* or *not exist* in a binary state. Rather, the continuum between visible and invisible speaks not just to the thing-ness of the world but to human perception itself. Invisibility is not a failure of perception, but rather, it is a freeing of the imagination, a liberation of consciousness. The ability to be beyond perception is the very nature of animals, to exist beyond our understanding.

References

[1] Haraway, Donna. "Anthropocene, Capitalocene, Chthulhucene: Donna Haraway in Conversation with Martha Kenney." In *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environment and Epistemology*. ed. by Heather M. Davis, and Etienne Turpin. (London: Open Humanities Press, 2015), 259.

[2] Todd, Zoe. "Indigenizing the Anthropocene." In *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environment and Epistemology*. ed. Heather M. Davis, and Etienne Turpin. (London: Open Humanities Press, 2015), 244.

[3] Crary, Jonathan. *24/7 Late Capitalism and the Ends of Sleep* (London: Verso, 2013), 57.

[4] Crary, Jonathan. *24/7 Late Capitalism and the Ends of Sleep,* 57.

[5] Donovan, Josephine. *The Aesthetics of Care: On the Literary Treatment of Animals*, (New York: Bloomsbury Publishing Inc, 2016), 2.

[6] Crary, Jonathan. *24/7 Late Capitalism and the Ends of Sleep,* 20.

[7] Gye, Lisa. "Half Lives (1998)" Massey Institute of

Technology Website archive, accessed Feb 4, 2018. http://web.archive.org/web/20070707014009/http://halflives.adc.rmit.edu.au/haunt/hl035.html
[8] Lisa G Gye, Lisa. "Half Lives." N.p.
[9] Akrey, Donna. "Nonuments." (2014) Accessed November 11, 2014. https://www.donnaakrey.com/nonuments.html
[10] Bataille, George. *The Accursed Share: An Essay on General Economy.* (New York: Zone Books, 1988), 4.
[11] Sontag, Susan. *Regarding the Pain of Others.* (New York: Picador, 2003), 22.
[12] Marc, Franz. *The Large Blue Horses*. 1911. Oil on Canvas, 2667 x 4597 mm, Walker Art Museum, Minneapolis.
[13] Marc, Franz. *Tierschicksale (Fate of the Animals)*. 1913. Oil on Canvas, 1950 x 2680 mm, Kunstmuseum, Basel, Switzerland.
[14] Wikipedia contributors, "Franz Marc (2019)" *Wikipedia, The Free Encyclopedia,* accessed February 21, 2018, https://en.wikipedia.org/w/index.php?title=Franz_Marc&oldid=874853054
[15] Wikipedia contributors, "Franz Marc," n.p.
[16] Marc, Franz. *Fighting Forms*. 1914. Oil on Canvas, 91 x 131 cm, Bavarian State Painting Collections, Munich, Germany.
[17] Cubitt, Sean. "Projection." In *Media Art Histories*, ed. Oliver Grau. (Cambridge: MIT Press, 2007), 421.
[18] Arendt, Hannah. *The Human Condition.* (Chicago: University of Chicago Press, 1958), 9.
[19] Arendt, Hannah. *The Human Condition*, 200.
[20] Buñuel, Luis. "Cinema as an Instrument of Poetry", in *An Unspeakable Betrayal: Selected Writings of Luis Buñuel*. (Berkeley: University of California Press, 1995), Pg. 136.
[21] Marks, Laura U. *Enfoldment and Infinity: An Islamic Genealogy of New Media Art*. (Cambridge, MA: MIT Press, 2010), 315.
[22] Rodriguez, Lupe. *The Arrival of Liam.* 1985. Oil on canvas, 78 x 101 cm, Grimsby Art Gallery.

Bibliography

Akrey, Donna. *Nonuments*. 2014. Cement, sand, pebbles, rain water. Art Gallery of Windsor. Accessed November 11, 2014. https://www.donnaakrey.com/nonuments.html

Bataille, George. *The Accursed Share: An Essay on General Economy.* New York: Zone Books, 1988.

Bogue, Ronald. *Deleuzian Fabulation and the Scars of History*. Edinburgh: Edinburgh University Press, 2010.

Broglio, Ron. *Surface Encounters: Thinking with Animals and Art*. Minneapolis: University of Minnesota Press, 2011.

Buñuel, Luis. "Cinema As an Instrument of Poetry", in *An Unspeakable Betrayal: Selected Writings of Luis Buñuel*. 136-141. Berkeley: University of California Press, 1995.

Crary, Jonathan. *24/7 Late Capitalism and the Ends of Sleep*. London: Verso, 2013.

Cubitt, Sean. "Projection." In *Media Art Histories*, edited by Oliver Grau. 407–22. Cambridge: MIT Press, 2007.

Donovan, Josephine. *The Aesthetics of Care: On the Literary Treatment of Animals*. New York: Bloomsbury Publishing Inc, 2016.

Gye, Lisa. "Half Lives." (1998) Massey Institute of Technology Website archive, accessed Feb 4, 2018. http://web.archive.org/web/20070707014009/http://halflives.adc.rmit.edu.au/haunt/hl035.html

Haraway, Donna. "Anthropocene, Capitalocene, Chthulhucene: Donna Haraway in Conversation with Martha Kenney." In *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environment and Epistemology*. Edited by Heather M. Davis, and Etienne Turpin. 255-269. London: Open Humanities Press, 2015.

Feder, Helena. *Ecocriticism and the Idea of Culture: Biology and the Bildungsroman*. Burlington V.T: Ashgate, 2014.

Marc, Franz. *The Large Blue Horses*. 1911. Oil on Canvas, 2667 x 4597 mm, Walker Art Museum, Minneapolis.

_____. *TIerschicksale (Fate of the Animals)*. 1913. Oil on Canvas, 1950 x 2680 cm, Kunstmuseum, Basel, Switzerland.

_____. *Fighting Forms*. 1914. Oil on Canvas, 91 x 131 cm, Bavarian State Painting Collections, Munich, Germany.

Marks, Laura U. Enfoldment and Infinity: An Islamic Genealogy of New Media Art. Cambridge, MA: MIT Press, 2010.

Rodriguez, Lupe. *The Arrival of Liam.* 1985. Oil on canvas, 78 x 101 cm, Grimsby Art Gallery.

Sontag, Susan. *Regarding the Pain of Others.* New York: Picador, 2003.

Szoke, Donna. *Alfred Waits*. 2012. Video installation, 34 second loop. https://vimeo.com/48884586.

_____. *Invisible Histories*. 2015. Mobile application. http://donnaszoke.com/?projects=invisible-histories

_____. *Invisible Histories*. 2015. Mobile application. Free Android Download: https://play.google.com/store/apps/details?id=com.igfich.invisiblehistories

_____. *Invisible Histories*. 2015. Mobile application. Free iTunes Download: https://itunes.apple.com/us/app/invisible-histories/id921390469?mt=8

_____. *Invisible Histories*. 2012. Video installation, 19 second loop https://vimeo.com/51470664

_____. *Midst*. 2019. Video installation. https://vimeo.com/309360862

_____. *Shot / Counter Shot: Self-Portrait as Mother*. 2018. Editioned digital print on Hahnemuhle paper, 47 x 61 cm. http://donnaszoke.com/?projects=shot-counter-shot

Tarkovsky. *Solaris*. Producer: Viacheslav Tarasov, 165 min. 1972.

Todd, Zoe. "Indigenizing the Anthropocene." In *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environment and Epistemology*. Edited by Heather M. Davis, and Etienne Turpin. 241-254. London: Open Humanities Press, 2015.

Author Biography

Donna Szoke creates expanded animation, video art, drawing, and printmaking. She investigates immanence, embodied perception, and the fluidity of lived experience. Her work has exhibited in Canada, USA, France, Germany, Turkey, Hungary, Croatia, Cuba, and UAE. She has received awards including SSHRC, Canada Council for the Arts, BC and Ontario Arts Council. She is Chair & Associate Professor, Visual Arts, Brock University where she received the Faculty of Humanities Award for Excellence in Research and Creative Activity in 2017.

Acknowledgements

Thank you to the Ontario Arts Council, Niagara Artists Centre, Grimsby Art Gallery, and Humanities Research Institute (Brock University) for their generous support of these artworks.

Multimodal Data Portrait for Representing Mobile Phone Use Behavior

Sihwa Park
Media Arts and Technology
University of California, Santa Barbara
Santa Barbara, CA, USA
sihwapark@mat.ucsb.edu

Abstract

This paper presents BeHAVE, a web-based audiovisual piece that explores a way to reveal my mobile phone use behavior through multimodal data representation, considering the concept of indexicality in data visualization and sonification. It visualizes the spatiality and overall trend of the records of my mobile phone use as a geographical heatmap visualization and a heatmap chart. On top of that, BeHAVE presents a mode for temporal data exploration to make a year of data perceivable in a short period and represent the temporality of data. Based on a microsound synthesis technique, it also sonifies data to simultaneously evoke visual and auditory perception in this mode. As a way of indexical visualization, BeHAVE also suggests an approach that represents data through mobile phones simultaneously by using WebSocket. Ultimately, BeHAVE attempts to not only improve the perception of self-tracking data but also arouse aesthetic enjoyment through a multimodal data portrait as a means of self-representation.

Keywords

Self-representation, quantified self, mobile phone use behavior, data art, multimodal data representation, visualization, sonification, indexicality, heatmap, WebSocket, WebAudio

Introduction

We have been representing ourselves to understand personality, improve behavior, or share personal experiences with others in various forms, such as self-portraits, autobiographies, memoirs, and diaries. In a digital world, as Rettberg [18] insists, self-representations can be categorized into three modes: written, visual and quantitative. Blogs, selfies, and self-tracking data gathered from sensors can be considered an evidence for each mode.

Especially, the quantitative self-representation has been growing over a decade due to advance in self-tracking technology. As mobile and wearable devices have become more accessible to people, collecting data about oneself and one's daily activities has also become easy. This change has given rise to the Quantified Self (QS) movement[1] that has the slogan of self-knowledge through numbers. In the era of QS, with the use of self-tracking devices and applications, automatically measuring our activities or status as numbers and sharing them are becoming commonplace. By looking at numbers about ourselves, we might be able to understand our lives better, become more productive and healthier, and feel the please of control as Benjamin Franklin, before the digital era, tracked his habits with pens and papers based on 13 virtues for arriving at moral perfection [18, 27].

In terms of making sense of self-tracking data, however, quantifying oneself can be a self-representational purpose. We can not only see ourselves through data but also express ourselves like a self-portrait by representing data in diverse ways. There has been an increasing number of researchers and artists that try to depict themselves by using self-tracking data and attempt to elicit aesthetic curiosity in representing data [27, 1, 15, 24]. Donath [7] suggests to call these representations 'data portraits' that function as data mirrors, showing patterns in data as a tool for self-understanding and evoking the impression of its subject like traditional portraits.

Visualization and sonification both can be used as a main tool in making a data portrait. Visualizing data can help a person reveal a story of data and perceptualize data for others, meanwhile, data sonification can generate knowledge about the subject of data, using non-speech sound to convey data. Whereas visualization exploits our visual perception that is more spatially adapted and optimised for understaning static phenomena, sonification takes advantage of the ability of acoustic perception to recognize temporal changes and patterns [6]. Simultaneously presenting these two representations, multimodal data representation can enhance the perception and understanding of data with multisensory stimuli. If aesthetics is about sensuous perception, the multimodal data representation can be seen as a form of data art that pursues an aesthetic goal, not to mention its pragmatic purpose in terms of information design [3]. In light of this, multimodal representation of self-tracking data can not only disclose the unexpected aspects of ourselves but also express ourselves aesthetically as a data portrait.

As a continuation of the previous study [2] that focused on visualization and sonification techniques based on a microsound time scale, this paper presents BeHAVE (Behavioral data as Heatmap-based Audio-Visual Expression) with the extended discussion of the concept of indexicality in data representation to explore a way to depict my behavior of mobile phone use as a form of multimodal data portrait. Particularly, it explains an indexical visualization approach that uses mobile phone screens as an additional channel to express the

[1] http://quantifiedself.com

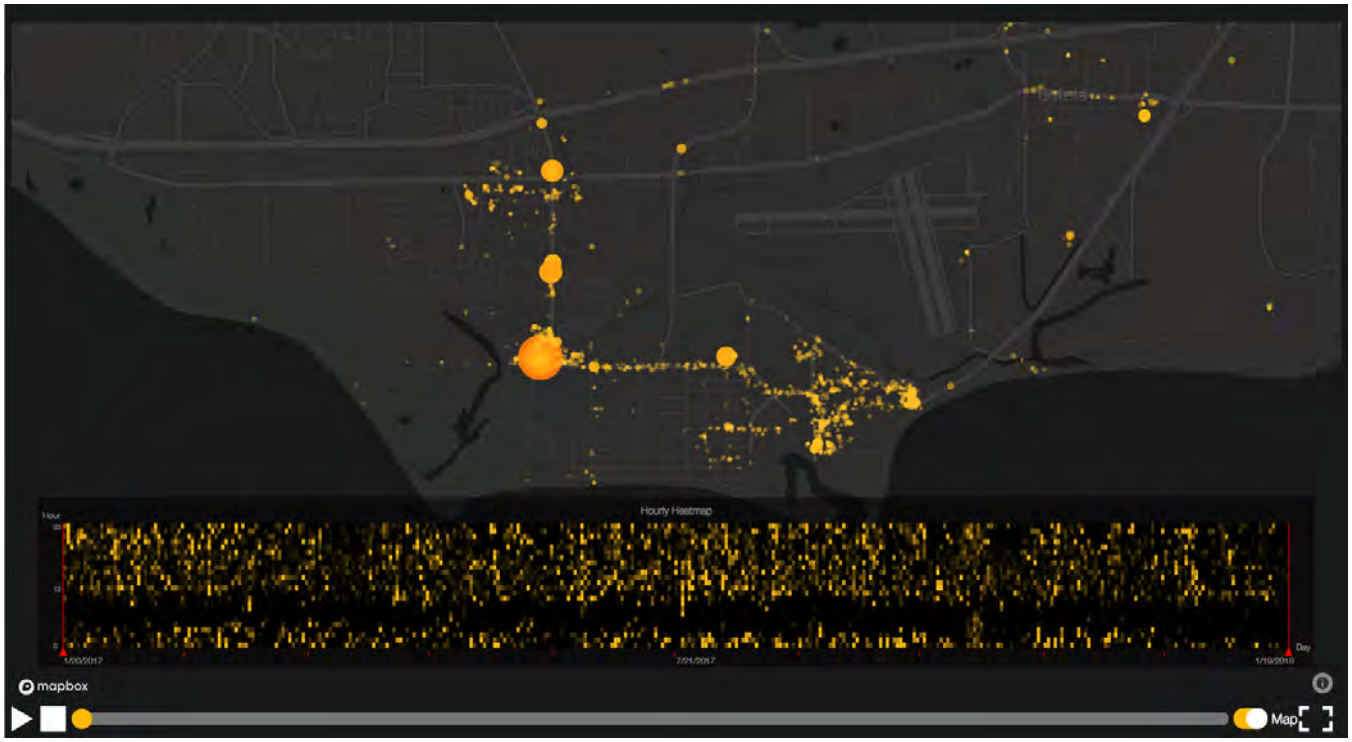


Figure 1: BeHAVE interface

context of data and facilitate audience engagement.

Background

Mobile Phone as the Extended Self

Technologies have been affecting how we perceive the relationship between ourselves and media or devices, which are byproducts of technologies. For this relationship, McLuhan's pioneering interpretation that media are the extensions of human senses is still applicable in the digital era. [14]. Especially, mobile technologies have become an important part of our lives as they are capable of representing an extension of our physical selves, functioning as comfort and intimate objects. [10]. This psychological perception, causing mobile phone attachment and dependency in the technology-driven society, can be also explained by Belkin's the Extended Self Theory that one's possessions can become an extension of oneself [4, 5].

In this context, representing mobile phone use behavior as a data portrait to understand and express ourselves can give an impression about our physical selves captured through an extended digital body although self-tracking data could be considered as just discrete snapshots of ourselves in time and space dimensions. As a self-experiment, BeHAVE attempts to portray my behavior through the multimodal representation of self-tracking data about mobile phone use, considering the data as a means of self-expression.

Mobile Phone Use Data

To obtain my phone use behavior data, I have used an active screen time tracking iPhone application 'Moment'[2], which detects where and when a user turn on or off her/his phone screen, since January 20, 2017. This app also exports all phone use records as a JSON format file that includes a daily using time in minutes, the number of pickups, a location, date, and duration in seconds of each pickup, and most used apps based on apps' battery consumption. Here, a pickup means each moment when a user unlocks her/his phone screen.

BeHAVE uses one year of data which has the records of total 11,367 pickups and the file size of 5.6 Mb. In statistical terms, the minimum, maximum, mean, and standard deviation values of the phone use duration are 0.017, 283.667, 6.243, and 14.465 minutes, respectively.

Behavior Data and Multimodal Representation

A variety of research has been conducted to represent phone usage data for an analytic purpose. Kang et al. [12] introduce 2D and 3D graphic representations of millions of raw mobile call records in a city in China to understand the dynamics of individual mobility patterns. Kaewoni et al. [11] present a visualization tool for mobile phone usage data of Portugal with flow and intensity modes that display a different 3D animation on the Portugal map according to each mode. Ville Vivante[3] is the City of Geneva's visualization project that illustrates 2 million mobile phone calls during a single day in

[2]https://inthemoment.io
[3]https://villevivante.ch

Geneva for the purpose of citizen science and urban planning. However, these works only deal with the behavioral data of the anonymous public merely based on a visual representation.

There have been various attempts to render temporal and geo-related data either visually or sonically. In terms of sonification, whereas iSonic [28] is a practical example that transforms georeferenced data into non-verbal sounds to make visually-impaired people recognize trends of data, COM-Path [16] has a focus on the musical sonification of geo-related data which is plotted on an online map and converted into OSC or MIDI messages to create sound. Similarly, in one of his works, Two Trains[4], Foo attempts to reveal income inequality through musical sound by sonifying income data along with the New York City subway lines. Besides these works that focus on sonification, there are also several examples of multimodal data representation. Rosli [21] suggested a multimodal data representation approach that sonifies and visualizes NASA's lightning data, based on the principles of Gestalt Psychology. Han and Tiwari [9] explored a way to enhance the perception of California drought data by combining a sonification technique with diverse visualizations.

BeHAVE suggests an approach to represent phone use behavior data in a multimodal way that visualizes and sonifies the data simultaneously. On top of that, it represents the mobile phone use data via a mobile phone as an indexical visualization approach not only to frame the context of data through a medium that generated the data itself but also to allow audiences to take part in the piece and more closely experience the data. With this approach, it aims to depict my behavior as a form of data portrait and evoke the aesthetic perception of data through multimodal representation.

Design

Indexicality in Data Representation

Figure 2: A spectrum of data representation (adapted from Keefe et al [13]). The closer the data representation sits to the left end it is more driven by artistic freedom, whereas the closer it is placed to the right end it has more the focus on clear representation which tightly connected with data.

As Donath [7] points out, data portraits could be difficult for the audience to infer meaning because of the abstract nature of data or its representation that has no everyday familiarity, compared to traditional portraits that use personal possessions and the structure and expression of faces as a visual language to evoke an impression. On the other hand, in the fields of data-driven art or artistic InfoVis, artists could emphasize this nature with the use of defamiliarization techniques in their works to prompt reflective insights [17]. A conceptual spectrum of representation proposed by Keefe et al. [13] also illustrates this subjectivity between data and its representation (see Figure 2).

In this regard, it is worth considering the concept of indexicality in designing data representations [22, 3]. Indexicality is a taxonomic concept in Charles Sanders Peirce's theory of semiology that proposes three categories of signs: icons, indices, and symbols. In data visualization, indexicality can be a measure of contiguity that how visual representations of data have a contiguous relationship with the physical world or the subject of data. As Schofield [22] insists, a physical contiguity to reality in visualization can impact audiences' understanding about the relationship between data and representation, framing a meaning through context. Also, indexical signs in visual representation may increase trust and support engagement as indexicality evokes a sensation of situatedness and temporality by revealing 'moments' of isolation in space and time, which mean that sensor data is taken from reality. In data sonification, Barrass and Vickers [3] also explain the indexicality as a measure of the arbitrariness in mapping data into sound. Direct data-to-sound mappings such as audification have high indexicality whereas a sonification system using symbolic or interpretative mappings exhibits low indexicality.

Although it is hard to find a direct connection between the visual indexicality and the auditory indexicality, considering what data attributes can primarily contribute to both visualization and sonification is significant to arouse congruent visual and auditory perception simultaneously. BeHAVE tries to find a relevant position in the indexicality spectrum of data representation for making an impression about the phone use behavior and to present a strong correlation between visuals and sound for multimodal data perception. In this sense, BeHAVE has three layers of data representation: a symbolic heatmap visualization, a parameter mapping-based data sonification which exhibits somewhat high indexicality, and a temporal data visualization on the mobile phone screen to increase indexicality in visualization.

Heatmap Visualization

Considering temporal and geographic attributes of data, BeHAVE visualizes data with two types of a heatamp representation, as shown in Figure 1: a geographic heatmap on an interactive online map and a heatmap chart at the bottom of the screen. For a geographical heatmap visualization, the raw data was pre-processed to change it into a GeoJSON format, which is a geographic data structure used in a map-based visualization, by using Python in the Jupyter Notebook[5].

A geographic heatmap is a typical representation to identify data location and depict data density in areas or at points by plotting geo-related data on an interactive or static map. As described above, the phone use data has spatial and temporal information. In this regard, an interactive map-based geographic heatmap, which is used as the main visualization frame, is an appropriate way to represent the behavior, where and how long I used my phone. Each phone pickup is expressed as a circle on a map according to the coordinates in-

[4] https://datadrivendj.com/tracks/subway

[5] https://jupyter.org/

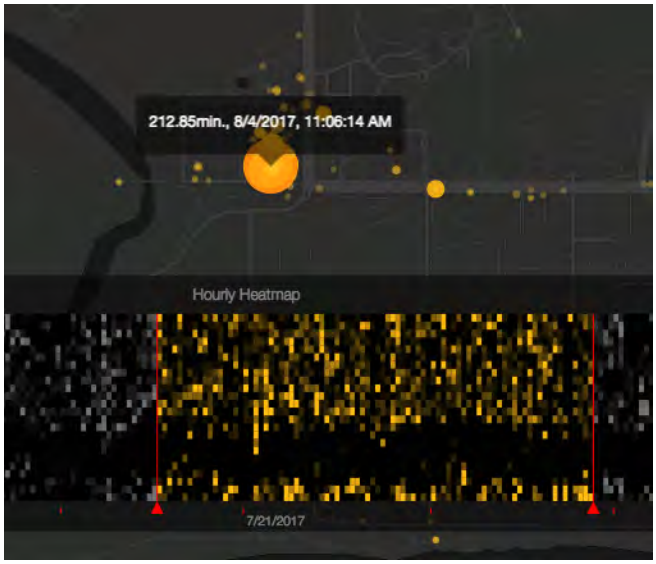


Figure 3: Close look of user interface. A tooltip on a circle shows a detail of data. Red handlebars on the heatmap chart determine an active data range.

formation of a phone pickup location. A circle's radius and color are determined by a phone use duration value. Based on the maximum and minimum phone use duration in the data, which are 0.017 and 283.667 minutes, respectively, a circle's minimum and maximum radii are linearly interpolated. A change of a zoom level on a map also affects the interpolation of this value range; the lower the zoom level is, the wider the range is. Due to the radius interpolation, a user can catch the outline of data points at a lower zoom level, whereas a detailed shape of data on a map is revealed at a higher zoom level. Also, between a certain low zoom level and the minimum zoom level 0, adjacent circles form a cluster like blobs to depict density as a heatmap representation.

In addition to the geographic heatmap, BeHAVE presents a heatmap chart at the bottom of a map, which visualizes all data grouped on an hourly basis to reveal the whole trend and pattern of my phone use behavior. The y-axis of the heatmap chart means hours for a day and the x-axis represents dates. The use duration of 60 minutes is mapped on the brightest yellow color. This heatmap graph also functions as a graphical user interface for trimming a data range, having start and end date selection bars at the left and right sides of it, respectively (see Figure 3).

However, both heatmap visualizations are symbolic, having an indirect or arbitrary relationship between size and color variant visual elements and the phone use behavior. It takes time in learning data-to-visual mapping and it may require an additional explanation about the mapping. It is hard to recognize the temporality of an individual data point although the geographical heatmap reveals the spatial distribution of data well and the heatmap chart shows the overall trend. Exploring data in chronological order will be a key feature to reveal a temporal character of data and evoke aesthetic perception in a data-portrait.

Temporal Data Exploration

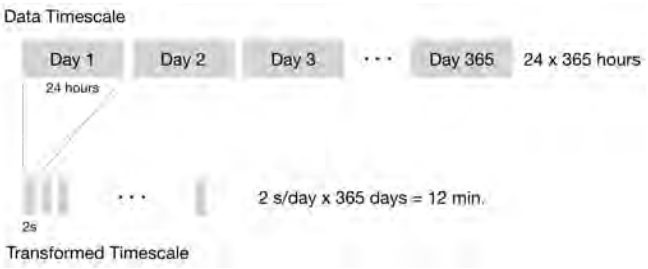


Figure 4: Time scale Transformation.

In realizing a data exploration mode, the original time scale of data should be compressed into a smaller scale to sequentially read a year of records in a short period as Figure 4 illustrates. As a default setting, a day is scaled down to 2 seconds so that it is possible to navigate 365 days of data in 12 minutes but it is flexible to change the setting by adjusting a parameter. By this time scale transformation, the use duration and occurrence timing of phone pickup records are proportionally re-calculated. For example, if the use duration of a pickup is 1 minute, its transformed duration based on 2 seconds per day is $(1 / (60 \times 24)) \times 2 = 0.0013$ s (= 1.3 ms). In this way, 238 minutes, which is the maximum value, is re-scaled to 383 ms.

During the temporal data exploration mode, which is triggered by clicking a play button on the interface (see Figure 1), the rendering of data points occurs over time according to calculated timing information based on the transformed time scale. Unlike the heatmap mode, if drawn circles are left on the screen in the exploration mode, it can cause visual ambiguity in perceiving instant and individual data occurrence. To enable audiences to catch the occurrence of data points, each drawn circle disappears according to the transformed phone use duration, resulting in a flickering visual effect (see Figure 5). Because circles quickly disappear, a color variation according to phone use duration is not effective as much as it is in the heatmap mode. So only the white color is used for the purpose of simplicity and aesthetics. Compared to the radius range of circles in the heatmap mode, a radius in the exploration mode is mapped in a bigger and constant range regardless of a zoom level.

To depict a spatial change in data over time, a translucent line is used. Whenever it draws a circle, it also make a line between the last data location and the current data location. As Figure 5 illustrates, translucent lines connecting data locations render a data route. It also reveals data density in a more abstract way compared to the clusters of a geographic heatmap because the degree of visual overlap among lines visually explains where data occurs the most. In case that a next circle's location is out of a currently visible area, the center location of the current area is transposed to the next location before drawing the circle so that audiences can keep track of a data route without a mouse manipulation. And it is possible to hide a background map and focus on a shape of a whole data route by toggling a map switch on the GUI.

In the temporal exploration mode, it is necessary to present time information as a context of a story, allowing audiences to

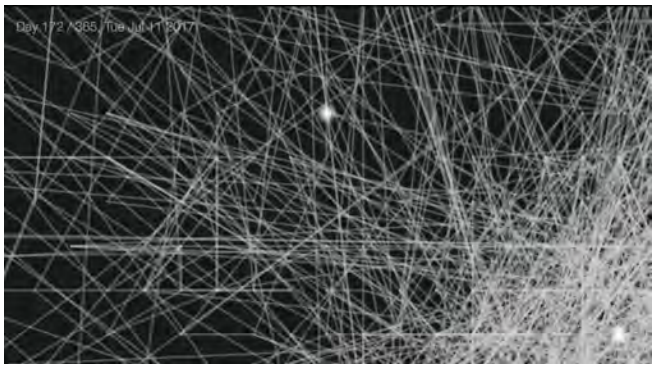


Figure 5: Visualization of the temporal data exploration mode. Flickering circles represent phone use at a location and overlapping lines express routes.

understand an elapsed time and a remaining time. BeHAVE has a time progress bar at the bottom of the screen, revealing a time context of the temporal exploration mode as a graphical form. It also has a text label at the top-left corner showing a date and elapsed days.

Data Sonification

Time Scale for Data Exploration In data sonification for the temporal data exploration, it is important to reflect the main characteristics of data-to-visual mappings in sound mappings to evoke multimodal data perception. It means BeHAVE should generate a sound that reveals the temporal attribute and spatial change in data, i.e., phone use duration and location. One of the appropriate approaches for this mapping will be parameter mapping sonification in which sound is closely derived from data, exhibiting somewhat high indexicality [3].

Because the data time scale is compressed into a shorter time scale for the exploration mode, data-to-sound mappings should be based on the time scale to reflect the temporality in data. As a result of the time scale transformation described above, sound can be dealt with on a microsound time scale [19] that is a duration threshold ranging from one to a hundred milliseconds, in which humans can perceive an acoustic event.

Granular Synthesis-based Parameter Mapping Granular synthesis is a microsound synthesis technique [19]. A grain of sound is a building block for sound objects, shaping a waveform by using an amplitude envelope of which the duration is within the microsound time scale. The main sonification approach of BeHAVE is to map the re-scaled phone use duration onto the duration of an amplitude envelope with constant properties such as attack, decay, sustain, and release (ADSR). During the temporal data exploration, this mapping irregularly triggers sound. As a result, the sound of BeHAVE can be considered as *Quasi-Synchronous Granular Synthesis* in which sound grains follow each other at unequal intervals. Beside the envelope mapping, a reverberation effect is applied to make a sound with the longer duration of an envelope stay more in a space.

As the visualization for temporal exploration represents a spatial property of data as a form of overlapping lines, sonification also needs to reflect a spatial change of data in sound. In this regard, BeHAVE maps a distance from the last data location to a current data location onto the frequency of a waveform. This mapping can cause a dynamic pitch change of sound if a data location frequently changes. It can also reveal a degree that how long the data continuously occurs at a point or an area through continuous low-frequency sounds. Compared to other ways to reflect the spatiality of data in sound, such as the use of a panning effect and directly mapping longitudes or latitudes to a frequency, this distance-to-frequency mapping can be effective even if the geographic data is not well distributed, expressing the temporary density of data at an area.

Indexical Visualization via a Mobile Phone

Figure 6: Visualization through a mobile phone. The phone is syncing with flickering circles on the BeHAVE main projection screen behind.

As a way to exhibit higher indexicality in visualization thereby giving a more intuitive impression to audiences, BeHAVE also represents phone use behavior data through a mobile phone that has a direct relationship with the data itself (see Figure 6). By accessing a mobile web page of BeHAVE, a mobile phone connect to a BeHAVE main web page via web-to-web communication established by the WebSocket technology. During the temporal exploration mode, a connected phone's whole screen becomes white or black, syncing with flickering circles, as a metaphor of turning the screen on and off. This visualization reveals a data context, giving an image of me as if an invisible but real person was using the phone at the moment. Due to the advanced WebAudio technology, the same sound also can be generated through a mobile phone by using the same code for sonification. As a result, using a mobile phone as a physical imprint like footprints can expand channels for multimodal data perception by framing a context of data.

Implementation

MapBox for Geographic Data Rendering

For a web-based geographic data visualization, BeHAVE uses MapBox GL JS[6], a WebGL-based JavaScript library for rendering interactive maps. By adding GeoJSON format data as a data source and layers that draw circles and heatmap blobs based on the data source, MapBox creates a geographic heatmap. Also, it is possible to set the steps of a circle's radius and color based on zoom levels, a phone use duration range, and an interpolation method. In visualization for the temporal exploration mode, lines are added as another layer on a map. In this mode, a layer for flickering circles is shown whereas the layer for drawing heatmap circles is hidden. A flickering effect is made by changing a circle's opacity with a JavaScript function, `setTimeout`.

The heatmap chart is drawn by using the HTML canvas element on top of the map. It plots an hourly phone use as rectangles with the same size and the yellow color of a rectangle is linearly interpolated by hourly phone use duration ranging from 0 to 60 minutes.

Gibberish for WebAudio Sound Synthesis

BeHAVE uses Gibberish[7], a JavaScript sound synthesis library. Gibberish can generate and synthesis sound based on per-sample basis processing [20]. One sample in digital audio processing with the audio sampling rate of 44,100Hz is a sound signal for 0.02 milliseconds. In terms of microsound synthesis, BeHAVE can benefit from this sample-accurate timing feature of Gibberish.

Table 1: Parameters for sonification

Parameter	Value
Envelope Duration	$transformedUseDuration \times 44100$
Attack Ratio	0.1
Decay Ratio	0.6
Sustain Ratio	0.2
Release Ratio	0.1
Sustain Level	0.6
Frequency	220 + distance

As a main sound source, Gibberish's `Synth` instrument, which has an oscillator connected with an amplitude envelope and a selectable resonant filter, is utilized. The envelope duration in samples is a transformed use duration value multiplied by the audio sampling rate. ADSR is also measured in samples based on the multiplication of ADSR ratios and the envelope duration (see Table 1). The resonant filter is set with a zero-delay 4-pole Moog-style ladder filter and `Synth` is connected to `Freeverb` for a reverberation effect.

To calculate a distance between two locations, the equirectangular projection [23] is applied. Due to the fact that a high frequency can cause an unpleasant or inaudible sound, it is necessary to limit a maximum distance value up to a threshold, e.g., 10 kilometers that results in a frequency range from 220 Hz to 10,220 Hz.

[6]https://www.mapbox.com/mapbox-gl-js

[7]https://github.com/gibber-cc/gibberish

WebSocket for Communication Browsers

WebSocket is a single Transmission Control Protocol (TCP) socket-based technology that enables full-duplex communication between a client and a server[8]. Because most modern web browsers, including mobile web browsers, support WebSocket, it is possible to develop a web application that provides real-time synchronization among multiple users via web browsers.

Communication between the main BeHAVE web page and the mobile web page is established through a sever application, which is run by a server-side JavaScript environment, Node.js [25]. During the temporal data exploration, when the main web page is about to draw a new circle at a data point, it sends a phone use duration value and a frequency to a server. Then, the server transmits received data to all connected mobile clients. The mobile web page changes the background color into white as soon as it receives a new message from the server and calls a color animation function to change back into black in a given phone use time. To reduce a networking delay, it uses a dedicated Wi-Fi router, to which a local computer and mobile phones connect. A local computer serves as not only a server handling client connections and messages and but also a client showing the main web page.

Exhibition and Discussion

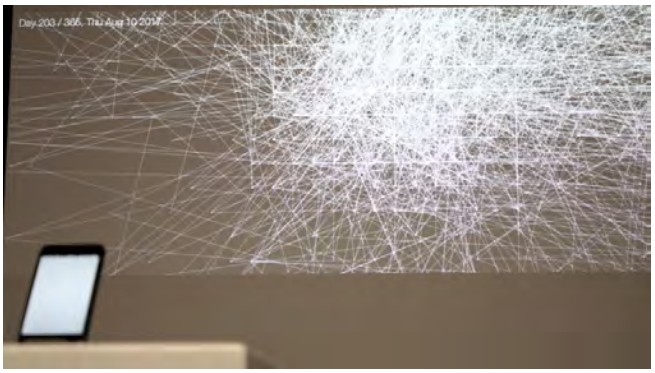


Figure 7: BeHAVE installation

BeHAVE was presented as an installation in a one-day public exhibition hosted by the Media Arts and Technology program at UCSB and it was able to test the system in a real situation and get interesting and constructive feedback from audiences. As Figure 7 illustrates, the installation consisted of the projection on a wall screen and my mobile phone, from which the data was collected, on a pedestal. For simplicity and an aesthetic purpose, the temporal exploration mode was only presented in the installation, looping a year of the data. A trackpad was placed on the pedestal to allow audiences to navigate the visualized data. Audiences were also able to experience the behavior data through their mobile phones by following an instruction attached on an entrance wall (see Figure 8). The sound of the main screen was played through stereo speakers and the mobile phone was also set to

[8]https://tools.ietf.org/html/rfc6455

play sound. However, generating sound through audiences' mobile phones was not included to prevent unexpected broken audio issues, which result in a displeasing audience experience, caused by a difference in versions of mobile web browsers.

Figure 8: Audience interaction. After accessing the mobile web page via a QR code or a URL with his or her mobile phone, an audience can see a user interface to connect or disconnect to the BeHAVE main web (top) and connected mobile phones are flickering (bottom).

Most audiences expressed a curiosity when they first looked at the piece that was drawing flickering circles and lines and generating short bursting or beeping sounds. After understanding what data was being represented, some audiences tried to guess locations where circles were frequently appearing and lines were densely overlapping. There was an expectation that something might happen differently at the end of the data exploration of 365 days, e.g., showing the whole shape of visuals or a cinematic description of the piece. While some audiences enjoyed interactivity given through a trackpad manipulation such as zooming in and out the visual space, one of the audiences suggested that it would be better if the piece has different zoom levels according to events, dates, or times. Interestingly, a couple of audiences asked if they can apply their own data after self-tracking with their mobile phones.

Most of the audiences aesthetically recognized the sound. One of interesting feedback about sonification was that it is felt like more musical rather than just data. The intention of changes in pitch was not intuitively perceived by some of the audiences without understanding the mapping although they were able to guess that a different pitched sound occurring along with a visual change means a different activity or state. When the distance-to-frequency mapping was explained, however, they acknowledged the effectiveness and relevancy of the mapping.

When it comes to the mobile phone-based indexical visualization, it was able to bring about an impressive effect as a metaphor of phone use activities, exposing the behavior that how frequently I used my phone, in a more direct representation. After recognizing the synchronization between the mobile phone on the pedestal and the wall screen, audiences actively tried to engage in the piece through their mobile phones as shown in Figure 8. However, some of the connections were unstable because of the nature of delay in the TCP-based WebSocket communication.

In overall, the main goal to give an impression of me by depicting the phone usage behavior as a data portrait was delivered through multimodal representation maintaining somehow high indexicality in both visualization and sonification. Although it is reasonable to raise a doubt whether the expression using simple lines and circles in a two-dimensional space is the only visual language to uniquely reveal one's behavior, my choice of simplicity in representation was effective in enhancing data perception and enough to be considered as a style in generating a data portrait and evoking aesthetic curiosity. A video of the BeHAVE demo and installation version is available at `https://sihwapark.com/BeHAVE`.

Conclusion and Future Work

BeHAVE is a web-based multimodal data representation that visualizes and sonifies my mobile phone use behavior. It explores a way to depict oneself as a data portrait, considering self-tracking data in the context of the extended digital self. In terms of the concept of indexicality, BeHAVE attempts to reduce arbitrariness in the mapping between data and representation and enhance the perception of temporality and spatiality in data. In the temporal data exploration mode, the main expression for visual perception, which uses circles and lines, and the sonification approach based on a microsound time scale help audiences get an impression of the behavior data and me. A synchronized visualization through a mobile phone, exhibiting a contiguous relationship between the data and the physical object, is an approach to not only allude to my behavior but also make audiences participate in the piece through their mobile phones, although it is yet unstable and has some delay.

As Donath [7] points out, we might discover and represent our identities entangled with data depictions, in the era of increasingly self-tracking data. However, it is also worthwhile to be aware of what perspective self-tracking data cannot reflect ourselves in reality as Druker [8] suggests the use of the term *capta*, which is *taken* from reality, instead of data which is believed as *given*. Similarly, Van Dijck [26] argues that understanding different reasons and contexts of data gathering is significant, criticizing a common belief in the objective quantification and self-tracking of human behavior with the term *dataism*. Also, a representation of the data gathered

from one's devices might not be about one's experience but the experience of the devices [18].

In this regard, future work will expand based on new questions: 1) What kinds of other data can increase the degree of contextualization and enhance uniqueness in a data portrait? e.g., used apps, activities during not using a phone, schedule, etc. 2) If other data is included, what visual language and sonification approach can more appropriately express oneself? 3) If the data representations are considered as seeing oneself through machines' vision, how can we compare human perception and machine perception about oneself?

References

[1] Abendo, P., and Fuchs, M. 2016. The quantified selves and statistical bodies. *Digital Culture & Society* 2(1):5—-21.

[2] Author. 2018. Behave: Heatmap-based audiovisual representation of personal data. In *Proceedings of the International Computer Music Conference*.

[3] Barrass, S., and Vickers, P. 2011. Sonification design and aesthetics. In Hermann, T.; Hunt, A.; and Neuhoff, J. G., eds., *The Sonification Handbook*. Berlin, Germany: Logos Publishing House. chapter 7, 145–171.

[4] Belk, R. W. 1988. Possessions and the extended self. *Journal of consumer research* 15(2):139–168.

[5] Belk, R. W. 2013. Extended self in a digital world. *Journal of Consumer Research* 40(3):477–500.

[6] Daurer, G. 2015. Audiovisual perception. In Daniels, D.; Naumann, S.; and Thoben, J., eds., *See this Sound: Audiovisuology*. Dap-distributed Art.

[7] Donath, J.; Dragulescu, A.; Zinman, A.; Viégas, F.; and Xiong, R. 2010. Data portraits. *Leonardo* 43(4):375–383.

[8] Drucker, J. 2011. Humanities approaches to graphical display. *Digital Humanities Quarterly* 5(1):1–21.

[9] Han, Y. C., and Tiwari, S. 2017. California drought impact: Multimodal data representation to predict the water cycle. *2017 IEEE VIS Arts Program (VISAP)*.

[10] Harkin, J. 2003. *Mobilisation: The growing public interest in mobile technology*. Demos.

[11] Kaewnoi, N.; Suntiparadonkul, N.; Phithakkitnukoon, S.; and Smoreda, Z. 2016. Visualizing mobile phone usage for exploratory analysis: A case study of portugal. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct*, UbiComp '16, 1358–1362. New York, NY, USA: ACM.

[12] Kang, C.; Gao, S.; Lin, X.; Xiao, Y.; Yuan, Y.; Liu, Y.; and Ma, X. 2010. Analyzing and geo-visualizing individual human mobility patterns using mobile call records. In *Geoinformatics, 2010 18th International Conference on*, 1–7. IEEE.

[13] Keefe, D. F.; Karelitz, D. B.; Vote, E. L.; and Laidlaw, D. H. 2005. Artistic collaboration in designing vr visualizations. *IEEE Computer Graphics and Applications* 25(2):18–23.

[14] McLuhan, M. 1994. *Understanding media: the extensions of man*. The MIT Press.

[15] Neff, G., and Nafus, D. 2016. *Self-Tracking*. The MIT Press.

[16] Park, S.; Kim, S.; Lee, S.; and Yeo, W. S. 2010. Composition with path : Musical sonification of geo-referenced data with online map interface. In *Proceedings of the International Computer Music Conference*, 5–8.

[17] Pousman, Z.; Stasko, J.; and Mateas, M. 2007. Casual information visualization: Depictions of data in everyday life. *IEEE transactions on visualization and computer graphics* 13(6):1145–1152.

[18] Rettberg, J. W. 2016. *Seeing ourselves through technology: how we use selfies, blogs and wearable devices to see and shape ourselves*. Palgrave Macmillan.

[19] Roads, C. 2004. *Microsound*. The MIT Press.

[20] Roberts, C.; Wakefield, G.; and Wright, M. 2013. The web browser as synthesizer and interface. In *Proceedings of the 13th Conference on New Interfaces for Musical Expression*, 313—-318.

[21] Rosli, M. H. W., and Cabrera, A. 2015. Gestalt principles in multimodal data representation. *IEEE Computer Graphics and Applications* 35(2):80–87.

[22] Schofield, T.; Dörk, M.; and Dade-Robertson, M. 2013. Indexicality and visualization: Exploring analogies with art, cinema and photography. In *Proceedings of the 9th ACM Conference on Creativity & Cognition*, 175–184. ACM.

[23] Snyder, J. 1997. *Flattening the Earth: Two Thousand Years of Map Projections*. University of Chicago Press.

[24] Thudt, A.; Perin, C.; Willett, W.; and Carpendale, S. 2017. Subjectivity in personal storytelling with visualization. *Information Design Journal* 23(1):48–64.

[25] Tilkov, S., and Vinoski, S. 2010. Node. js: Using javascript to build high-performance network programs. *IEEE Internet Computing* 14(6):80–83.

[26] Van Dijck, J. 2014. Datafication, dataism and dataveillance: Big data between scientific paradigm and ideology. *Surveillance & Society* 12(2):197.

[27] Young, N. 2013. *The Virtual Self: How Our Digital Lives Are Altering the World Around Us*. McClelland & Stewart.

[28] Zhao, H.; Plaisant, C.; Shneiderman, B.; and Lazar, J. 2008. Data sonification for users with visual impairment: A case study with georeferenced data. *ACM Trans. Comput.-Hum. Interact.* 15(1):4:1–4:28.

Author(s) Biography(ies)

Sihwa Park is a sound interaction designer, media artist, and developer. His interest mainly lies in data-driven audiovisual arts. He also seeks to create new musical experiences by embracing advanced technologies in making a novel musical interface/interaction. He is currently a Ph.D. candidate in Media Arts and Technology at UCSB.

Plant Based Bio-Drone for Environmental Monitoring in The Amazon

Zane Cerpina
Oslo School of Architecture and Design
Oslo, Norway
cerpina.zane@gmail.com

Abstract

This paper explores merging technology and biology into semi-living designs in order to rethink and advance current ecological surveillance tools. Drone technology combined with (the sensory capabilities of) living plants could provide our monitoring tools with plant based intelligence and more advanced ways of sensing ecological changes. Drones are currently designed to collect specific data through single-flight missions without longer-term interaction with the target location or non-human species. The paper speculates on the potential use of recent discoveries of the ways plants sense and interact with their environments as well as each other as part of the monitoring process. The paper presents and discusses a future design proposal The BIO_DRONE—an autonomous hybrid drone designed by merging the plant *Boquila trifoliolata* with a flying device. The resulting concept is a hybrid biosensing drone that aims to provide manifold data about the world's most complex biome—the Amazon rainforest.

Keywords

Ecological surveillance, Biosensing technology, Plant based intelligence, Environmental adaptation, Amazon rainforest, Speculative design.

Introduction

There is a growing need for more effective and efficient ways of ecological surveillance as vast and complex terrains, such as Amazon rainforest, become affected by devastating ecological factors and environmental issues in this onsetting age of the Anthropocene. [1] Research over the past few years suggests that drone-based technology may be the most suitable monitoring tool for the Amazon. [2] However, potential success of using drones in rainforests is dependent on these technologies' ability to survive the harsh weather conditions such as extreme heat, fungi, humidity, vast distances and even predator attacks. [3] Other critical factors such as energy consumption, the need to recharge, physical maintenance and software updates have to be taken into consideration.

To solve these issues, the paper proposes to use plant based intelligence and principles of environmental adaptation to advance the environmental monitoring tools. From a technical perspective, how can hybrid, semi-living plant-based drones be enabled to survive harsh rainforest weather conditions and provide better and more useful, insightful data about the Amazon?

The Amazon rainforest in the Anthropocene

The tropical forests are often seen as the most significant biomes on the planet Earth. [4] Although many of them have been domesticated for tens of thousands of years, [5] the negative impact of humans has increased substantially in the new geological epoch of the Anthropocene. These environmental issues include: deforestation, land resource extraction, change in biodiversity, the spread of fire, landscape fragmentation, industrial pollution, new species invasion and climate change. [1] The increasing amount of ecological issues, points to the demand for more advanced long-term environmental monitoring approaches. [6]

Ecological surveillance in the Amazon

Traditionally, the Amazon rainforest has been monitored by foresters, using field and aerial surveys. [7] Ground surveys are still widely used to monitor biodiversity, however this approach is time consuming, financially expensive, and challenging in remote areas. [8] Illegal activities are mainly monitored by on-ground environmental defenders—human agents that often put their own lives at risk. [9] These critical issues suggest that the loss of human lives in the direct process of environmental monitoring should be limited and replaced by technological solutions. Using advanced technology to monitor and to collect environmental data in the Amazon is nothing new. As an example, Brazil has been providing annual estimates of deforestation using satellites since 1988. [7] Although satellites are becoming increasingly popular in environmental monitoring, [10] the accuracy of this method is limited. Most satellites are based on optical systems, that cannot collect imagery through the clouds. [11]

The above-mentioned monitoring approaches are usually used for distinct tasks and to collect data only from individual viewpoints (e.g., ground level, sky). However, to ensure a complete and long-term ecological surveillance of the Amazon rainforest, all forest levels should be monitored—above the treetops, where human agents

cannot access, on the ground and in the forest level, an area otherwise invisible to satellites and aerial photos. This requires a technology with advanced abilities to maneuver throughout the forest.

Ecological surveillance by drone technology

Several studies point to the large potential of unmanned aerial vehicles (UAVs) as substitutes for traditional environmental surveillance approaches. [12] UAVs, commonly known as drones, are considered a major step towards more effective and efficient monitoring of natural resources. [14] For example, drones are used in precision agriculture, to monitor vegetation, biodiversity, habitat and soil, as well as for forest mapping and monitoring of forest fires. [2] Drones can be equipped with a wide range of sensors, including various types of optical cameras, multispectral cameras, hyperspectral cameras and thermal cameras. [14] For example, near infrared and ultraviolet cameras are useful to identify warm-bodied wildlife in the forest. [8] Drone technology can also potentially perform a wide range of physical tasks such as: broadcasting insecticides and pollen, gathering water, leaf and soil samples, and transporting physical items. [15]

In addition to the range of digital and physical data collecting possibilities, drone technology can be deployed more quickly over large distances than local agents on the ground. [8] Small drones are especially preferred as a monitoring solution for difficult-to-access terrains with no people. [15]

The mobility, small size, and the numerous possible applications are the main reasons why drones have a good potential in long-term surveillance of the Amazon rainforest. There are an increasing number of case studies investigating various applications of drone technology in the rainforests. For example, monitoring river dolphins in the Amazon river in Brazil, as an alternative to standard visual counts carried out on a canoe [16] or equipping indigenous communities with easy to use and repair drones to monitor their surroundings and the illegal activities. [17] The current focus in the Amazon is on developing semi-autonomous or fully autonomous drones. This would allow the members of local communities to participate in monitoring projects without needing extensive training. [2]

Although drones seem to be well suited for environmental monitoring, there are several challenges for this technology, especially if used in harsh climates and complex environments. [3] Most of the small-size multirotor drones run on rechargeable battery cells, providing only enough battery life for still relatively short flights up to 30 minutes. [18] Therefore, requiring repeated human maintenance, such as recharging the battery between every mission. [15] According to a study done by a group of drone-piloting scientists, another important challenge is the eventual technical damages caused by rainforest specific climate risks: high humidity and extreme heat. [3]

To provide ongoing monitoring of Amazon using drones, the above-mentioned technical challenges have to be overcome. Only then the potential of drones in monitoring processes can be fully explored. Possibly ensuring ongoing surveillance with repeated cycles of—monitoring, charging and relocating—without any interruptions or need to return to the starting location. Based on the large variety of ecological issues in the Amazon, the future monitoring tools should be equipped with much more advanced monitoring systems, capable of collecting better data. This in contrast to specialized drones with only limited capabilities to observe single species, or a seperate change in the environment (e.g., deforestation).

An appropriate place to look for the ways to overcome these critical issues may be the target location itself—the Amazon rainforest. Despite the harsh climate, it is the most biodiverse biome on Earth. [4] Currently all of the existing drone technologies will eventually break down in the Amazon rainforest. How can plants extend their capabilities to survive and thrive in such harsh weather conditions?

Plant based intelligence and environmental adaptation

What can we learn from plants, that could lead us to the development of longer lasting and smarter ecological surveillance tools? Plants have a complex sensory system. Their roots serve as the biosensors responding to various signals from the external environment. [20] This is considered plant intelligence—plants' ability to sense, interact and respond to the environment, with an objective to survive and reproduce. [20]

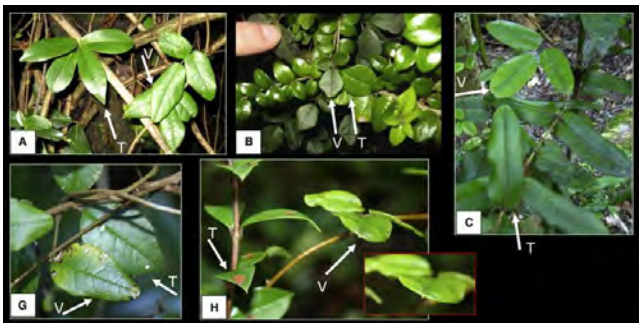


Figure 1.*Boquila trifoliolata* (V) mimicking six different trees (T). (Gianoli & Carrasco-Urra). [19]

All plants are able to read and adapt to their environment on some level, but one plant in particular has very advanced environmental adaptation skills. The climbing vine *Boquila trifoliolata* from the temperate rainforest of

southern South America can mimic the leaves of surrounding plants in terms of size, shape, orientation, petiole length and tip spininess, see Figure 1. Although there are other plants using this mimicry method, *B. trifolata* is the only one capable to mimic several—up to eight types of leaves on a single stem. It uses leaf mimicry as a defensive strategy that can occur even without a direct contact between the vine and the plant it mimics. [21]

This points to the several sensory capabilities that *B. trifoliolata* must have, such as somehow seeing, touching, memorizing and even understanding the external environment. According to Trewavas [22], green plants are able to sense all the following external signals:

-light (quality, intensity, length of exposure)
-temperature
-touch, weight, vibrations, gravity
-sound
-humidity
-chemical/gas concentration
-biotic signals (competition, cooperation).

If plant sensory system was adapted by drone technology, there would be no need to equip the monitoring devices with any external mounted sensors (e.g., optical vision sensors, cameras, microphone etc.) besides the plant itself. This would free the monitoring devices from requiring sensor software and hardware updates.

Understanding plant behaviour is at the frontiers of the plant biology. [20] However, plant intelligence differs from animal or human intelligence, as plant memory can operate in different time frames—from milliseconds to weeks and months, depending on the signals from the environment. This makes the plant intelligence difficult to study. [22]

These findings point to the potential of using plant intelligence and plant abilities to sense and adapt to their surroundings as a potential area of investigation to radically change and improve the ways we collect data about environmental changes. Once advancing our understanding of plant intelligence and behaviour, plants could be potentially included directly in the process of environmental monitoring.

Merging technology and biology

Combining plant-based intelligence with new technologies could radically advance our understanding of our biosphere. In addition, the concept of environmental adaptation could be employed by current monitoring technologies to increase their durability in especially harsh environments.

According to a case study by Volkov and Ranatunga, plants can potentially be used as biosensors through computers, allowing to predict and monitor climate change and other changes in the environment. [23] There are several exploratory projects investigating the possibility to merge plants with modern technologies. “The dream of flying” by Chiara Esposito features an interface that enables a plant to control its position via a small drone. The direction of the flight is based on the electrical activity sensed from the plant. [24] Another project that explores plant-machine relationship is Guto Nobrega’s “BOT_anic”. Here, a robot allows the plant to crawl towards the source of carbon. [25] More examples are provided by the EU funded research projects “Flora Robotica” and “NASCENCE,” which investigate mixed societies of symbiotic robot-plant bio-hybrids. [26] A similar goal is presented in the project “PLEASED”—exploring and demonstrating the whole plant being used as biosensor of external stimuli, further recognized by a machine. [27]

These projects are some of the examples on how technologies can be used to gather and translate the plants’ sensory signals. “The dream of flying” and “BOT_anic” also open up the discussion of what would be the benefits for a plant if it entered a symbiotic relationship with technologies based on electronics and digital controls. The bio-machines presented above can serve as a starting point to imagine how could we use plants in environmental monitoring and developing tools that directly interact with the target habitat.

Figure 2. BIO_DRONE’s design draft. (Cerpina, 2018).

Towards biosensing plant based drones

The previous section has pointed out the potential of merging technology and plants into advanced biosensing devices. Combining the plant-based intelligence and plant adaptation skills with the mobility of drone technology could result in overcoming the previously discussed critical issues of currently available drone technology: a) need for between-flight maintenance; b) limitations in data collection; c) short range; d) decreased lifetime due to harsh climate conditions.

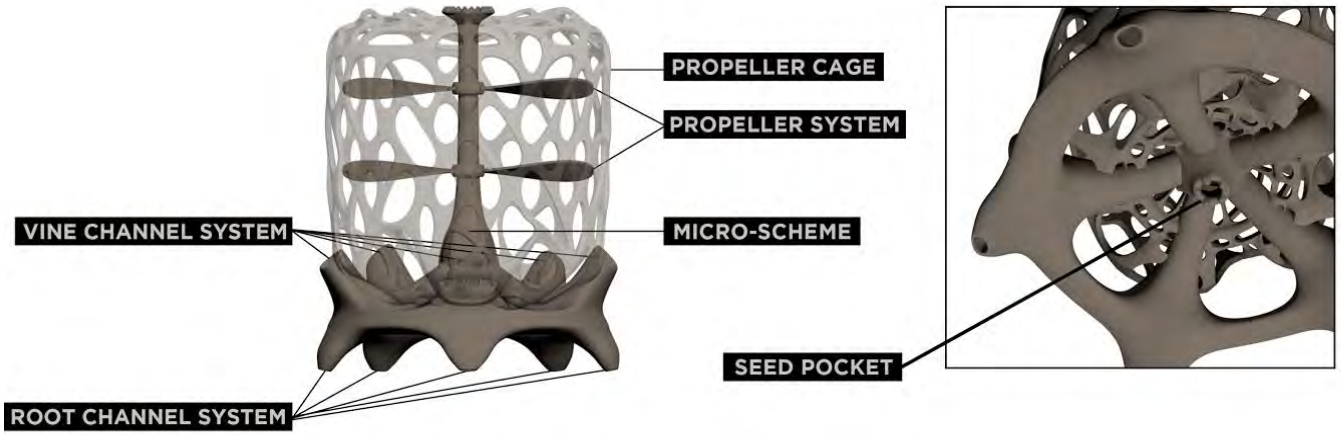


Figure 3. BIO_DRONE's design structure. (Cerpina, 2018).

To further the ideas outlined in this paper, a design draft of a bio-drone was made. The experimental layout aims to further explore potential functions and future perspectives of a hybrid monitoring technology that could permanently inhabit the Amazon rainforest.

The resulting concept is an autonomous hybrid technology, "The BIO_DRONE," created by merging the vine *Boquila trifoliolata* and a custom-designed two-propeller, single axis flying device, see Figure 2. As described earlier in this paper, the plant was chosen due to its unique abilities to mimic the leaves of several surrounding plants. These extreme adaptation skills make the *Boquila trifoliolata* a good choice for a mobile sensor device, exemplified through the plants' ability to adjust to any habitat within the vast rainforest. The design draft of "The BIO_DRONE" is developed based on the basic plant physiology, such as plant morphology (structure of a plant), plant ecology (interactions with the environment) and basic aerodynamic principles of currently available commercial drones.

The BIO_DRONE consists of the following elements: a) The seed pocket (at the bottom of the device) that allows to obtain a new seed. b) Root channel system for the plant to intake water and sense the external environment using roots. c) Vine channel system - directs the plants growth towards and around the propeller cage. d) Two propeller system enables relocation for data collection purposes and plants survival (e.g., reaching sunlight, water source). e) The cage secures propellers from external obstacles and allows the plant to climb. f) Micro-scheme (located near the seed-pocket) processes plants sensory signals, forwards the collected data for research purposes. For overview of the design elements see Figure 3, 4.

A highly mobile and environment-adaptive monitoring drones using complex plant-based sensory systems, could provide an ongoing, long-term ecological surveillance of the whole region of the Amazon rainforest. This would also ensure a close interaction between the monitoring system and the environment. The symbiotic relationship between the drone and its inhabiting plant could also be discussed, as the plant is given a more efficient means of relocating.

The BIO_DRONE is a future design proposal, at this stage serving as a design object that allows us to imagine radically different approach to environmental monitoring tool development. In order to further explore and demonstrate the potential of BIO_DRONE as a bio-sensing device, further research and practice-based experiments are required.

Figure 4. See-through sketch of BIO_DRONE. (Cerpina, 2018).

Outlook

To ensure ongoing long-term environmental monitoring of the most biodiverse biome on the planet Earth, the Amazon rainforest, researchers and scientists are constantly seeking more effective and efficient monitoring technologies. Several studies have pointed to drone technology as

potentially the most fitting surveillance tool for the Amazon rainforest, yet there are several critical issues to be solved.

The research on plant-based intelligence and environmental adaptation in this paper has pointed to the potential of using plants as biosensors in the environmental monitoring processes. Currently we are in the early stages of understanding plant-based intelligence. However, the discussed case studies point to several successful experiments using plant's sensory abilities to monitor and effect changes in the environment.

Plant intelligence could be used as a tool to collect highly advanced and complex data about the environmental processes and ecological changes in the Amazon, while plant environmental adaptation techniques could improve our drone technologies' longevity in the harsh rainforest climate conditions. Merging plants and drones into bio-sensing devices promises the better solution for long term monitoring of the Amazon rainforest.

References

[1] Malhi, Y., Gardner, T. A., Goldsmith, G. R., Silman, M. R., Zelazowski, P. (2014). *Tropical Forests in the Anthropocene.* Annual Review of Environment and Resources, 39, 125-159. https://doi.org/10.1146/annurev-environ-030713-155141

[2] Paneque-Gálvez, J., McCall, M. K., Napoletano, B. M., Wich, S. A., Pin Koh, L. (2014). *Small Drones for Community-Based Forest Monitoring: An Assessment of Their Feasibility and Potential in Tropical Areas.* Forests 5(6), 1481-1507.

[3] Duffy, J. P., Cunliffe, A. M., DeBell, L., Sandbrook, C., Wich, S. A., Shutler, J. D., Myers‐Smith, I. H, Varela, M. R., Anderson, A. (2017). *Location, location, location: considerations when using lightweight drones in challenging environments.* Remote Sensing in Ecology and Conservation, 4(1). https://doi.org/10.1002/rse2.58

[4] Hill, J. L, Hill, R. A. (2001). *Why are tropical rainforests so species rich?* Classifying, reviewing and evaluating theories. Progress in Physical Geography, 25(3) 326–354. https://doi.org/10.1177/030913330102500302

[5] Clement, C. R., Denevan, W. M., Heckenberger, M. J., Braga Junqueira, A., Neves, E. G., Teixeira, W. G., Woods, W. I. (2015). *The domestication of Amazonia before European conquest.* Proc. R. Soc. B, 282(1812). http://dx.doi.org/10.1098/rspb.2015.0813

[6] Lindenmayer, D. B., Likens. E. (2010). *The science and application of ecological monitoring*. Biological Conservation, 143(6), 1317–1328. https://doi.org/10.1016/j.biocon.2010.02.013

[7] Fuller, D. O. (2006). *Tropical forest monitoring and remote sensing: A new era of transparency in forest governance?* Singapore Journal of Tropical Geography, 27(1), 15-29. https://doi.org/10.1111/j.1467-9493.2006.00237.x

[8] Pin Koh, L., Wich, S. A. (2012). *Dawn of drone ecology: low-cost autonomous aerial vehicles for conservation.* Tropical Conservation Science, 5(2), 121-132. https://doi.org/10.1177/194008291200500202

[9] Watts, J., (2018, February 2). *Almost four environmental defenders a week killed in 2017.* Retrieved from https://www.theguardian.com/environment/2018/feb/02/almost-four-environmental-defenders-a-week-killed-in-2017

[10] Milodowski, D. T., Mitchard, E. T. A. (2017). *Forest loss maps from regional satellite monitoring systematically underestimate deforestation in two rapidly changing parts of the Amazon.* Environmental Research Letters, 12(9). https://doi.org/10.1088/1748-9326/aa7e1e

[11] Chen, F., Ishwaran, N., Brito Pezzuti, J. C. (2016). *Deforestation monitoring in the Amazon River estuary by multi-temporal Envisat ScanSAR data.* IOP Conference Series Earth and Environmental Science, 34(1):012003. https://doi.org/10.1088/1755-1315/34/1/012003

[12] Zahawi, R. A., Dandois, J. P., Holl, K. D., Nadwodny, D., Leighton Reid, J., Ellis, E. C. (2014). *Seeing the forest from drones: Testing the potential of lightweight drones as a tool for long-term forest monitoring*. Biological Conservation, 198, 60-69. http://dx.doi.org/10.1016/j.biocon.2015.03.031

[13] Anderson, K., Gaston, K. J. (2013). Lightweight unmanned aerial vehicles will revolutionize spatial ecology. Frontiers in Ecology and the Environment, 11(3), 138-146. https://doi.org/10.2307/23470549

[14] Manfreda, S., McCabe, M. F., Miller, P. E., Lucas, R., Pajuelo Madrigal, V., Mallinis, G., Ben Dor, E., Helman, D., Estes, L., Ciraolo, G., Müllerová, J., Tauro, F., Isabel de Lima, M., de Lima, J. L. M. P., Maltese, A., Frances, F., Caylor, K., Kohv, M., Perks, M., Ruiz-Pérez, G., Su, Z., Vico, G., Toth, B. (2018). *On the Use of Unmanned Aerial Systems for Environmental Monitoring.* Remote Sens. 2018, 10(4), 641; https://doi.org/10.3390/rs10040641

[15] Gallacher, D. (2016). *Drone Applications for Environmental Management in Urban Spaces: A Review.* International Journal of Sustainable Land Use and Urban Planning, 3(4), 1-14. https://doi.org/10.24102/ijslup.v3i4.738

[16] Fürstenau Oliveira, J. S., Georgiadis, G., Campello, S., Brandao, S., Ciuti, S. (2017). *Improving river dolphin monitoring using aerial surveys*. Ecosphere 8(8):e01912. https://doi.org/10.1002/ecs2.1912

[17] Paneque-Gálvez, J., Vargas-Ramírez, N., Napoletano, B. M., Cummings, A. (2017). *Grassroots Innovation Using Drones for Indigenous Mapping and Monitoring*. Land, 6(4), 1-25. https://doi.org/10.3390/land6040086

[18] Vergouw, B., Nagel, H., Bondt, G., Custers, B. (eds.), *The Future of Drone Use: Opportunities and Threats from Ethical and Legal Perspectives* (pp. 21-45). http://dx.doi.org/10.1007/978-94-6265-132-6

[19] Gianoli, E., Carrasco-Urra, F. A. (2009). Current Biology. Retrieved from https://www.sciencenews.org/blog/wild-things/south-american-vine-masterful-mimic

[20] Trewavas, T. (2016). *Plant Intelligence: An Overview.* BioScience, 66(7), 542–551. https://doi.org/10.1093/biosci/biw048

[21] Gianoli, E., Carrasco-Urra, F. A. (2014). *Leaf mimicry in a climbing plant protects against herbivory.* Current biology, 24(9), 542-551. https://doi.org/10.1016/j.cub.2014.03.010

[22] Trewavas, A. (2017). *The foundations of plant intelligence*. Interface Focus 7: 20160098. http://dx.doi.org/10.1098/rsfs.2016.0098

[22] Trewavas, A. (2005). *Plant intelligence.* Naturwissenschaften, 92(9), 401-413. https://doi.org/10.1007/s00114-005-0014-9

[23] Volkov, A. G., Rufus Ranatunga, D. (2006). *Plants as Environmental Biosensors.* Plant signaling & behavior, 1(3), 105-15. http://dx.doi.org/10.4161/psb.1.3.3000
[24] Esposito, C. (2013). *Sometimes a plant dreams of flying (The dream of flying)*. Retrieved from http://www.chiaraesposito.it/works/sometimes-a-plant-dreams-of-flying/
[25] Nobrega, G. (2013) *BOT_anic.* Retrieved from https://gutonobrega.co.uk/BOT_anic
https://doi.org/10.3390/f5061481
[26] Nichele, S., Risi, S., Tufte, G., Beloff, L. (2017) *Towards a plant bio-machine.* 2017 IEEE Symposium Series on Computational Intelligence (SSCI).
https://doi.org/10.1109/SSCI.2017.8285288
[27] Manzella, V., Gaz, C., Vitaletti, A., Masi, E., Santopolo, L., Mancuso, S., Salazar, D., de las Heras, J. J. (2013). *Plants as sensing devices: the PLEASED experience*. Proceedings of the 11th ACM Conference on Embedded Networked Sensor Systems.
https://doi.org/10.1145/2517351.2517403

Author Bibliography

Zane Cerpina is Oslo based artist, organizer and designer working within experimental new media. Zane currently works as creative manager at PNEK (Production Network for Electronic Art, Norway), curator, producer at TEKS (Trondheim Electronic Arts Centre), editor and manager at EE: Experimental Emerging Art.
Her writing and editorial work include the ongoing publication series: The PNEK FILES (2015-) and editorial work of the upcoming Book of Electronic Arts Norway. She has also written for Neural magazine. Zane is internationally active as a lecturer and presenter and has shown her work at venues such as: ISEA (Vancouver 2015, Hong Kong 2016, Manizales 2017), STRAND (Serbia 2016), LABVERDE (Brazil 2017), V2_ (Netherlands).
Her extensive body of works include curating and producing Dangerous Futures Conference 2018; Oslo Flaneur Festival 2016 and The Anthropocene Cookbook (2016 -). She is also one of the curators and producers of The Temporary Library of Norwegian Media Art.

Seeing Life: The Impalpable Entanglement of an Artist and Microbes in Bio-Art

Jongcheon Shin[1], Siwon Lee[2], Suk Chon[3], Keyan Jiang[4], Joonsung Yoon[5]

[1 3 5] Global School of Media, Soongsil University, Seoul, Korea

[2] Fiber Science Design, Dankook University, Yongin, Korea

[4 5] Digital Media Art, Tianjin Normal University, Tianjin, China

[1] jasonshin@maat.kr, [2] siwonlee@hotmail.com, [3] tians@maat.kr, [4] jiangkeyan@126.com, [5] dryoon@maat.kr

Abstract

This paper introduces Korean bio-artist's works producing fungi-based patterns and analyzes them as aesthetic results which apply Erwin Schrödinger's hypothesis of life and Maurice Merleau-Ponty's painting theory, in order to consider the impalpable entanglement between an artist and microbes in the creation process of bio-art. Schrödinger regarded life as an open system, and implied that a living system imports negative entropy and stores it. Interestingly, it can be linked to 'the genesis of things' of Merleau-Ponty. In his painting theory, he focuses on the inseparable interactions between an artist and visible things. It could draw the aesthetic discussion of life that recognizes things as living beings and connects the aesthetic process with the interaction between an artist and things. Furthermore, it is related to the aesthetic characteristics of bio-art in which art intertwines with life.

Keywords

Bio-art, Schrödinger's hypothesis of life, Merleau-Ponty's painting theory, Genesis of things, Communion, Painting system, Bio-art system

Introduction

Eduardo Kac, one of the pioneers in the emerging field of art, used the term 'bio-art' for the first time, creating his work *Time Capsule*. Then, Kac and other bio-artists such as Peter Gerwin Hoffmann, Marta de Menezes, Paul Vanouse and SymbioticA work with genes, cells, tissues, organisms and life processes, using a variety of biotechnologies [1]. Even if the definition and scope of bio-art is not clear, it refers broadly to the art that manipulates the process of life by utilizing biotechnology in critical and creative ways [2].

In fact, artists' interest in biological forms and motifs has been since the early 20th century. The expressions of embryonic and microbial forms in the works of Wassily Kandinsky, the pioneer of abstract art, have evolved into a genre of "Biomorphic abstraction" and influenced the works of Surrealists such as Joan Miro and Jean Arp [3]. On the other hand, Alexander Fleming, the discoverer of penicillin, made works using microorganisms directly. He enjoyed the artistic play by multiplying the microorganisms in petri dishes in the laboratory and utilizing the various colors they create [4].

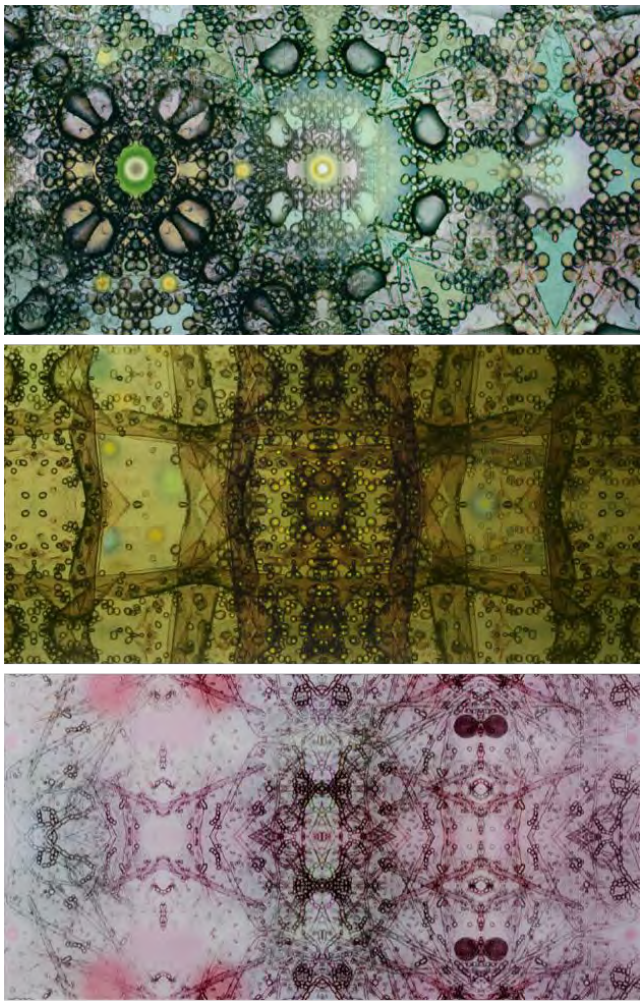


Figure 1. Lenticular images created from various fungi-based patterns: (Top) The G-color image by the life cycle of Aspergillus, 100×50cm, Graphic, Lenticular; (Middle) The Y-color image by the life cycle of Epicoccum nigrum, 100×50cm, Graphic, Lenticular; (Bottom) The R-color image by the life cycle of Gibberella zeae, 100×50cm, Graphic, Lenticular © 2018 Siwon Lee.

Interestingly, some bio-artists try to include both Kandinsky's process of creating biomorphic abstraction and Fleming's process of making a microbial painting. In a laboratory of life sciences, they utilize not only artistic senses and aesthetic knowledge, but also technical knowledge of biotechnology and biological knowledge of genes, cells, and microbes. Thus, those practicing bio-art can be regarded as artists, and be seen as scientists or engineers [5]. In that sense, bio-art is a boundary between art and biology, and it also becomes a trading zone between artists and scientists. Bio-artists play a role of trader in the boundary and build a new area of art while blurring the boundary [6]. Actually, Figure 1 consists of lenticular images obtained from the process of cultivating microorganisms and observing their morphogenesis in a bio-laboratory. They are the works of Korean bio-artist Siwon Lee, which express the mysterious forms and beautiful motifs in the process of fungal growth.

Here, the unique thoughts of life and art, discussed by the scientist Erwin Schrödinger and the philosopher Maurice Merleau-Ponty, provides clues to understanding the identity of a new field called bio-art. They have already dealt with the potential features of the aesthetic elements in bio-art through in-depth exploration of the essential characteristics of life and art. Furthermore, the aesthetic discussion of life derived from Schrödinger and Merleau-Ponty can be applied to the works of bio-art, and can be linked to the current art trends in which artists, living beings, and technology collaborate.

Life as an Open System

Questions about life are not exclusive to biology. They seek answers throughout religion, philosophy, and science. In particular, Schrödinger, who won the Nobel Prize for Physics thanks to his Schrödinger equation, carried out a wide range of inquiries about life. In 1944, in his book *What is Life? In The Physical Aspect of the Living Cell*, he explored and predicted the nature of life through the eyes of a physicist. For the first step, he looked into magnetic bodies, Brownian motion, and the problem of precise measurement and explained that although all physical phenomena are uncertain at the atomic level, they are stable when the level is large enough to apply statistical mechanics [7]. That is, while the surrounding thermal motion significantly affects quantum phenomena at the microscopic level, quantum phenomena at the macroscopic level can maintain stability due to statistical offset from the effect of the thermal motion.

However, Schrödinger believed that this statistical approach would not apply to genes that are not very large in size. He explained the stability problem of mutation and gene in relation to the energy level of quantum mechanics and the problem of quantum jump [8]. According to him, something that contains genetic information has a near-miraculous durability. It is a non-periodic crystal and has stability through a high-energy barrier [9]. This bold physical interpretation of life stimulated the intellectual curiosity of biologists such as James Watson and Francis Crick, and eventually became the background to discover the double helix structure of DNA [10].

Furthermore, Schrödinger explained that it is possible for life to maintain stability by importing the negative entropy from the environment [11]. By doing so, life may not reach the thermodynamic equilibrium of death (a state of maximum entropy). The organism uses the energy of organic compounds in the environment to maintain its high degree of order (a low entropy level), and then maintains life by releasing the metabolized form (a form of higher entropy) into the natural world. If Schrödinger is right, the difference between life and death may be the difference of whether or not it can import negative entropy from the environment.

Here, we can think of the difference between life and death as the difference between the visible and the invisible. Life as an open system has increasingly distinct forms and colors in the process of importing negative entropy. Death, on the other hand, makes the form and color of life increasingly faint. Life and death eventually represent changes in shape and color in the process of importing negative entropy or importing positive entropy. Interestingly, this interpretation of life is linked to a genesis of things that Merleau-Ponty discussed.

A Genesis of Things

Henri Bergson discussed the form of living being in *The Creative Mind: An Introduction to Metaphysics*. Above all, he did not look for the undulating outline outside living beings. He said that the sinuous line of living being could be no one of the visible lines of the figure [12]. It means that, for living beings, there is no fixed outline and there is only a generative outline that makes living beings form themselves. It can be related to the idea that the form of living being is not fixed but is generated and continually changed.

Merleau-Ponty brought Bergson's discussion to art. In *Eye and Mind*, he noted that it was already familiar to painters. According to him, painters regard things they draw as living beings. People think that a meadow and an apple painted by a painter are circumscribed in lines, but the meadow and the apple form themselves from themselves [13]. In particular, impressionist painters incl ding a l anne created contours and borders of things in that way. They showed that there is no line visible in itself and that neither the border between meadow and field nor the contour of the apple is here or there. As a result, for Merleau-Ponty, painters are a kind of generative artists who experiment with a genesis of sinuous lines on the basis of Bergson's discussion on the form of living being.

Here, it is interesting to compare bio-artworks produced using living organisms with Merleau-Ponty's view. In fact, as living beings are open systems that exchange energy or matter from the external environment and generate its form, so things in artworks that Merleau-Ponty discussed are also

open systems that import negative entropy from the environment and generate forms. Some bio-artworks utilize the forms and colors that life reveals in the process of importing negative entropy. It means that they use life as things in artworks. In addition, some bio-artists are similar to painters that Merleau-Ponty mentioned, in that they experiment aesthetically with the characteristics of life.

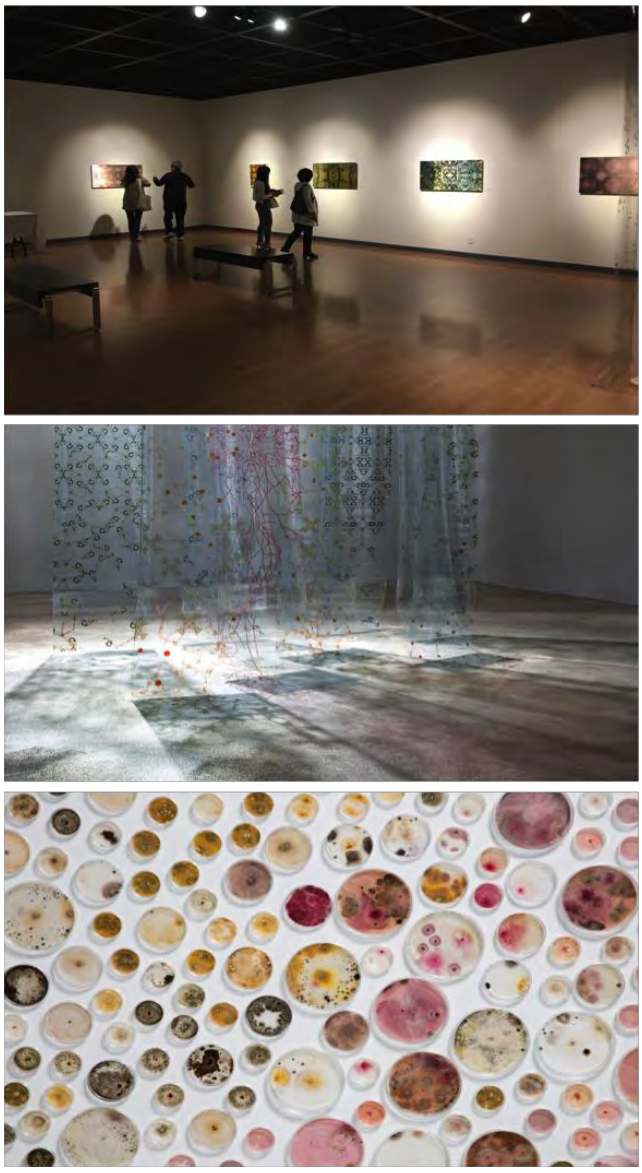


Figure 2. The works and installations of exhibition <A Beautiful Trading: The Trade between Art and Biology>: (Top) The inside view of exhibition; (Middle) “Form from life nseen”, 50×300cm x 10(ea), Print installation; (Bottom) “The Color in Bio, Fungi on Fabric”, etri dish installation © 2018 Siwon Lee.

Actually, some bio-artists use the fact that living beings create their own forms and automatically generate contours and boundaries in the process of importing negative entropy. The bio-artist Lee also uses the automatic genesis of contours and boundaries, and creates her own works using fungi-based patterns. Figure 2 shows her works and installations that she exhibited at the Hangaram Design Art Museum, Seoul Arts Center from May 6th to May 13th, 2018 [14]. Her works are results of the microbial art project that she carried out in the laboratory in the Department of Microbiology at Dankook University in Korea. She observed the forms and colors generated by each microorganism, and then produced the various composite patterns using the basic patterns created by each individual community of microorganisms, as shown in Figure 3. In this process, the contours and boundaries created by microbial communities are formed not by being placed in the original position, but by a genesis of each individual microbial entity. Lee has used such a genesis of contours and boundaries as a self-formed image, thereby exploring a genesis of things that Merleau-Ponty focused on. It means that Lee has obviously utilized microorganisms in a way that things emerge in paintings. As a result, through some bio-artists including Lee, Schrödinger's discussion of life is linked to a genesis of things in Merleau-Ponty's discussion.

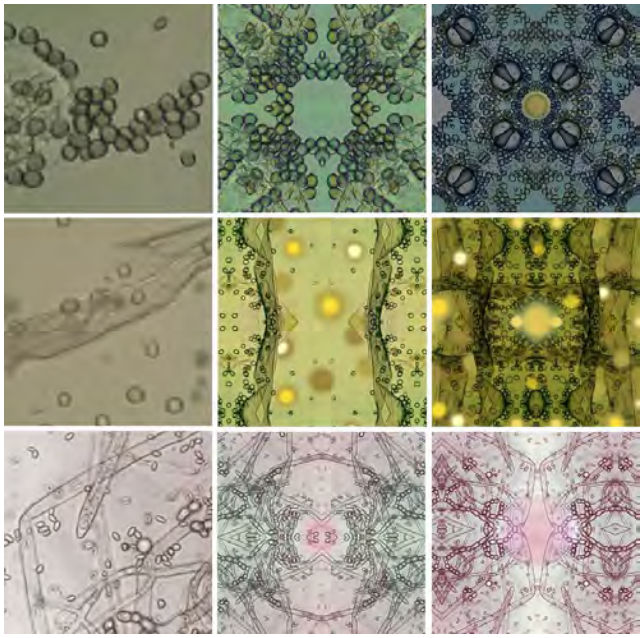


Figure 3. The fungi-based images producing from the basic patterns to the composite patterns: The top images are based on the life cycle of Aspergillus; The middle images are based on the life cycle of Epicoccum nigrum; The bottom images are based on the life cycle of Gibberella zeae © 2018 Siwon Lee.

Communion between an Artist and Microbes

Merleau-Ponty certainly presupposes things in paintings as open systems. Things in paintings import negative entropy through a painter in order to generate the forms. At the

same time, a painter as an open system can also import negative entropy from things in paintings. But Merleau-Ponty goes one step further. It is about the relationship between a painter and things outside paintings. He said, “The painter lives in fascination. The actions appropriate to the painter seem to emanate from the things themselves [15].” and “The roles between the painter and the things are inevitably switched [16].” According to him, such actions of a painter are the tracings that will be revelations to others because they do not lack what the painter lacks. They are also the tracings that a painter can experience as the secret and feverish genesis of things in his body. It means that a painter as an open system is not only influenced by things outside paintings but also imports negative entropy from things in paintings. Overall, the relationship between a painter and things in Merleau-Ponty's painting system can be summarized in Figure 4.

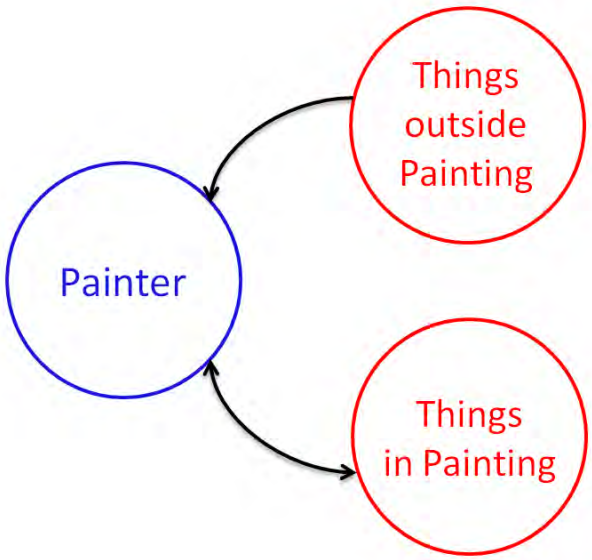


Figure 4. The relationship between a painter and things in Merleau-Ponty's painting system © 2018 Jongcheon Shin.

Interestingly, the way that a painter as an open system works in Merleau- onty’s painting system is similar to the way that a bio-artist creates artworks. The creation process of bio-art by Lee is a good material for reviewing the creation system of bio-artworks. She found the fungi that emerged from an apple by chance, and became interested in their aesthetic values. After then, she began in earnest observing various types of fungi in the laboratory of microbiology. She artificially cultured a variety of fungi in an incubator using a PDB (Potato Dextrose Broth), and saw directly through an optical microscope (Zeiss Ax ioskop 40, Dixi Digital Camera Excope). In the process, Lee inspired the various patterns revealed by the life cycle of fungi, changed the culture conditions, and created other patterns.

Lee looks back on the creation process as follows: “F ng s is not an existence that dwells only in a h mid and dark place. It wanders through the open spaces in the laboratory and reveals its existence if it meets reasonable environmental conditions. It is a living being that dwells in the same space as me. The visual appearance of this living being enables the artist to identify something that is not visible but present. To witness the emergence of living beings and to capture their growth in communion with them is in itself art [17].” As she has said, she waits for the emergence of living organisms and gets artistic inspiration through forms generated by living organisms. At the same time, she also provides them with changed conditions and influences them.

Lee is a kind of open system that absorbs energy from microbes in petri dishes. Her actions are the tracings that reveal what she lacks. They are also the tracings that she can experience as the secret and feverish genesis of things in her body. Hence, the bio-art system that Lee has experienced in the creation process is similar to the painting system of Merleau-Ponty. Of course, there is a little difference. Merleau-Ponty's painting system considers the relationship between a painter and things by dividing things into existences in paintings and existences outside paintings. Lee's bio-art system, on the other hand, considers the relationship between a bio-artist and microbes without the need to divide microbes into existences in artworks and existences outside artworks. Her microbes are objects that inspire her and become things in her works. It means that the bio-artist as an open system is influenced by organisms and provides them with negative entropy while importing negative entropy from organisms in artworks. Therefore, the bio-art system based on Lee's creation process can be expressed as shown in Figure 5.

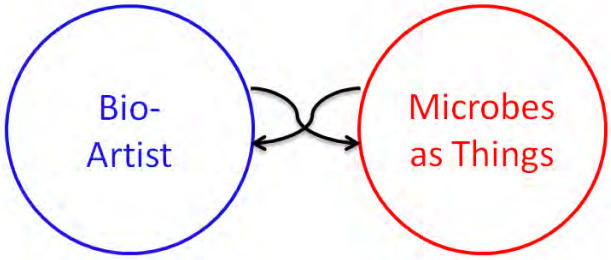


Figure 5. The relationship between a bio-artist and microbes in the bio-art system based on Lee's creation process © 2018 Jongcheon Shin.

In *Eye and Mind*, e rlea - onty began with anne's words: “What I am trying to convey to yo is more mysterious; It is entwined in the very roots of being, in the im-

palpable source of sensations [18]." s anne said, the painting is derived from the impalpable source of sensations. It means that the painter feels the mystical communion between him or her and the things and expresses it on a canvas. That is why the aforementioned genesis of things in the painting means that the forms of things are not only automatically generated on a canvas, but also are automatically influenced by the invisible communion between the painter and the things. Also, it is involved in the relationship between a bio-artist and living organisms. Although bio-artists are not directly involved in the morphogenetic processes of living beings, they constantly communicate with the living beings and reflect their communion in their work. Therefore, although bio-artists have merely moved their workplaces from studios to laboratories and have just changed their tools from brushes to experimental instruments, their work is essentially similar to the artistic behavior of anne.

Conclusion

Seeing is basically the process of moving light. To see something implies that a part of light bounced out of an object reaches our eyes. Then, the light passing through the crystalline lens forms an image of the object on the retina and turns into an electrical signal to reach the brain. That is why we see the light that is bounced out of the object. In fact, seeing is a very confusing problem when we enter the world of small particles like atoms. Tiny little particles can deviate from their orbits only by light (or photons) [19]. Thus, if we can get into the world of atoms, we can learn that seeing is about an indeterminate object, not a definite object. For that reason, quantum physicists like Schrödinger have been concerned about that problem for the rest of his life.

But Merleau-Ponty seemed to think the problem was not too difficult. He did not think that seeing (especially seeing things by a painter) was about a definite thing. To him, seeing is related not only to the change of things, but also to the painter himself. In terms of the painting theory of Merleau-Ponty, the painter stands on the opposite side of the Cartesian. According to him, while a Cartesian believe that what human beings see is not the world itself and that all vision takes place in God, a painter accepts the myth of the windows of the soul. In other words, for a Cartesian, seeing is a certain mode of thought, but for a painter, seeing is a means given to him for being absent from himself [20]. Thus, for a painter, seeing makes him aware of the secret and feverish genesis of things that happen in his body. At the same time, for things, seeing becomes a driving force for new changes. Surprisingly, it contains a concept of quantum mechanics. As seeing in the atomic world implies the detection of changes of indeterminate things by light, so seeing by a painter implies that he also senses atomic changes within things or within his own body.

In fact, the creation process of bio-artists includes unique experiments on seeing. Unlike scientists, they think of biotechnology as a medium for communicating with living beings, not only a tool for manipulating life. The bio-artist Lee looks at microbes from the perspective of a painter who Merleau-Ponty noted. She brings the living beings into herself, recognizes them as new beings, and creates new works by reprocessing and linking the tracings of the living beings. Meanwhile, microbes as things also look at Lee. It relates to the process in which visible things are created as new things via the artist and work toward new aesthetic things. As a result, the impalpable entanglement between a bio-artist and living beings in bio-art emerges as the genesis of new aesthetic life.

References

[1] Jessica M. Pasko, "Bio-artists use science to create art", US Today website, accessed October 27, 2018, http://usatoday30.usatoday.com/tech/science/ethics/2007-03-05-bio-art_N.htm

[2] Eduardo Kac, *Signs of life: bio art and beyond* (Cambridge: Mit Press, 2007), 18-20.

[3] Encyclopedia of Art History, "What is Biomorphic Abstraction?", Art Encyclopedia website, accessed November 2, 2018, http://www.visual-arts-cork.com/history-of-art/biomorphic-abstraction.htm

[4] T. Ryan Gregory, "Sir Alexander Fleming's Germ Paintings", Microbial Art website, accessed October 28, 2018, http://www.microbialart.com/galleries/fleming/

[5] Ingeborg Reichle, "Where art and science meet: genetic engineering in contemporary art," *Bild Wissen Technik* 3, accessed October 28, 2018, https://doi.org/10.18452/6917

[6] Jongcheon Shin, Siwon Lee, and Joonsung Yoon, "Bio rt as a Trading Zone: re oli ed rt Form of Biology and rt", (paper presented in Durban, South Africa, June, 2018). *ISEA 2018*, http://www.isea-international.org/isea2018/wp-content/uploads/2018/07/ISEA-proceedings-final.pdf

[7] Erwin Schrödinger, *What is Life?: The Physical Aspect Of the Living Cell and Mind and Matter*, Insuk Seo, trans. (Seoul: Hanool, 2001), 26-47.

[8] Erwin Schrödinger, *What is Life?: The Physical Aspect Of the Living Cell and Mind and Matter*, 77-95.

[9] Erwin Schrödinger, *What is Life?: The Physical Aspect Of the Living Cell and Mind and Matter*, 99-115.

[10] Matthew Cobb, "What is life? The physicist who sparked a revolution in biology", The Guardian website, accessed November 9, 2018, https://www.theguardian.com/science/blog/2013/feb/07/wonders-life-physicist-revolution-biology

[11] Erwin Schrödinger, *What is Life?: The Physical Aspect Of the Living Cell and Mind and Matter*, 144-152.

[12] Henri Bergson, *The creative mind: An introduction to metaphysics*, Andison Mabelle, trans. (Massachusetts: Courier Corporation, 2010), 196.

[13] Maurice Merleau-Ponty, "Eye and ind", in *The Merleau-Ponty aesthetics reader: philosophy and painting*, (Illinois: Northwestern University Press, 1993), 142-143.

[14] Siwon Lee, " Bea tif l Trading: The Trade between rt and Biology", Lee's exhibition, accessed November 28, 2018,

https://www.youtube.com/watch?v=NCxnoS1exTg&feature=youtu.be
[15] Maurice Merleau-Ponty, “Eye and ind”, 127.
[16] Maurice Merleau-Ponty, “Eye and ind”, 128.
[17] Siwon Lee, “ pple project, Bio-pattern”, Lee’s artist note, aaccessed November 19, 2018, https://blog.naver.com/designfi/220932200664
[18] Maurice Merleau-Ponty, “Eye and ind”, 121.
[19] Alok Jha, “What is Heisenberg's Uncertainty Principle?”, The Guardian website, accessed November 15, 2018, https://www.theguardian.com/science/2013/nov/10/what-is-heisenbergs-uncertainty-principle
[20] Maurice Merleau-Ponty, “Eye and ind”, 146.

Colliding systems: formal and real-life learning

Dr. Anne Nigten, Annemarie Piscaer (MA)
Affiliation (s): The Patching Zone, HKU University of the Arts Utrecht, formerly Rotterdam University of Applied Sciences; Studio Dust
Location: Rotterdam, Utrecht, Rotterdam / Rotterdam. Country: The Netherlands
Contact Emails: Anne@patchingzone.net, Annemarie@studiodust.nl

Abstract

In this paper the authors analyse the incompatibilities and collisions that occurred when they tried to implement their real-life learning insights and experiences from transdisciplinary practice in the regular western education programmes for higher education and Vocational Education and Training (VET). The analysed case studies share an interest in transition issues in urban environments. The issues at stake were considered to be complex and were approached according to an artistic, designerly and participatory way of working. All projects had an innovative scope and thus an open ending or unknown outcomes at its starting phase. The case studies (interim) outcomes and its obstacles and challenges, that the authors and their collaborators encountered in the respective learning processes, were shared and weighted in a series of meetings and workshops with teachers, teacher/artists, teacher/designers, students and laypeople. Besides these feedback sessions and workshops the outcomes of the case studies are complemented with literature studies. The authors conclude this part of their research with a discussion and suggestions for future research to bridge the experienced systematic or paradigmatic obstacles and future research.

Keywords

Art education, hybrid learning, transdisciplinary collaboration, life long learning, participatory design, peer-learning, creativity, improvisation, situated design, transition design, amateurs, pro-am

Introduction

Living in the Anthropocene we are facing unprecedented ecological problems, whilst more and more people will have cities as their habitat, it will put a pressure on finding new modes to create healthy environments. In these times we are also challenged with technological and economic changes that will impact our society deeply as for instance automation will change our current system of paid-labour. This means we need to re-evaluate important aspects in the current educational system. For example we observe a growing interest in vocational and higher art and design education to shift from a goal oriented education that is modelled after paid jobs, towards educating for 'change-agents' who are prepared to deal with our current complex transition issue's. This often causes a collision of institutional education with real-life learning. It could be read as a re-interpretation of the word 'school' as it has the entomological origin of 'skholē' (Greek): 'leisure time'. These times of transition require new modes, for this we draw on transdisciplinary or cross-over approaches with transcending boundaries between disciplines and merging positions, where 'the change agents' could be citizen, (art, design) professionals, experts or amateurs in new fields, with the city itself as a localised -situated- design canvas.

The background of the authors lies in the above described setting. They both have a practice based on a participatory design approach, and both run collaborative / community projects in the art and design field. Dr. Anne Nigten initiated the Patching Zone. This studio runs projects in the field of New Media and technology in the Art and Culture sector based on the '*processpatching*', approach. In this approach knowledge, experience and methods from different disciplines and backgrounds are used to patch together different knowledge fields. Annemarie Piscaer initiated Studio Dust, a research by design studio operating in the field of healthy environments, by using material research as a communicative instrument to connect unusual domains and disciplines. Although the authors operate in different fields (media technology and healthy environments) their participatory projects served as ground for a practice led research on informal learning environments. In this paper they share the collisions that occurred between real-life learning and formal institutional learning, the challenges they met and the questions that arise in their practice and are not covered yet in current literature and research.

Problem framing

As stated earlier, we are living in unprecedented times of transition with its accompanying new real-life transition issues. The two case studies that will be discussed in this paper could be considered as typical transition issues: 1. to make a healthy and sustainable city and 2. to bring a technical vocational education course up to speed with today's technological and social changes. The two case studies in

this paper were developed in a co-creative way with references to participatory design and (informal) approaches from community projects in the art and design field. In both case studies, formal knowledge domains merged or blended with informal knowledge brought in by its non-academic participants such as citizens, professionals, policymakers and so on. Building on literature studies, previous publications and the authors' creative practice (case studies) it is argued that, although artists and designers often have the interest, skills and opportunities to transcend boundaries between disciplines and positions, the learning potential in these projects is often not fully utilised and valued. This often leads to misunderstandings and frustrations among the project's participants and could thus be ground for demotivation to pursue these (kinds of) projects. (Brickwood et al, 2007; Nigten, 2004) In the analysed case studies, the applied artistic and design approaches encounter practical, systematic, paradigmatic and institutional obstacles that often prevent a fluid knowledge transfer and thus block the ability to learn in and from these projects. The personal knowledge transfer among those who are involved in the afore mentioned complex transition issues is considered to be of high value for (re-) connecting formal and informal learning. The case studies expose innovation opportunities for today's art education and its potential spill overs to other domains as outlined in the OECD future research agenda (Winner et al, 2013). By mapping the collisions and obstacles we aim to indicate new directions for art education that focuses on innovative spill overs and change agents.

Literature studies

Literature studies over the last four decades often refer to different types of complex (transition) issues that bring forward the need for cross-over, transdisciplinary knowledge or transversal skills and competencies such as subjectivity, creativity, intuition, improvisation, holistic approaches and so on to cross the boundaries between the knowledge domains (Somerville, 1998, Guattari, 2015). The referred collisions in this paper's case studies sometimes resonate the lack of common ground between different knowledge domains as is often described in literature and expert panels (Brickwood et al, 2007, Nigten et al, 2004) More detailed analyses of the case studies however, revealed another gap or mismatch: between formal (codified) and informal (personalised) learning. Here the informal refers to the field of learners and makers represented by the stakeholders, amateurs and residents. The authors therefore complement the afore mentioned literature with literature dealing with learning communities (Wenger, 1998), community art and participatory design (Nigten, 2014; Ehn, 2008;) as these bring in references on co-design and co-creation. This in turn seems useful to understand how formal and real life learning could come together in project based learning. And how real life learning could inform/transform formal art education with spill overs to other domains such as VET. This is illustrated by two examples in resp. *'Design is Learning'* at the University of the Underground and *'Exploration in Urban Practice'* in the Urban School Ruhr, both presented '*a School of Schools*' during the Istanbul Design Biennale 2018. These practices experiment with colliding systems of formal and real-life learning for example by positioning not only the student of formal higher art and design education in real life situations but also the institution as such. In both examples design students are equipped with the skill-set to transcend the boundaries between formal and informal. The University of the Underground examines power structures by challenging relationships, creating new roles and role play -on an equal base-. On the projects both have to work as peers, building an equal friendship. (Abdulla et al, 2018) The Urban School Ruhr does not have an institutional framework, no school building, no bureaucratic structure etc., whilst retaining links with institutions, placed not outside but deliberately mingling formal and informal. It operates as an open lab, using the city as a situated school; mobilize people thus enacting spaces of learning in the city. (Assmann et al, 2017) The skills and knowledge generation among those who are involved in afore mentioned complex transition issues is considered to be of high value for (re-) connecting formal and informal learning. (Abdulla et al, 2018; Assmann et al, 2017; Hamerset al, 2017) Special attention should be paid to the fluid boundaries between the various professionals and amateurs as these are potential pockets for knowledge exchange and innovation. The so called change agents (Barnard et al, 2015)) cause a merging of professional and amateur fields. Here *the Pro-Am's* come into the picture. The term *Pro-Am's* was coined by Leadbeater and Miller in *'The Pro-Am Revolution!: How enthusiasts are changing our economy and society'* for a new breed of amateurs, that work to a professional standard; knowledgeable due to technology an highly networked. They are capable to develop catalysing or disruptive innovations. These pro-ams are creating new or combined streams of knowledge. (Leadbeater and Miller, 2004). In the context of the case studies we'll discuss the value of equality in these co-creative practices as a process of converging formal knowledge with informal knowledge when they are equally valued. (Rancière 1991) In this paper we'll elaborate on the obstacles that occur when these formal and informal learning processes collide. This could cause friction on the informal side, where the amateurs have to cross their comfort zone; as observed in the case study 'Mediawharf'. As well as the formal side; as argued in '*The Cult of the Amateur: How Today's Internet Is Killing Our Culture'* it could cause an erosion of the professional standard. We also briefly touch upon the lack of critical validation of the amateurs (the crowd) versus the academic education's emphasis on validation. (Keen, 2007) The obstacles and frictions

are observed in our case studies and described in the obstacle paragraph.

The case studies show the potential of personalised, artistic and designerly approaches to deal with complex, and messy processes with unpredictable outcomes. For the patching or transversal tools, skills, and probes we'll build on the theory of the reflective artistic and designerly skills and competencies (Cross, 2001; Schön, 1983; Nigten, Kotey, 2017), experiential or tacit knowledge (Dewey, 1934; Polanyi, 1967) and the role of artists and designers in situated creativity. We'll suggest creativity and its closely related improvisation (Csikszentmihalyi, 1996) as artistic and design competences to bridge the gap between the disciplines as an extension of two main theories of creativity Glaveanu's (2013) and Kirsch's theory: *Hybrid Approach to Creativity: Arts, Science and Everyday Life*. (2016) This study should be positioned in the hybrid approach of today's creativity debate, where artists and designers bring in interpersonal creativity (mini-c) to bridge their professional creativity (pro-c) with real-life creativity (little-c). Although the potentiality and the need for these in-between pro-am spaces are beginning to settle, the learning potential in these fluid spaces is (still) not fully utilized, so far it often doesn't exceed the intuitive and personal level (Winner et al, 2013).

Case studies

The first case study is the City Lab 'Stadslab Luchtkwaliteit' (2015-2018). City Labs are recent phenomena. The labs are situated learning networks that experiment cooperatively with various complex (urban) issues. The initiators of these labs have a diverse disciplinary background, and are often run by independent professionals that share a pragmatic nature. 'Stadslab Luchtkwaliteit' is an initiative by designers, architects, engineers (independent professionals) and local citizens, and functions as an open platform addressing the issue of air quality in Rotterdam, on a self-organised base by experimenting, connecting, gathering and sharing ideas. Originally situated around the most polluted street 's Gravendijkwal Rotterdam (NL). There are a few projects evolving from this City Lab that are now being prototyped and tested in public space. For example one of the activities of the lab was the citizen driven measuring of the air quality, to test the experiments and prototypes and its values in co-operation with the experts from the Netherlands National Institute for Public Health and the Environment. Another project (Smogware) is a participatory project where the citizens join 'harvesting' (urban mining) settled urban dust to use as a source for glazing a tableware. The tableware visualises the invisible air pollution. City Lab Stadslab Luchtkwaliteit started organically in 2014 after an open call issued by the municipality of Rotterdam. The initiators developed this open platform according to a co-creation (with citizens and institutions) approach as a learning environment in order to catalyse a change and improve the ideas, prototypes and designs. 'Stadslab Luchtkwaliteit' has been part of a learning community initiated by Creative Industries Fund NL (Dutch cultural fund for architecture, design, and digital culture). In these sessions knowledge and learned lessons where shared between other newly build City Labs within the Netherlands.

Figure 1. Citylab / Stadslab Luchtkwaliteit members.

The second case study is Mediawharf (2013-2015), a multi-annual project for VET innovation by The Patching Zone for and with the Human Technology (and related) department of Zadkine and Techniek College Rotterdam (technical vocational school, Rotterdam, The Netherlands). Mediawharf was shaped as a participatory praxis studio where teachers, students, young professionals, experts, professionals and public organisations worked together. Its participants brought along a range of cultural backgrounds and knowledge from different domains such as technique, technology, design, art and humanities. The core of Mediawharf was a series of real-life assignments which were translated into challenging and meaningful learning tasks in transition areas such as healthcare & technology, automation, manufacturing industry and new crafts, the Internet of Things and sustainable construction. The project was developed in an iterative way, after each assignment the students, commissioners, teachers and The Patching Zone participated in an evaluation of both the student work and the project's results. (Nigten, 2013)
Mediawharf's first year's outcome was an essential contribution in shaping and kick-starting Zadkine's new Human Technology course, after that the collaboration with the teachers and course leaders focused on an education design training, that accommodated the flexibility and personalisation which are required for real-life assignments. (Niedeveld, 2015)

Figure 2. Mediawharf; Sebastien Seynaeve (The Patching Zone, team member) and students are working on audio recordings.

Feedback loops: workshops and meetings

The case study City Lab 'Stadslab Luchtkwaliteit' revealed that artists and designers take new roles in order to create learning networks bridging formal knowledge and real-life learning. Piscaer reflected on the insights that she obtained in her role as a designer in 'Stadslab Luchtkwaliteit' by a follow-up research 'As a designer I'm an expert. I'm an amateur, operating on the fluid boundaries of the design profession' (Piscaer 2017) within the frame of Master Education in Arts at Rotterdam University of Applied Sciences, Piet Zwart Institute. In this research the role of design and its artistic approach in theses learning networks was studied by comparing the case study 'Stadslab Luchtkwaliteit' to other representative case studies.

The Mediawharf follow-up consisted of a feedback session, two workshops and two design sessions with the stakeholders (students, teachers, tutors from Technical College and higher vocational education in the similar fields, professionals, education experts and so on). This follow-up was initiated by Anne Nigten, in her role as professor at Rotterdam University of Applied Sciences as a, so called, research exploration. In these sessions that were organised under the label 'learning environments' (Lerendeomgevingen/Learning environments, 2017), the participants dealt with the project's outcomes, experienced institutional (formal) educational obstacles and shared insights and understandings. The conclusions from each session were integrated in the next session. The sessions were organised in groups of participants with mixed backgrounds (cultural and professional, student and amateur) who shared, discussed and evaluated experiences and came to new insights with representatives from the education and work field. The sessions were concluded as a plenary.

All in all, the authors reflected upon their findings with a wide variety of experts with mixed backgrounds (teachers, expert-designers in real life learning settings, professionals in public organisations involved in developing open-learning platforms). After this the authors organised a workshop held during Balance-Unbalance 2018/ New Value Systems, in Rotterdam, The Netherlands (Nigten & Piscaer, 2018). In this workshop the authors proposed to examine the conditions, suggestions or guidelines for a 'hybrid learning model' with the workshop participants.

Finally, the outcomes of the workshop and the feedback moments were shared and weighted during a plenary expert meeting *New Learning Environments for the Future* initiated by Creative Fund NL and Haus der Kulturen der Welt in Berlin (DE) during the Istanbul design Biennale *'A school of schools 2018*'. This session dealt with environmental, technological and economic changes in our cities, neighbourhoods and regions, and the challenges this all brings along for what we learn, how we learn and the spaces where we learn. Central questions were: How can art and design schools prepare students for life? Can informal learning environments create new connectivity? Can art and design schools position themselves within a wider ecosystem in their surroundings?

Shared interests and equal roles

In this part the characteristics of the participants whom transcend disciplinary boundaries are described. This paper's case studies share a common ground as they all incorporated and attracted a diverse range of participants who, in turn, all share a specific interest in the given transition issues**.** In both cases they worked towards producing tangible or experiential outcomes. According to the co-creation principles, the involved people are working peer-to-peer on an equal footing as this generates trust and openness. Taking these equal roles can be beneficial as all participants are engaged students, citizens, professionals, or amateurs in a certain field. Here the two systems (formal and informal) are not opposite towards each other by definition, but could fluidly merge into a new space for learning. (Wenger, 1998) By crossing the boundaries of the traditional disciplines, and taking on different roles, the participants are better equipped in 'speaking the same (disciplinary) language's'. This process profits from a physical common ground and shared tacit or material (boundary) objects. (Rancière 1991; Nigten, 2015).

The case study City Lab 'Stadslab Luchtkwaliteit' showcases the profit that is gained from a physical common ground. The City Lab initially focused around the s'Gravendijkwal, a very polluted street in Rotterdam. Participants live around that street, thus attracting a variety of people with different disciplinary backgrounds and ages. The knowledge exchange within the events focused also around that area. It helped focussing the complex topic and sharpening the discussion. After this initially phase the City Lab widened the knowledge network to a larger group

of experts, participants and to a wider scope of Rotterdam and thus broadening the subject.

"The notion that we disagree with one another in the lab makes me question more. So I call the experts. But it is easier to connect to them and get an appointment with a bigger group of people." Kirsten Kentler, team member City Lab / Stadslab Luchtkwaliteit, 2017

In the Mediawharf case study the shared interest was to establish a new high quality Human Technology course that included a new 21st century skillset for vocational students to work in the (future) smart network society. In Mediawharf the earlier mentioned equalised peer-connection was established among the vocational students and the Patching Zone's team of creative young professionals. The team was, from time to time, extended with academics and European partners. The Patching Zone's team members came from diverse European cities and regions and studied in a range of fields such as (interaction) design, technology engineering, digital art, social sciences and so on. Mediawharf was composed of a series of (short) real life projects (assignments) with social partners. The real-life project assignments served as place holders for the training of students and teachers. The students worked and learned as peers with The Patching Zone young professionals and experts.

'We were neither teacher, boss, parent or friend, and we all represented different cultures including cultural norms and behaviors….' Ida Toft, team member Mediawharf, The Patching Zone, 2013

In both case studies it brought forward a vivid exchange of practical and cultural knowledge. These networks of relationships allow for the wide variety of participants to collaborate, share ideas and take risks together. Taking equal roles in tangible settings, builds on trust; essential in a polarizing society. The respectful and equalised way of working created trust and openness, that turned out to be a fruitful ground for shared real-life and professional creativity. (Leadbeater and Miller, 2004; Kirsch et al, 2015) Building these fluid learning networks where 'experts and non-experts' are equal and can both learn together thus is a responsibility of society. (Rancière, 1991) These so called 'fluid learning environments' can be shaped more effectively (for all participants) if we have a better understanding of what obstacles prevent the collision to occur and the approaches that smooth the process. This will be described in the next chapters followed by arguments on how to utilise the learning potential by shaping a 'hybrid learning model'.

How to overcome obstacles and collisions

In hindsight the main obstacles in the case studies went beyond the known obstacles caused by linguistic misunderstandings and confusions about ways of working as known from literature (Brickwood et al, 2007; Nigten, 2004, Guattari, 2015). In both case studies the mismatching expectations among the involved parties and stakeholders and the colliding outcome's evaluation criteria, could be identified as the major obstacle to bridge the worlds of the formal and informal learners. In this paragraph we'll unravel the experienced collisions regarding the expectations and evaluation criteria for both case studies.

In Mediawharf the team anticipated on the obstacle that could be caused by a mismatch of expectations of the real - life projects' outcome between the real-life partners (stakeholders), students and teachers. It therefore was tackled in the project and introduced as a 'translation' phase where real-life assignments and its expected outcomes had to be translated to learning assignments. In this 'translation' phase it was also acknowledged that open endings, as known from art and innovation projects did not match with the vocational school's evaluation process and their students' expectations. This pitfall was overcome by shifting the outcome focus from a product, object or service towards a learning outcome that was manifested in the iterative cycles of the design process. The new workflow was, after the projects' first year evaluations and iterations, mapped out as an infographic roadmap for teachers, students and stakeholders alike.

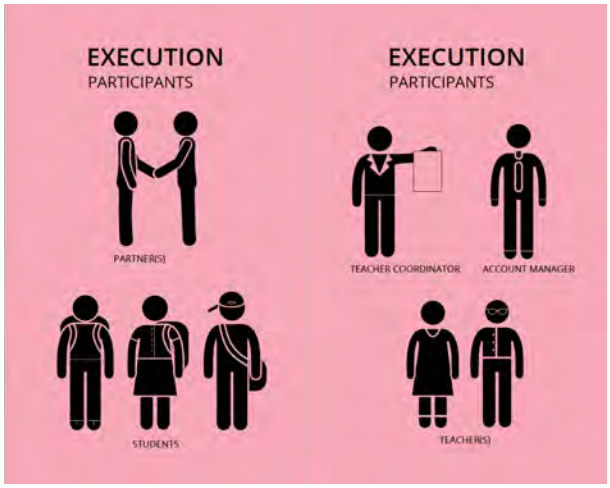


Figure 3. Mediawharf; two screens from Roadmap Real-Life Projects, graphic design by Yoana Buzova, © The Patching Zone.

Another obstacle that was met in Mediawharf was working outside the school building: real-life projects also required working in the real world outside the school building and with stakeholders' interaction in public space. Besides some practical, and solvable issues the Patching Zone realised that the engagement with residents and audience in the public city space was another challenge. These kinds of encounters and collaborations might be obvious and natural for artists and designers (Ehn, 2008; Toft, 2013), they did not match naturally with the technical vocational school students' and teachers' comfort zone for learning.

Another Mediawharf real-life obstacle we'll bring forward concerns the evaluation criteria and expectations from the vocational education partners towards the Patching Zone team regarding the implementation level of the innovative course by The Patching Zone team, who felt that their role in the project was the catalysing role and not the operational role. Some of The Patching Zone team members felt insecure or not at ease in the role as amateur teacher, whilst the teachers expressed their trust in The Patching Zone team members' skills. Here the planned course evaluation by the end of the first schoolyear also played part of the felt responsibilities (towards the students and the school) of all involved. All in all, some of The Patching Zone team members preferred to work in their creativity comfort zone as a catalyst, whilst others also expressed interest in contributing to a creative context and developing a creativity training plan for the new course, for example in engineering field:

'My desire was to teach the students creative programming..' Victor Diaz Barrales, team member Mediawharf, The Patching Zone, 2013

The main lesson learned from this obstacle is that creative catalysing requires different skills and work structures than implementation. (Nigten, 2014) It is therefore important to identify, in the course of the project, the situations where catalysing turns into implementation so measures can be taken. Either the project can be **re**directed or staffed with the suitable team members. The given example also shows the team members' concern regarding the erosion of the expert fields or disciplines. Moreover, this issue underlines the unexpected tension around the expectations and felt accountabilities when the borders between amateurs and professionals start to shift to a formal educational setting.

Other obstacles that concerned the teachers in Mediawharf dealt with the professional development and institutional support and infrastructure. For example, it turned out to be somewhat problematic for teachers to work as peers in this setting as this required an uneasy dynamic role shift from being the classical teacher at one moment and acting as peer to the next. The shifting of roles also included new tasks and skills for the teachers in other respects. Besides the earlier mentioned peer-learning approach, real life project assignments brought forward a need for more tailored and flexible curricula. Up until recently the vocational school's curriculum had been designed in advance for multiple years by a specialist team and was implemented by the teachers. The 4C/ID education design system (Merriënboer van, 2007) that was used in this case study's institute was well suited for a dynamic curriculum though it was hardly used in such a flexible way. So the teachers needed training and thus time to get familiar with these instructional design systematics. The workshops and design sessions following Mediawharf focussed on listing the recommendations for the institutional obstacles that required formal action.

The informal obstacles were mostly solved or have been overcome through the natural or improvised use of artistic and designerly transversal or patching skills, shared technical tools, probes or boundary objects (Nigten, 2015; Cross, 2001). The games that were developed in Mediawharf worked as boundary objects. The software and hardware tools that were used to design and develop these games turned out to be helpful for catalysing the bridging process between design and art and formal education. The technical tools resonated the shared interests and facilitated learning through making as known from art, design and learning experiences in makerspaces and fablabs. (Troxler & Mostert- van der Sar, 2018; Trust et al, 2018)

In the case study City Lab / Stadslab Luchtkwaliteit designerly approaches were instrumental for bridging or patching formal and informal learning. The main obstacle concerned the friction between the amateurs and professionalised. (Leadbeater and Miller, 2004; Keen, 2007) One of the activities of the lab was the citizen driven measuring of the air quality; to test the experiments and prototypes and its values. This was done co-operatively with the experts from the Netherlands National Institute for Public Health and the Environment in an attempt to learn from one another. Members of the City Lab felt insecure and not strengthened by the experts in their choice of measurements tools and transferring the generated input regarding the air-quality data. On the other hand, the air-quality scientist were careful in sharing all their knowledge as it could have possibly be used in the wrong context, as a misinterpretation of the found data. The designerly (professional) creative approach was complemented with interpersonal creativity by the City Lab / Stadslab Luchtkwaliteit members for transferring or bridging the formal field to the informal field. The combination of the City Lab members facilitated this process: there was a landscape architect trained with an ability to diverge, architects who brought in holistic approaches, and designers that were able to deal

with open endings (doubt). Moreover, the process of creative catalysing and questioning each other, showed the commonalities and the value of cooperation. It showed that daring to ask (naïve) questions can be of value for the experts. A trusted work environment and well-informed participants are conditional for this open-minded questioning.

"insecurity is liberating but constraining at the same time. It is good to realize the importance of insecurity, are my questions not naïve? After I gained a huge amount of knowledge, then I was able to ask these naïve questions again. ... My role as a designer is to realize that these naïve questions have a huge value (for the experts), and is an important attitude." Kirsten Kentler, team member City Lab / Stadslab Luchtkwaliteit, 2017

During the workshop Balance-Unbalance 2018/ New Value Systems, in Rotterdam, the authors proposed to examine the conditions, suggestions or guidelines for a 'hybrid learning model' to overcome the above described obstacles with workshop participants from art, design and higher education. The participants recognised 'working with open endings' as a key condition needed in the unprecedented times of transition. In co-creative and community-oriented projects artists and designers often fluidly move between implicit professional and implicit real-life knowledge levels. The required skills set like improvisation and implicit knowledge are taught in art schools, though hardly communicated in detail and difficult to measure. (Winner et al, 2013) One of the participants, an art university tutor, mentioned the contradictive forces at play in real-life project based education: on one hand, there is an urgent need for this 'implicit knowledge' and on the other hand there is a strong movement of quantifying outcomes. All workshop participants confirmed that a formal approach that uses a business-case model and focusses on quantifying evaluation criteria doesn't acknowledge the importance of implicit knowledge in the catalysing artistic endeavour. Moreover, it sharpens the collision of the personal and codified systems. To overcome this collision, the current focus on measurable outcomes could be balanced with qualitative evaluation criteria as known from art and design practice. The knowledge exchange of implicit skills that complements the (economic) measurable jargon, could be used to bridge informal with the formal domains.

As stated earlier it is argued that complex transition issues require new modes that could use transdisciplinary approaches to transcend boundaries between disciplines and merging positions. It was observed that artists and designers often have the interest, skills and opportunities to transcend boundaries between disciplines and are skilled to create learning potential in these formal/informal settings. Based on literature and both case studies we consider the following characteristics valuable: a subjective and often holistic approach, ability to diverge, improvisation, dealing with open endings (doubt), implicit knowledge, tacit knowledge, ability to listen. These 21st century skills are seen in a wider debate around education, as they need to be implemented in institutional education to deal with an unknown future in times of transition. As argued in *'design as learning'* (Boelen, 2018) design has a capacity (deal with doubt and uncertainty) to develop this new educational model that evolves from a goal-oriented education towards learning without pre-determined outcome. It is important to study these characteristics as it defines how we can guide and utilize this process of collision of these systems of institutional and real-life learning as well as it gives direction on what this new 'fluid learning environment' will look like. The authors conclude this paragraph by stating that several formal or institutional obstacles in the case studies prevented a fluid knowledge transfer and thus block parts of the ability to learn in and from these projects.

Discussion

This study brings forward several issues that could serve as a start for a discussion such as: How to bridge formal and real-life (informal) education from a 1.) amateur or 2.) a professional or an institutional perspective? The authors are interested to discuss the outcomes of other initiatives to understand more about the conditions, opportunities and implications for creative and technical vocational education.

Conclusion

This study contributes to the discourse about the potential value of art education for hybrid and cross-disciplinary learning. In literature studies and two case studies the authors identified several obstacles to bridge formal (institutional) learning and informal (daily practice, real-life) learning. The case studies and workshops demonstrate that personal designerly and artistic creative approaches including situated creativity, participatory design, improvisation, learning through making are useful to approach complex transition issues. It was observed that designers, artists and developers used both professional and interpersonal creativity skills and competences to build bridges between their practice and real-life learning. However, it turned out to be more problematic to overcome several more obstacles with the formal and/or institutional field. These concerned especially the evaluation criteria on the professional level and the focus on quantitative project outcomes in real-world projects. Here a knowledge exchange of implicit, subjective and personal artistic and designerly knowledge to the

formal fields could be beneficial to fluidly merge the formal and informal learning fields. The case studies and workshops show the risk of poor implicit knowledge anchoring. The authors conclude that with the latter one risks a knowledge drain that deprives art and design scholars, and practitioners alike, to learn from these practices and to build on the lessons learnt.

Future research

We are interested in the understanding through research and experiments how to develop learning communities where scholars, pro-ams and stakeholders learn through making collaboratively and where artists and designers learn about the potential of their role as change agents. Furthermore, we advocate research with multi-level educational institutes in art, design and technology if and how the above could be part of their life-long-learning policy plans.

Acknowledgements

Mediawharf received funding in the CRISP programme by NWO (Dutch Scientific Research Agency), DOEN, VSB fund, Prins Bernhard Culture Fund, SNS Reaal Fund, Fund for Cultural participation, European Culture Programme. Creative Industries Fund NL, City of Rotterdam, Mediawharf partners: Zadkine, Technical Vocational School Rotterdam; Netherlands Photo Museum; LP2; SKVR; Luxor theatre; Lantaren Venster (NL); Blast Theory (UK); Trans Local (FI); OCAD u (CA). The Learning environments project was coordinated by research centre Creating 010, Rotterdam University of Applied sciences, and funded by SIA: Dutch Research Agency for Higher Education (NL).

Citylab / Stadslab Luchtkwaliteit was financially supported by Creative Industries Fund NL and the municipality of Rotterdam and received content support by AIR (Architecture Institute Rotterdam) and Netherlands National Institute for Public Health and the Environment and winner of the Job Dura Award 2018.

References

Abdulla, D. , Boelen. J., Botha, N. , Ferreira, J. , Gisel, C. , Kubota, N. , Paim, N. , Saccetti, V. (2018) Design as Learning; a school of schools reader, Amsterdam: Valiz

Assmann, K. , Bader, M. , Schipwright, F. , Talevi, R. (2017) Explorations in urban practice; urban school ruhr series, Barcelona: dpr-barcelona

Barnard B., Beekman, N., van Dartel, M., Nigten, A ., (2015) Artists and Designers as Agents of Change -,, PIN-c conference The Hague, The Hague University of Applied Science, SPIRE Research Centre, University of Southern Denmark (NL)

Boehnert, J. (2011) Transformative learning in sustainable education, Farnham: Design Research Society: Experiential Knowledge Special Interest Group

Brickwood, C., Ferran, B., Garcia, D., Putnam T., eds. (2007) (un)common ground, Creative Encounters across Sectors and Disciplines, Bis Publishers, ISBN 978-90-6369-166-0,

Dewey, J. (1934). Art as Experience. New York: Penguin

Cross, N. (2001), Designerly Ways of Knowing: Design Discipline versus Design Science, Design Issues vol. 17, No. 3, pp.49-55

Csikszentmihalyi, M. (1996). Creativity: Flow and the Psychology of Discovery and Invention. New York: Harper- Collins)

Ehn, P., (2008), Participation in design things

Diaz Barrales, V., (2013) Creativity: It's all about context! Pp. 45-49 in: Real Projects for Real People, volume 3, A. Nigten (eds.), The Patching Zone, The Netherlands

Franke, S., Niemans, J., Soeterbroek, F. (2015) Het nieuwe stadmaken Amsterdam: Trancity&Valiz

Glaveanu, V., Lubart T, Bonnardel N, Botella M, de Biaisi P-M, Desainte-Catherine M, Georgsdottir A, Guillou K, Kurtag G, Mouchiroud C, Storme M, Wojtczuk A and Zenasni F (2013) Creativity as action: findings from five creative domains. *Front. Psychol.* **4**:176.

Guattari, F. (2015). Transdisciplinarity Must Become Transversality. *Theory, Culture & Society*, *32*(5–6), 131–137.

Hamers, D. , Bueno de Mesquita, N. , Vaneycken, A. , Schoffelen, J. (2017) Trading places ; practices of public participation in art and design research, Barcelona: dpr-barcelona

Keen, A. (2007) The Cult of the Amateur: How Today's Internet Is Killing Our Culture, New York: Currency

Kirsch C., Lubart, T., Houssemand, C. (2016), Hybrid Approach to Creativity: Arts, Science and Everyday Life, LAP Lambert

Merriënboer, van J. J. G., & Kirschner, P. A. (2007). Ten Steps to Complex Learning. A Systematic Approach to Four-Component Instructional Design. New Jersey: Lawrence Erlbaum Associates.

Leadbeater, C. and Miller, P. (2004) The Pro-Am Revolution!: How enthusiasts are changing our economy and society, London: Demos

Lerende omgevingen,/ Learning environments http://lerendeomgevingen.nl/ (accessed Nov. 22nd, 2018)

Niedeveld, E. (2015) New models for vocational education and training in the Netherlands, in: Real Projects for Real People, Volume 4, Nigten, A. (eds) The Patching Zone, The Netherlands

Nigten, A., (2004) Tunnels, Collisions and Connections, in: online proceedings ISEA 2004, Tallinn / Helsinki / Stockholm

Nigten, A. (2013) Mediawharf learning environment, in: Real Projects for Real People, Volume 3, The Patching Zone, The Netherlands

Nigten A. (2014) The Design Process of an Urban Experience. In: Streitz N., Markopoulos P. (eds) Distributed, Ambient, and Pervasive Interactions.

Nigten, A., Kotey, H., (2017) Whitepaper: Hybrid Learning environments, Designing innovative, participatory and sustainable solutions for complex issues

Nigten, A., Piscaer, A., (2018), Fluid environments for transdisciplinary learning, Proceedings Balance-Unbalance 2018 conference, Rotterdam, The Netherlands

Piscaer, A., (2107) As a designer I'm an expert, I'm an amateur, operating on the fluid boundaries of the design profession, Rotterdam

Polanyi, M., (1967) The Tacit Dimension, University of Chicago Press

Ranciere, J. (1991) The Ignorant Schoolmaster Five Lessons in Intellectual Emancipation, Stanford : Stanford University Press

Schön, D. (1983) The Reflective Practitioner: How Professionals Think in Action, Basic Books
Somerville, M., (1998), transdisciplinarity, stimulating synergies, integrating knowledge, Unesco, p17,
Troxler, P., Mostert - van der Sar, M. (2018) Seven years of plenty? Learning at, with, through, from and for the FabLab at Hogeschool Rotterdam, in: Proceedings of FabLearn Netherlands 2018, http://fablab.nl/PSz2L0Of/wp-content/uploads/2018/09/FabLearn-PaperPresentation-def.pdf (accessed November, 22nd, 2018)
Trust, T., Maloy, R.W. & Edwards, S. TechTrends (2018) 62: 19. https://doi.org/10.1007/s11528-017-0214-0
Toft, I., (2013), Participatory art in an educational context, pp. 51-59 in: Real Projects for Real People, volume 3, A. Nigten (eds.), The Patching Zone, The Netherlands
Wenger, E. (1998). Communities of practice; learning, meaning and identity. New York: Cambridge University Press
Winner, E., T. Goldstein and S. Vincent-Lancrin (2013), Art for Art's Sake? Overview, OECD Publishing, pp 263-264

Authors Biographies

Dr. Anne Nigten (NL) is a curator, researcher at HKU University of the Arts Utrecht and the initiating director of The Patching Zone, a transdiscplinary media laboratory for innovation in Rotterdam (NL). Over the last years she was research professor at the Rotterdam University of Applied Sciences and the Hanze University of Applied Sciences in the Netherlands. Prior to her current positions she was director of V2_Lab, the aRt&D department of V2_, Institute for the Unstable Media in Rotterdam.
She frequently publishes on collaboration in art, technology and the creative innovation field. Nigten lectures on collaborative research and development in the trans- and interdisciplinary field from a creatively engaged perspective. She completed her PhD at Smartlab, Central Saint Martins, University of the Arts London (UK).

http://patchingzone.net
https://www.researchgate.net/profile/Anne_Nigten

Annemarie Piscaer (NL) is a designer, guest-lecturer (the Design Academy Eindhoven and Avans University of Applied Sciences, Art faculty St. Joost), initiator of Studio Dust, a participatory research by design studio with the principle that all has value even dust -'from dust to dust'- and member of the City Lab 'Stadslab Luchtkwaliteit'. In the last few years she developed participatory design projects by using material research as a communicative instrument to connect unusual domains and disciplines. This practice with its transcending boundaries between disciplines was ground for the research about consequences of this for design education 'As a designer I'm an expert I'm an amateur'. She completed the Design Academy Eindhoven (NL) and Master Education in Arts at the Willem de Kooning Academy Rotterdam (NL).

www.studiodust.nl
www.ser-vies.nl
https://www.researchgate.net/profile/Annemarie_Piscaer

"The Transmediated Self"
An interactive and visual metaphor of human cognition.

Anatol Bologan, Dr. Jinsil Seo, Dr. Joseph Orr, Dr. Vidya Sridhar

Texas A&M University, College Station, USA
abologan@tamu.edu, hwaryoung@tamu.edu, joseph.orr@tamu.edu, vidyas@exchange.tamu.edu

Abstract

"The Transmediated Self" draws upon contemporary discourse and theoretical debates surrounding concepts of subjectivity and objectivity in relationship to the mediated self. The artwork is grounded in interdisciplinary collaboration between art and science, in particular Functional Magnetic Resonance Imaging (fMRI), Neuroscience and Interactive Arts. "The Transmediated Self" presents a deconstructed human form, overlapped by video of the artist, 3D mesh and maps of active areas and tracks of the brain as well as medical MRI scans of the head of the artist, in order to demonstrate the contrast between humanist and technicist approaches to viewing the human and "the self". The main artist serves as the subject of the medical imaging and as the primary subject for this art-based study. This intentional use of contrasting visual methods serves to highlight and question our cultural predisposition to "virtual media" and our trust in technological platforms as origins of informational and cultural "truth."

Keywords

Art, interactive art, installation, human consciousness, human cognition, medical imaging, fMRI, brain activity.

Introduction

In 2010 in the *Scientific and Philosophical Perspective in Neuroscience* Paolo Costa wrote: "We need a theory of the self – and a very special theory, too – in order to speak about something that lies exactly on the border between inner and outer, value and fact, subjective and objective" (Giordano 2010). This "new theory" of human consciousness was one of the motivating factors for this art-based research project. The challenge is to encapsulate the "the inner and the outer," as well as the "subjective and the objective," in one artwork, which represents this search for a "new theory of the self." The project is also intended to raise awareness and question the impact of technology on medicine and contemporary culture by treating the human body as more than a "carrier," "case-study," "medical anomaly," or "statistic." By introducing the audience to a deconstructed model of human visual and auditory cognition, these works invite the viewer to participate in analyzing the relationship between the conscious and unconscious self (Fig. 1). The project draws on previous theoretical works that focus on the impact of media in contemporary culture as well as on medicine and power. For example, *Remediation* by J. Bolter and R. Grusin, introduces the concept of the "remediated self"; *The Birth of the Clinic* by Michael Foucault, examines and critiques the ways in which the medical field normalizes and controls the human body due to advancements in technology. This project places these two critical discourses in dialogue, through the practice of the interdisciplinary art

Figure 1. *Prototyping Abstract Thought.* Digital painting. © Anatol Bologan.

& science collaboration among the Department of Visualization, the Department of Psychology and Texas A&M Institute of Preclinical Studies. The primary drive of this collaboration is focused on exploring how the confluence of art, technology and science continue to offer a deeper understanding of the human body and mind.

In order for the project to include a mode of "subjectivity" as well as "objectivity," the main artist is the subject of medical imaging. The medical data is used as the "objective" source material for the project. Additionally, video of the artist was recorded speaking the words depicting the emotions that were assessed during the fMRI scan. The emotions scanned were a set of primordial emotions such as love, pleasure, fear, anger, disgust. The list of words chosen was based on the research of neuroscientist Derek Denton and his book *The Primordial Emotions* (Denton, 2006).

As audience members approach the installation space, they are greeted by a gallery of prerecorded faces and voices of previous audience interactions with the installation. This is meant to simulate preexisting memories of the consciousness, encapsulated in the cognitive processes of the artist and displayed as conscious and unconscious modes of awareness. The audience is encouraged and visually primed to speak their own emotions into a microphone in order to reveal the "active listening" mode of the artwork (described in detail in the "Interactive Technology Platform" section of this paper).

From a conceptual point of view, the project engages with contemporary research in the field of human cognition and consciousness, human centered design and philosophy. New concepts have been visually explored and prototyped through photography, image manipulation and digital painting (Fig. 2). Resulting compositions were presented at exhibitions and public participation and feedback was assessed. The images served as metaphors and visual narrative to be explored further in physical and interactive spaces.

To make the audience's experience more responsive and engaged, the artwork is based on real representation of the artist, his brain anatomy and medical imagery. The driving concept is to make the public's experience as authentic as possible. According to J. Bolter, "The appeal to authenticity of experience is what brings the logics of immediacy and hypermediacy together" where *hypermediacy* is a "style of visual representation whose goal is to remind the viewer of the medium" and *immediacy* "is a style of visual representation whose goal is to make the viewer forget the presence of the medium" (Bolter & Grusin, 2000). In other words, while the viewer is aware of the medium, they are also perceiving the media to exist independently from it, providing an experience supported by the medium but not confined by it.

Interdisciplinary art: overview of approach

Our current research is focused on the virtual aspect of photography found in medical imaging as a space of "intermediation and thinking of interactive visual spaces as a medium born of remediation and entanglement of technology, science and art" (Bolter & Grusin, 2000). According to Kathryn Hayles, *remediation* is a "more faithful" term that incapsulates "the spirit of multiple causality in emphasizing interactions among media" (Hayles, 2010, p. 33). She claims, "in the twenty-first century, the debates are likely to center not so much on the tension between the liberal humanist tradition and the posthuman but on different versions of the posthuman as they continue to evolve in conjunction with intelligent machines" (Hayles, 2010, p. 2). The main artist explores and depicts this concept of different versions of the posthuman consciousness in the digital painting *Layers of consciousness* (Fig. 3). Specifically, the cross-sections of the human face represent different senses while exposing computer circuitry between the layers. By focusing on the subjectivity and objectivity of the mediated self, this project follows Hayles's call for a "repositioning" of "materiality as distinct from physicality" towards "re-envisioning the material basis for hybrid texts and subjectivities" (Hayles, 2010, p. 2). Interactive works created by this ongoing research, such as the series of sculptures entitled *Prototyping the Posthuman Self* create "feedback loops," not only between "computation and human consciousness," but also "between human consciousness and the nature of reality" (Hayles, 2010, p. 11). As the main artist's research expands to include additional technologies that involve computer systems and software, he builds his practice on theoretical works such as *Human Machine Reconfigurations* by Lucy Suchman, who is specifically interested in the interactivity and the "human conversation" with the machine (Suchman, 2007). Suchman's theoretical approach regarding the impact of technology critiques what she calls "parochial and conservative forms of liberal humanism" (p.256) by drawing upon ideas of "intelligent machines" found "at the intersection of AI and new media art" (p. 243). Within this specific intellectual space, she finds herself interrogating and analyzing the "the ongoing labors of

Figure 2. *Cognitive map prototype*. Digital painting. ©Anatol Bologan.

Figure 3. *Layers of consciousness.* Digital painting. ©Anatol Bologan.

design practitioners, the unruly contingencies and material particularities of computational artifacts, and the artfully collusive performances that make up encounters at the human–computer interface" (Suchman, 2007).

Art, Science and the Posthuman

This work engages posthumanism and the impact of science on what we currently consider to be transformational. It uses visually complex narratives to respond to debates including those of art versus science, human versus non-human, nature versus technology. The main artist creates works that explore the possibilities and implications of using technology and science to imagine ourselves as posthuman. He is seeking to create a new aesthetic that at once draws attention to the pitfalls of Anthropocentrism while at the same time keeping an essence of humanism. To do so, we encourage the audience to interact with the artwork, controlling and reinterpreting it by introducing their own imagery and narrative into the performance of the piece.

The interactivity of this work draws upon previous projects such as "The Eighth Day" by bio artist Eduardo Kac among others. Kac first exhibited this work at Arizona State University in October of 2001, soon after he introduced his famous GFP Bunny. The exhibit was formed of transgenic life forms modified by an enhanced CFP gene, a Green Fluorescent Protein that was extracted from an Aequorea Victoria jellyfish that glows in the dark. The artwork seems to be technically sophisticated and difficult to create as many other works created by Kac. The entire installation represents a "Biobot" that serves as an "Avatar" for web participants that remotely control the "eye" of the creature and perceived "behavior of it is a combination of activity that takes place in the microscopic network of the amoebae and in the macroscopic human network." Cary Wolfe, in his book *What is Posthumanism*, argues that the conceptual merits of Kac's installation are as impressive as the technical and logistical ones. (Wolfe, 2017) He quotes the artist in saying that "artists can contribute to increase global diversity by inventing new life forms." This artwork embodies Kac's "own manifesto on transgenic art" and that he imagines "the artist literally becomes a genetic programmer who can create life forms by writing or altering a given (genetic) sequence."

While Wolfe makes these statements about the artwork, he is aware of the ethical implications that it brings to the forefront as highlighted by critics such as Steve Baker and even Derrida. The author quotes Baker as saying that this kind of work is dependent on "institutions and practices of scientific research that subject millions of animals a year to distressing, often painful, and usually fatal experimentation" and Derrida pointing out that these practices are "artificial, infernal, virtually interminable survival, in conditions that previous generations would have judged monstrous." While Wolfe admits that the concerns are important and relevant, he chooses to dismiss them and not "discuss them" in his critique of Kac's work and refers to it as human/animal relationships and "a question of posthumanism" in general.

Instead, my work directly engages the potential real or perceived violence and ethical concerns of scientific imaging systems and methodologies (Fig. 4) by drawing a parallel between the lead artist as the subject of this study and the "Visible Human" project that is currently hosted by

the U.S. National Library of Medicine. The human cadaver "specimen" that was used for the project was physically transformed by being frozen and then cut in the axial plane at 1 mm intervals and photographed for a total of 1871 anatomical images generating a 15 Gigabyte dataset (www.nlm.nih.gov). By contrast, the dataset acquired for the "The Transmediated Self" project is 325 Megabytes and it consists of MRI and fMRI scans of the head of the artist. Data captured provides access to neurological structures of the grey and white matter of the brain, revealing an insight into the cognitive model of the "specimen." The overarching conceptual theme is focused on highlighting the intervention of science and technology that have the potential to render the human as "invisible" and disembodied "specimen" of human anatomy and cognition. By prompting the visitors to engage with *The Transmediated Self*, the audience supply their visual and oral narrative and generate context for the growing complexity of the piece. The audience generated context provides the artwork with a sense of cognition and awareness for the following wave of visitors. A continuous feedback loop between the artwork and the audience generates an increasing set of recorded accounts of user interactivity and user supplied memories, reactions and sensations. The work self-consciously highlights the viewers' creation of their own meanings. According to Hales, "Cognition is a process of interpreting information in context that connects it with meaning. If there is no context, there is no way to generate meaning."

Art + Science: collaborative methods

A number of contemporary artists are actively working at the intersection of art and science. There are artworks that engage the field of biology, microbiology and computer science. Some of the more iconic artists such as Eduardo Kac and Stelark have served as examples and inspiration for many and helped establish the field of Bioart. In one of his projects called *Natural History of the Enigma*, Kac created a piece entitled *Edunia*, a genetically-engineered flower that is a hybrid of Kac and Petunia. Kac is using his own body as source material for his artwork and transforms and remediates his own DNA "thus creating a new kind of self that is partially flower and partially human" according to the artist's own statement. (www.ekac.org)

Another prominent creative influence is Stelark, especially the project entitled *Partial Head* where the artist 3D prints the surface of his face out of biological material and "is a partial portrait of the artist, which was partially living. Its life-support system was a custom engineered bioreactor/incubator and circulatory system which immersed the head in nutrient kept at 37° Celsius." (www.stelark.org). In both cases the artists collaborated with researches in the field of Biology and computer science and list a number of collaborators that helped them achieve their creative vision. The complexity of the creative thought and scientific expertise needed to be deployed in order to bring these collaborations to fruition is hard to comprehend without having been involved in such a project. The benefits of such collaboration are long lasting and have a great impact on contemporary culture by highlighting the importance of creative thought and creativity needed in order to push scientific innovation forward. The number of interdisciplinary artists is continuing to grow, and as an artist I consider that it is very important to continue to engage collaborators as well as the audience to push the cultural and scientific boundaries.

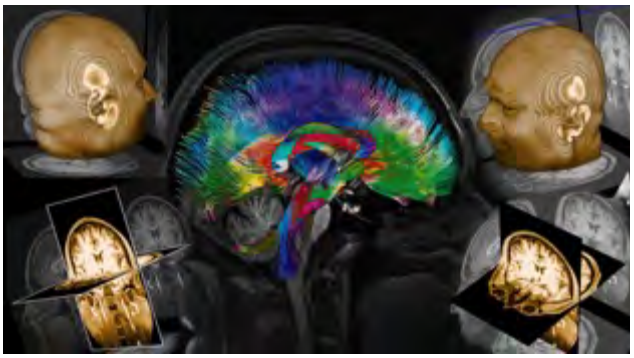


Figure 4. Source MRI and fMRI images acquired at TIPS. ©Anatol Bologan.

Further, a strong parallel could be drawn between *The Transmediated Self* project and the project developed by Diane Gromala and Yacov Sharr entitled *Dancing with Dervish: Virtual Bodies* developed in 1994 which was one of the first Virtual Reality (VR) art-based experiences. "Body parts from MRI scans of Gromala's body comprised the immersive 3D environment," writes J. H. Seo describing the project. She continues by adding more detail: "As users navigated within the body parts, they deformed and reformed according to users' movements" (Seo, 2011). When talking about the technology and the platform used for this artwork, Gromala says: "What is different about the more recent technologies, however, is the reach and scope of these tools, their instrumentality — their ability to allow us to « see » both inward into our own bodies and outward to the universe" (Gromala & Sharir, 1995). In both cases, the artists use their own medical imaging at the center of the art pieces to engage the audience in an interactive performance through technology that as a process of mediation erases the artist and gives way to the new experience generated by the viewer to take place. The dance performances choreographed by Yacov Sharir are an integral component of the installation and are viewed by the audience in conjunction with the VR experience. The noticeable difference in approach between the two artworks is that the artist is setting the stage for the audience to become the driving force behind the content generated by the artwork, whereas Gromala's 3D VR installation is guiding the viewer through a mediated space. *The Transmediated Self*, however, serves as an invitation for the

audience to engage with the artwork and input their own images, experiences and emotions that later become integral to the artwork.

The Transmediated Self: Design and Process

Medical Image acquisition

The MRI and fMRI session were conducted at Texas A&M Institute for Preclinical Studies (TIPS). The scanning session lasted two hours and forty minutes, during which the lead artist was positioned in the 3T Siemens Magnetom Verio Magnetic resonance imaging (MRI) scanner (Fig. 5). Images were acquired on a 32-channel head coil. The following sequences were imaged:

1. Standard localizer sequence.
2. Two T1-weighted imaging sequences with a 0.8mm voxel size.
3. Resting functional MRI sequence.
4. 3 runs of functional MRI test sequences assessing five emotions, each of which was recalled for 30seconds.
5. Diffusion sequences using 96 and 97 diffusion directions in the anterior to posterior as well as posterior to anterior phase encoding directions.

Image reconstruction was done on various software including the Siemens Syngo MRI workstation (Fig. 6). The complete dataset is 1.25 Gb in DICOM format that has been converted to NIFTI format using MRIgroGL and FreeSurfer software in order to make it available across other research-based, open source medical imaging and research applications such as FreeSurfer, DSI Studio and TrackVis.

While the anatomical and diffusion data provided to be very detailed, the first fMRI session did not yield significant results as the data acquired was inconclusive. Dr. Joseph Orr recommended conducting additional fMRI scans that would have a narrower focus and multiple repetitions of the cognitive and emotional response in order to calculate a more accurate median result and be able to extract a coherent dataset.

Interactive Technology platform

The interactive platform chosen for the installation is based on Derivative TouchDesigner software, as it provides a node-based system that allows for multiple devices to serve as input sources such as depth of field, proximity, live video, image and audio capture, as well as conduct calculations and processes. The ease of use of the software provided a fair amount of creative freedom as multiple iterations of interactive functionality were prototyped and tested with ease. Nodes designed to provide access to the sensory input from the capture devices, such as the Kinect camera and microphone, allowed the selection of certain parameters such as strength or duration of soundwaves or the ability to lock and track the face of an approaching audience member and frame it in a specific space on the frame.

The intuitiveness of the visual way to build an algorithm to run the artwork proved to be sufficiently sophisticated to provide the functionality and adjustability needed to create the front-end of the interactivity. Special nodes that used

Figure 5. Lead artist fMRI imaging session at TIPS. ©Anatol Bologan. Photo: Glen Vigus.

Kinect SDK allowed for the approach of the viewer to be captured both on video camera as well as the infra-red sensors, providing the ability to use multiple kinds of functionality with a single device.

As the viewer approaches the installation area in the Z (depth) plain, the depth sensor engages the pre-recorded video of the artist's head and exposes the overlapped MRI images of the head of the artist (Fig. 7). This effect is reversed if the audience moves back in the Z plain out of the 3D X, Y, Z space axis, therefore giving the viewer control of how much of the depth in MRI imaging is revelled. The microphone is used to record viewers accounts of their memories and sensations vis-à-vis the five primary emotions the artist fMRI reveal.

The intensity and loudness of the voice as well as the duration of the narrative expose the active tracks in the white matter of the brain or the artist as well as a grey versus white surface scan of the cerebral cortex creating a rich visual effect simulating brain activity as the artist's brain becomes engaged and responding to the voice of the viewer. Simultaneously, the portrait of the audience speaking is

Figure 6. fMRI imaging session, software screen. TIPS © Anatol Bologan. Photo: Glen Vigus.

becoming more apparent and is projected into the composition, facing the artist's portrait. This suggests a face to face conversation. The image of the viewer is rendered with diffused edges and desaturated colour. As the narration stops, the image fades away, exemplifying perception and the artist's cognitive mechanisms of memory.

Integration

From a conceptual point of view, integrating different visual sources into coherent artwork has proven to be one of the challenges in this project. Each type of media, such as medical imaging and video, contains a certain pre-existing aesthetic and cultural meaning. The intention was to separate the clinical application of the brain MRI and diffusion data imaging and interject it with a metaphor of consciousness and dimension of thought. Computer-generated medical images have a clinical and utilitarian cultural association. Converting that perception of the public to accept it as an objective representation of the mediated self of the artist is a conceptual requirement for the project.

The other important aspect of the project is focused on is the audience interaction with the installation. A large portion of the overall layout remains invisible until the audience chooses to engage with the artwork by walking closer to a designated area, where they can speak into the microphone, therefore exposing hidden functionality that is not initially accessible. Once the sound of the speaker's voice triggers the particle cluster to expose the overlaid 3D image of the grey and white matter of the artist's brain, the audience can see that the intensity and duration of their speech activates additional interactivity and provides additional content and context for the artwork. Proximity to the artwork is another important element of the interactive space, as it reveals the overlay of medical MRI imaging over the exiting video of the lead artist in the left side of the screen. The overall orchestration of a coherent collaboration of all elements involved creates an organic and immersive experience. The viewer is engaged with the artwork as it feels and responds to his or her interactions.

Interactive Experience

The intention for the project is to draw the audience into a mediated experience where they are included into the artwork by engaging with the physical space and narrate their emotional responses, memories and associations with a predetermined set of primordial emotions such as Love, Fear, Disgust, Pain and Pleasure. Derek Denton argues that "neuroimaging confirms major activations in regions of the basal brain during primordial emotions in humans" and that they are the "likely precursors to consciousness" (Denton, 2006). While participating, the audience is interacting with the artwork, their images and narrative is being captured and processed by the system.

As previously mentioned, the physical installation is comprised of camera and depth sensor such as a Microsoft Kinect, camera, microphone and a display. This allows the participants to be visually included into the installation and take active part in how the artwork is displayed. The interactivity platform is built using Derivative TouchDesigner and is using Microsoft Kinect SDK to track the subject from the audience and include their image in the interactive visual space of the installation. An overlay of structural anatomical images was displayed over the main portion of the head of the artist as the viewer was approaching the display of the installation. As the next set of viewers approaches the installation space, they will be greeted by a gallery of prerecorded faces and voices of previous audience interactions with the installation. This is meant to simulate preexisting memories of the consciousness encapsulated in the cognition model of the artwork that is based on the neurological network of the lead artist.

The composition of the "The Transmediated Self" installation has different stages of engagement with the audience. The first reveal of the composition is shown to the public as a visitor approaches the installation area and he or she can see previous interactions in a form of recorded and stylized images and narrations of the prior interactions. The second stage is when the audience enters the active viewing space designated to engage depth perception of the Kinect camera and the layout of the visual space is showing the artist's head ready to engage with the new visitor (Fig. 8) and engaging the viewer and his/her proximity to the artwork. The third and final stage of the interactive space becomes active and visible to the viewer when he or she starts speaking into the microphone, and the layout of the visual interactive space is reacting to the audience participation. As the viewer stops the vocal narration and moves backwards, the visual space becomes less engaged and reverts back to the original composition. Within

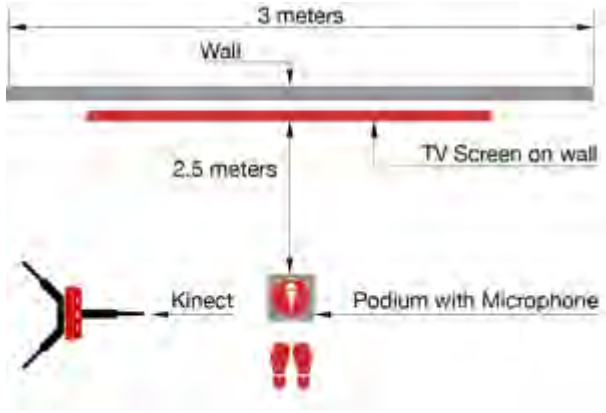


Figure 7. Floor plan for *The Transmediated Self* interactive installation. ©Anatol Bologan.

Figure 8. *The Transmediated Self.* Image capture from interactive installation. ©Anatol Bologan.

moments the image and the vocal narration of the latest interaction is in played back, symbolizing becoming a memory in artist's consciousness.

As the audience interacts with the artwork, each interaction is different. While having a similar overall interactive structure, each experience is unique due to the visual and vocal input from the viewer. The viewer's initial reaction is to passively observe the installation; however, his or her interest is captured the moment they realize that his or her proximity to the artwork influences the visual composition. In many cases, the audience moves back and forward in order to test the responsiveness of the artwork. Once they start a speaking into the microphone, they are surprised again by the fact that there is an additional visual response by the artwork to their actions. These simple interventions by the audience results in their interest and commitment to continue their interactions and experience the installation in more depth. Further studies of user experience and feedback from the audience on their experience will be conducted at future exhibitions and events where the artwork will be shown.

In summary, the creative interpretation of the medical images invites us to analyse how we can counteract through art the potential dehumanization of medical imaging. We create our own aesthetic out of our own bodies, and thereby claim our subjectivity through objective data.

Future Directions

A series of art projects are planned to expand the usage of the dataset created through this interdisciplinary collaboration. It is bound to address a series of philosophical questions regarding mediated and disembodied identity of self through a process of digitization and commoditization of the individual in contemporary society. Questions regarding the neuroethics, artificial intelligence, cognition and consciousness will be pursued through the visual analysis of the process of interpreting information and the context that connects it with meaning. Through this current project the main artist is creating a model, a mode of enquiry: as a "human specimen," he is in possession of his own data and he can access the data by using open-source software to view and analyse it. He can generate new connections, content and source material for future projects and extract more context out of the dataset he currently has.

However, this account also highlights the fact that this model cannot be democratized under current socioeconomical circumstances. It underlines existing ethical concerns surrounding medical data and patient privacy, as it is still a challenge to allow patients to truly possess their own data. Another important factor is access to medical imaging technologies by patients who need it as well as the privilege of access to medical and computer-based technology. Therefore, we would hope that "The Transmediated Self" project can start a productive and collaborative conversation about research-based art and can become and invitation for future debate about how this aesthetic can be truly transformative.

Conclusion

"The Transmediated Self" project serves as a first proof of concept in a list of planned future collaborative work where art, medical and computer science converge to generate a mutually inclusive and coherent collaboration. The collaboration with Texas A&M Institute for Preclinical Studies are continuing for future projects, and full body scans are planned to create a larger and more encompassing

data set of the artist's biological information. A number of the artworks and case studies about the projects will be made available to a wider audience online at www.humanspecimen.com

Acknowledgements

Special thanks for continuous support to Dr. Jinsil Hwaryoung Seo, Michael Bruner, Dr. Joseph Orr and Dr. Vidya Sridhar from Texas A&M Institute for Preclinical Studies. Important contributions have been made to the conceptual development of this project by Dr. Kristi Sweet and Dr. Frederique Parke.

References

Bolter, J. D., & Grusin, R. (2000). *Remediation Understanding new media* (pp. 1–282). MIT Press.

Braidotti, R. (2013). The Posthuman. Wiley.

P. Costa, Giordano, James J, and Bert Gordijn, et. al., (2010) *Scientific and Philosophical Perspectives in Neuroethics*. Cambridge University Press.

Costello B., Edmonds E. (2007) A Study in Play, Pleasure and Interaction Design. *Designing pleasurable products and interfaces*. 76-91.

Denton, D. (2006). *The Primordial Emotions*. Oxford University Press.

Grusin R. (2015) *The Nonhuman Turn*. University of Minnesota Press.

Gromala, D., & Sharir, Y. (1995). *Dancing with the Virtual Dervish : Virtual Bodies*. Erudit, (63), 1–4. Retrieved from id.erudit.org/iderudit/46529ac

Haraway, D. J. (1991). *Simians, Cyborgs, and Women* (pp. 1–157). Routledge I New York.

Hayles, N. K. (1999). *How we became posthuman*. The University of Chicago Press.

Hayles, N. K. (2010). *My Mother Was a Computer* (pp. 1–301). The University of Chicago Press.

Kac, E. (2007). Signs of Life. Mit Press.

Lippert-Rasmussen, et. al., (2011) *The Posthuman Condition: Ethics, Aesthetics and Politics of Biotechnological Challenges*. Aarhus University Press.

Lyotard, J.-F. (1999). *Postmodern Fables*. University of Minnesota Press.

McLuhan M., Fiore Q. (1967) *Medium is the message*. Penguin Books.

Seo, J. H. (2011). *Aesthetics of Immersion in Interactive Immersive Environments*. Lap Lambert Academic Publishing.

Suchman, L. (2007). *Human–Machine Reconfigurations* (2nd ed., pp. 1–328). Cambridge University Press.

Wolfe, C. (2009). *What Is Posthumanism?* (pp. 1–393). University of Minnesota Press.

Author Biographies

Anatol Bologan is an Instructional Assistant Professor in the Department of Visualization at Texas A&M University. He holds an MA in Image and Communication from Goldsmiths College, University of London, and a MFA in Visualization from Texas A&M University. He is a classically trained painter as well as digital artist working in the space of multidisciplinary and interactive arts. His work has appeared at national and international conferences and exhibitions such as SxSW, ISEA, Creativity and Cognition and iDMAA.

Jinsil Hwaryoung Seo is an interactive artist/researcher focusing on aesthetics of interactive experience. Currently she is an aassociate professor in the Department of Visualization at the College of Architecture and a faculty fellow in the Center for Health Systems & Design at Texas A&M University. Seo received a Ph.D. in Interactive Art and Technology from Simon Fraser University in Canada and an MFA in Computer Arts from School of Visual Arts. With interdisciplinary, interactive art practice, Seo investigates the intersection between body, nature and technology. She has exhibited and published her art research projects nationally and internationally.

Dr. Joseph Orr's research examines the psychological and neural mechanisms underlying executive functions. Specifically, he is interested in the factors that underlie voluntary task selection; while we may think we have control over which task we choose at any given moment, there are a number of factors that influence our choices. Dr. Orr work suggests that overcoming task choice biases from external stimuli depends on the frontal pole of the brain, which is thought to be involved in coordinating the activity of multiple other brain areas.

Dr. Vidya Sridhar is a research specialist at the Texas A&M Institute for radiological imaging, which aims to provide state-of-the-art imaging services to researchers both within and outside of Texas A&M University. She is trained in diagnostic and interventional radiology. Dr. Sridhar has extensive experience in neuroradiology, including functional magnetic resonance imaging (fMRI) and brain mapping, as well as cardiothoracic computed tomography (CT), echocardiography and magnetic resonance (MR) imaging. Her areas of special interest include neuroimaging and translational imaging research.

Humanoid Robot Magic: various responses and communication

Jeehyun Yang, Jaesik Jeong, Jacky Baltes
National Taiwan Normal University
Taipei, Taiwan
zstt.jh@gmail.com jslvjh@gmail.com jacky.baltes@gmail.com

Abstract

This paper describes the system design of *Robinion* - a robot magician. In particular, we focus on *Robinion*'s personality traits. One of the research goals is human robot interaction. A good magic trick includes good presentation to increase the enjoyment of the audience. Magicians often use various personalities in their performance to adapt it to the audience. We describe *Robinion*'s sophisticated traits and communication system that allows it to present different personalities during the performance of a magic show. A magic trick is broken down into a discourse plan which may include speech, gestures, or actions. We call each step in a discourse plan a speech act. Each speech act in the discourse plan is labeled along various dimensions. The system selects a suitable response by calculating how well the speech act matches the magician's current personality and the current state of the discourse. So *Robinion* can keep the audience interested, even when repeating a similar trick.

Keywords

Robot performance art, Humanoid robot, Robot magic show, Robot personality, Verbal & Non-verbal Communication, Human Robot Interaction, Roulette Wheel Selection

Introduction

Each year, the *IEEE* International Conference on Intelligent Robots and Systems (*IROS*) organizes a series of competitions to showcase the current state of various important robot technologies for other roboticists, hobbyists, and the general public. "Robot Magic" was the topic of the fifth Humanoid Robot Application Challenge (*HRAC*) and the second time that the area of robot magic tricks was used as the application domain[3]. The judges in *IROS HRAC* evaluate the live performance of a humanoid robot magician[5] (see Fig. 1).

The famous magician *James Randi* (1928) states "Magicians are the most honest people in the world; they tell you they're gonna fool you, and then they do it.". Good magicians are masters of misdirection, using biases in human attention, perception, and reasoning to their advantage. For example, they make people focus on their right hand, while the trick happens in their left[2].

We were concerned about how our humanoid robot, *Robinion*, could make a magic show. We researched the history of magic and analyzed various videos of magicians and their acts. We also referred to videos of robot magicians that participated in the previous competition. We learned that there are two equally important aspects to a magic trick. One is the technical aspect of the trick. That is, how does the magician palm a coin or move a card to the top of a deck of cards. The other part is the interaction with the audience. This includes the magician's persona, the banter during the act, and other interactions with the audience. We therefore focused on two factors in our magic trick. Firstly, we selected magic tricks that technically could be performed by the robot. Secondly, we worked on developing a persona for our robot magician *Robinion* and developed some interesting interactions between the robot and the audience. Showy magic tools can be effective, but they are difficult to apply to humanoid robots. So we selected two magic tricks using a coin, a plastic bottle, a piece of paper, and a marble. Our magic tricks are simple, but they are very effective in attracting an audience.

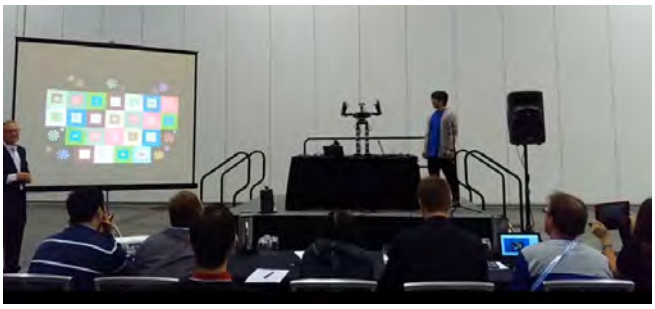


Figure 1: IROS2017 HRAC stage

Coin magic is the manipulating of coins to entertain audiences. Coin magic is generally considered harder to master than other close-up techniques such as card magic, as it requires great skill and grace to perform convincingly, and this takes a lot of practice to acquire[6]. An audience is the most important element of a magic show. Therefore, we have to consider how an audience appreciates a magic show. We developed an interesting and engaging magic trick and also developed a sophisticated model of the robot magician - audience interaction. In particular, our robot will not present the same magic show twice, since we can adapt the interaction by changing the personality of *Robinion*. So the audience is entertained, even if they watch the same trick twice.

In the Magician: Humanoid Robot section, we describe the hardware architecture of our humanoid robot magician and explain some of the important design choices. The System Architecture section describes the humanoid magic show composition and tricks. We describe the speech act algorithm of our robot magician based on personality vectors in the Speech Act Selection section. In the Communication section, we show the communication model that we used in the magic show. Finally, we mention our experiment results and future work in the Conclusion.

Magician: Humanoid Robot

This section describes the hardware of our magician humanoid robot (*Robinion*). The humanoid robot is 85cm tall and weighs 7.5kg. In total, the robot has 25 degrees of freedom (five in each leg, six in each arm, one in the torso, and two in the head) as shown in Fig. 2.

Figure 2: Magician: Robinion

The robot is manufactured using aluminum and uses a *Robotis Dynamixel* series for each joint. *MX-106* is used in the leg, *MX-106*, *RX-64*, and *MX-28* are used in the arm, while *AX-12* is used in the neck. For better noise resistance we use an *RS-485* bus to communicate with the actuators in a star topology. There are communication buses connected to the main processor board, one for the legs, another for the arms, and another for the head[4].

The robot system is divided into 2 parts: a controller that controls servo motors, reads sensors and calculates motions, and a single board computer (*SBC*) that recognizes the environment and controls the robot's behavior (see Fig. 3). The controller is composed of a Cortex-M3 board for controlling devices, an *IMU* for reading the robots status, servo-motors for moving the robot, a *PMIC* for regulating power sources, and FT232/Bluetooth for communicating data with the controller. The *SBC* calculates real-time image processing, handles voice recognition, calculates algorithms, and controls robot behavior[4].

System Architecture

Composition of robot magic show

Reacting quickly and quick-handedness are important components of magic, that is why most people think that "magic

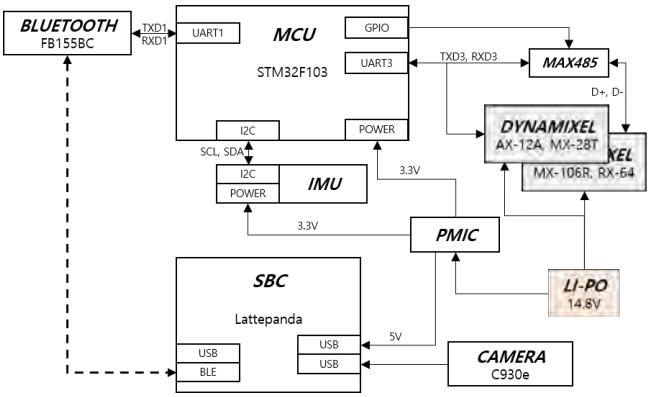


Figure 3: Robinion Block Diagram

is a deception.". The hands of robots developed so far are limited in being able to express things as delicately as a human hand. It is not easy for audiences to have a 'fantasy' about magic, as the number of people who do magic as a hobby is increasing and research of the tricks is becoming more popular, so the secrets of magic tricks can now be easily accessed online, such as on *YouTube*. *Robinion*, our humanoid robot, needs the help of the participant in *IROS*2017 *HRAC*. Therefore, it is difficult for the humanoid robot to perform the magic show completely independently from start to finish. Also, it is difficult for competitors who are not professional magicians to demonstrate their showmanship skillfully in situations that cannot be predicted with a humanoid robot. How can we perform an effective magic show with a humanoid robot under these restrictive conditions? Good magicians are masters of misdirection, using biases in human attention, perception, and reasoning to their advantage.

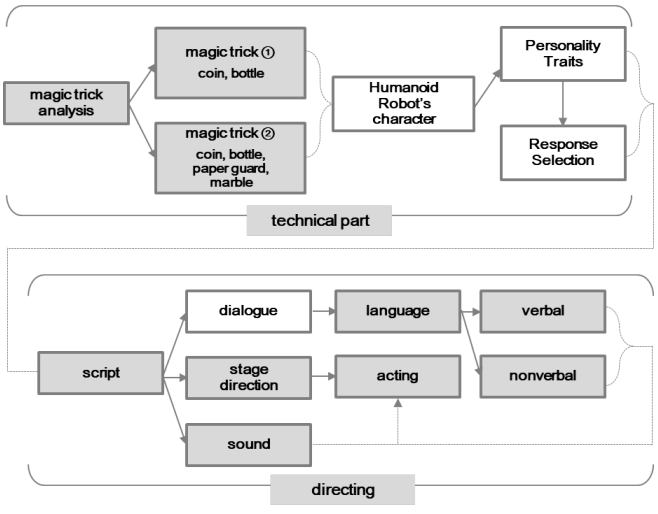


Figure 4: team ZSTT - Magic Show composition

For example, they make people focus on their right hand, while the trick happens in their left. Robot magic shows need not only the technical parts, but also the research that reflects

the various senses of the audiences who watch the show, the background music and the story. This research consists of technical parts that analyze and apply the magic tricks that a humanoid robot can perform, and a directing part that creates a script (see Fig. 4).

Humanoid magic show tricks

Trick	Tool	Type	Sensory system
1st magic	coin, bottle	stage magic	sight,touch, listening
2nd magic	coin,paper guide bottle,marble	stage magic	sight,touch, listening

Table 1: Team ZSTT: Magic Tricks

*IROS*2017 *HRAC*-Robot Magic was stage magic which was held in a large stadium (see Fig. 1). The magic show of team *ZSTT* consisted of two tricks (see Table 1), and it proceeded with some magic tools, as well as the interaction of participants and robots through speech recognition.

Figure 5: 1st magic trick: Grasp bottle, Grasp coin, Line up bottle and coin, Release coin

The first trick was made up of a simple illusion that used a coin and a plastic bottle (see Fig. 5). The magic was to put the coin in the correct position of the plastic bottle with a hole (see Fig. 7(a)). Before showing the magic, the participant confirmed with the audience several times that it is impossible to put a coin in the plastic bottle, which had a lid screwed on it, but actually also had a hole which was being hidden by his hand. The audience cannot predict the trick if the plastic bottle entrance is blocked by a lid. *Robinion* can proceed quickly on the first trick because it is very simple, but it is not easy to calculate the kinematics and Centre of Mass (*CoM*) of a robot when the robot moves its arm to grasp the bottle and drop the coin into the correct position. If the robot performs the motion of the magic trick, the center of gravity of the robot changes. Therefore, the robot controls its balance through *CoM* analysis. The robot failed several times during practice, and we were able to calculate the robots exact arm position through various kinematic iterations when the robot grasps the plastic bottle, grasps the coin, and puts the coin in the bottle.

In the second magic trick, after analyzing a trick performed by an actual magician, we modified the trick so that our humanoid robot could do it. The robot puts a paper guide at the entrance of a plastic bottle and puts a coin in the guide to

Figure 6: 2nd magic trick: Grasp bottle, Grasp paper guide, Line up bottle and paper guide, Release paper guide, Grasp coin, Line up bottle and coin, Release coin, Grasp marble, Line up bottle and marble, Release marble

block the entrance (see Fig. 6). The robot drops a marble and puts it into the plastic bottle, the entrance of which is blocked by the coin. What is important in this magic is the entrance size of the plastic bottle, the coin, and the marble, and the weight of the coin and the marble. The original trick is to put the marble into a plastic bottle with the coin turned upside down by the momentary force of the marble when the marble is dropped. However, there were some problems in that the robot failed when it dropped the marble according to the weight of the marble. For example, when a heavy marble was thrown into the bottle, the robot missed the bottle or when a light marble was thrown into the bottle, the marble did not enter in the bottle and stayed on the coin. If the magic that failed in the practice was shown again in the actual magic show, the immersion of the audience would be reduced. If the difficult second trick was unsuccessful, it would reduce the magic show's perfection. To solve problems, the robot dropped the coin between the guide and the entrance of the bottle with accurate position control (see Fig. 7(b)), but people thought that the bottle was blocked. After that, we put the marble in the bottle, which, of course, was not really blocked by the coin.

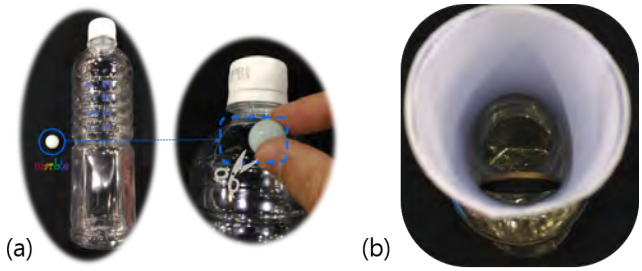


Figure 7: Magic tricks: (a) 1st trick, (b) 2nd trick

Speech Act Selection

This study was developed to enable the robot to perform a magic show that is not repeated word-for-word each time. That way, even if the audience keeps on watching the same magic show, it makes the magic show more interesting because they cannot predict the robot's next line. Users can continue to add robot personality traits and different responses. The more robot personality traits and responses there are, the more various the magic shows the robot can produce will be.

Magician Personality Traits

Before starting the show, the user sets *Robinion*'s personality based on the Magician Personality Vector (*MPV*). Each property of the *MPV* has a value between 0 and 1. *Robinion* will perform magic shows with different personality traits every time according to how the *MPV* is set up before the start of the magic show. For example, if *Robinion* has three personality traits: humor, aggression, political, the *MPV* is composed of humor(serious[0] to comedy[1]), aggression(nice[0] to aggressive[1]), and political (neutral[0] to political[1]).

- ***MPV***: [Humor], [Aggressive], [Political]

Response selection

In the magic show, the humanoid robot communicates with participants and audiences with various responses. The Response Selection Vector (*RSV*) is set to the same properties as the *MPV*'s chosen personality traits. There are various responses for each situation, and if there are more responses, various magic shows are possible. The properties of the *RSV* have a value between 0 and 1, and 0.5 is neutral. Each *RSV* is expressed as a vector of humor, aggression, and political as with the composition of the *MPV*.

- ***RSV***: [Humor], [Aggression], [Political]
  - **Sentence 1**: My dog is smarter than you.
  - **Sentence 2**: You and [Politician A] must have been in the same jerk school.

For example, in the two response sentences above, the first sentence is expressed as an *RSV* of [0.8, 1.0, 0.0] since it is quite humorous, very aggressive, and not political. The second sentence is expressed as an *RSV* of [0.8, 0.8, 1.0] because it is humorous, aggressive, and a controversial political opinion. In other words, all responses are expressed by vectors such as [Humor, Aggressive, Political], and the final response is determined by the calculation of the developed Roulette Wheel Selection (*RWS*) algorithm.

Roulette Wheel Selection

Our humanoid robot selects one response from various responses by applying the Magician Personality Vector (*MPV*) and Response Selection Vector (*RSV*) to the Roulette Wheel Selection (*RWS*) Algorithm. The *RWS* normalizes the result of a dot product of the *MPV* and *RSV* to a value between 0 and 1 to apply to *RWS*. Then, the algorithm arranges the result of the normalization using the *RWS*. The selected response is more likely to be the higher of the dot product result of the *MPV* and *RSV*. For example, a user sets *Robinion*'s personality trait to $\vec{m}$, and sets the two sentences described above to $\vec{s1}$, $\vec{s2}$ (see Fig. 8).

$$\vec{m} = [0.3, 0.8, 0.5]$$
$$\vec{s1} = [0.8, 1.0, 0.0]$$
$$\vec{s2} = [0.8, 0.8, 1.0]$$

The result of a dot product of m and s1, m and s2 is as follows.

$$Dot\ product: \ s1_d = \vec{m} \cdot \vec{s1} = 1.04$$
$$Dot\ product: \ s2_d = \vec{m} \cdot \vec{s2} = 1.38$$

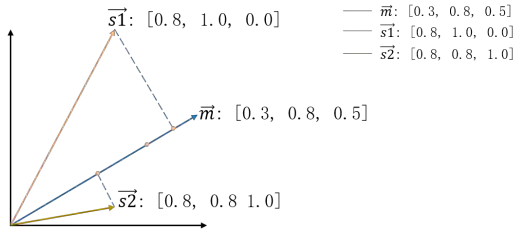


Figure 8: Dot product of MPV and RSV

Then we normalize the result of the dot product to 0 and 1 for the *RWS* as shown below (see Fig. 9).

$$Normalize: \ s1_n = \frac{s1_d}{s1_d + s2_d} = 0.43$$
$$Normalize: \ s2_n = \frac{s2_d}{s1_d + s2_d} = 0.57$$

The user cannot predict the Roulette Wheel result, but it is true that the second sentence with the higher dot product result is more likely to be selected. In this research, we developed the Magician Personality Vector, Response Selection Vector, and Roulette Wheel Selection Algorithm based on a system of probability. So our humanoid robot can perform various magic shows through the *MPV*, *RSV*, and *RWS*.

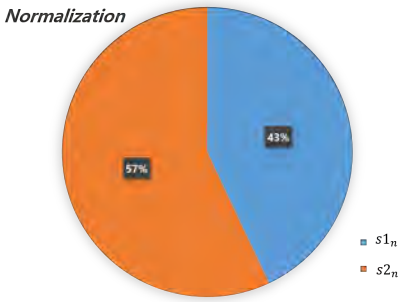


Figure 9: Normalize

Communication

Humanoid robots, which are similar to a human, are used in various performing arts such as theaters and musicals[1]. The communication in this show consists of interactions between several players. In the magic show, interaction between *Robinion* and an assistant (Jaesik) occurs visually, but interaction between *Robinion* and the audience occurs invisibly. Visible interaction is created in the direct process of sending and receiving magic tools between the magician and the assistant, and invisible interaction is generated in the process of

observation (without direct participation) of the two performers by the audience. In this study, interaction is defined to include both active interaction and passive interaction. Human Robot Interaction and Human Robot passive Interaction were defined as *HRI* and *HRpI*. Fig.10 shows the process in which *HRI* and *HRpI* occur between *Robinion*, the assistant, and the audience in this magic show.

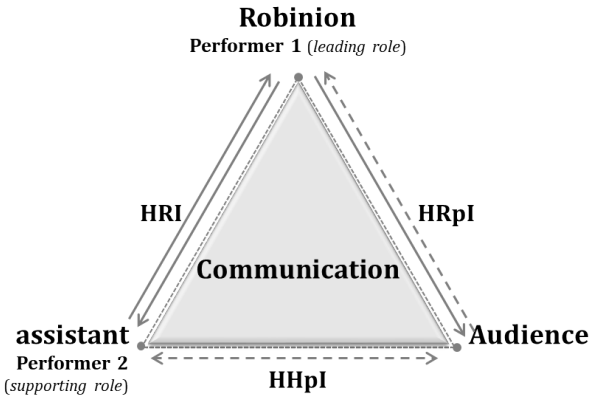


Figure 10: HRI communication block diagram

When a magician humanoid robot starts the performance on a stage, the stage becomes a special space because the humanoid robot interacts with the audience. In this space, the audience communicates directly or indirectly through sensory organs with the humanoid robot. Communication in a performance such as a magic show is a complex mixture of two elements: verbal and non-verbal communication. Fig. 11 depicts a communication model which is a process in which the audience watches *Robinion*'s magic performance. The largest rectangle in the model expresses an area in which communication takes place between the audience and *Robinion*. Our humanoid robot is a sender who sends a message in the magic show, and an audience acts as a receiver in the magic performance. Each of the areas of step1 and step2 in the model express a step where the audience receives our message while watching the magic show, this is an important aspect of what we want to deliver in the magic show. From the moment the audience enters a venue, the audience begins to communicate with *Robinion*'s message (triangular area in the model). An area of mutual understanding gradually increases after passing the message and method fields. In the model, the method in which the message is delivered is by having the magic show and communication proceed in parallel. *Robinion*'s magic performances are not interactive, and the audience appreciate the show through vision and a sense of hearing in the channel. *Robinion*'s magic performances use both verbal and nonverbal communication, and the viewpoint is part of our intention. The viewpoint is intended as a deliberately planned form of behavioral communication to influence others. *Robinion*, which transmits messages in the magic show, is a direct medium, in which the physical interaction is expressed more strongly than the communicative interaction.

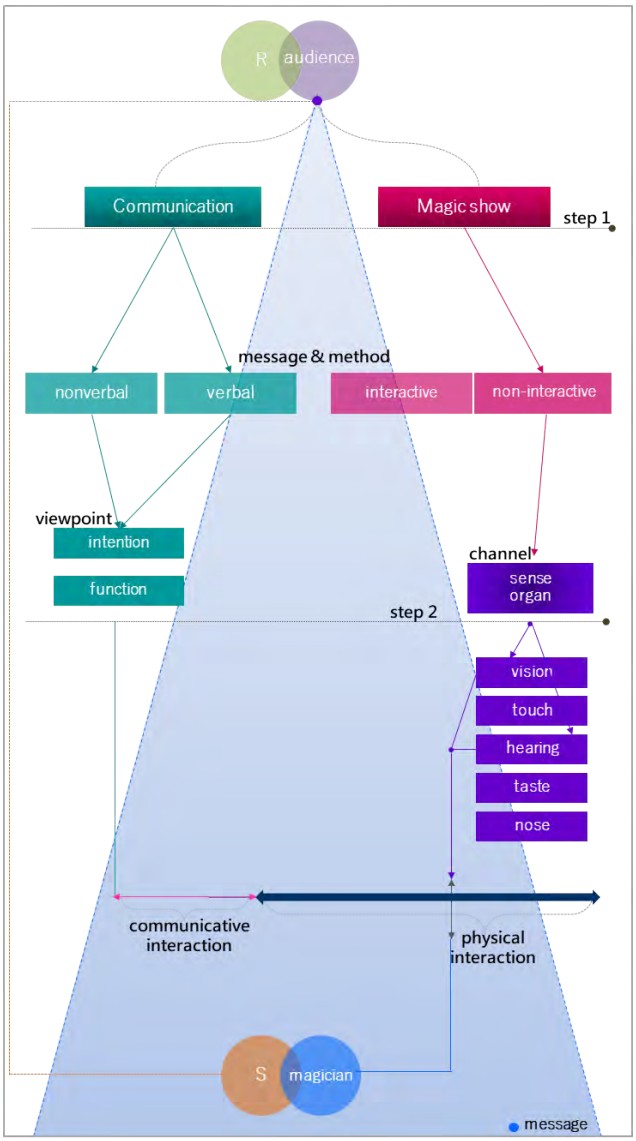


Figure 11: Robot magic show communication-model

Conclusion

In this paper, we show our research in *IROS HRAC-Robot Magic*, an international robotics competition that evaluates a humanoid robot's magic. This paper shows our research after participating in *IROS HRAC*, a global robot competition that comprehensively evaluates the performance of humanoid robot magic. It is a special experience for an audience to appreciate the magic show that the humanoid robot performs, but it can only focus on some aspects of technology. We showed *Robinion*, a humanoid robot magician with a variety of tendencies, which were included to create more interest in and appreciation of the magic show. Because the competition is a live performance for a given time, it is important to research how to express magic tricks and communicate with the audience. Our humanoid robot magician, which is not simply a robot that only works as programmed, gives us an oppor-

tunity to think about the benign interaction of humans and humanoid robots, instead of raising philosophical and other heavy questions. We achieved a good result(2nd place) in *IROS*2017 *HRAC*, but there are still a lot of things to do in the future, such as creating a scenario with a story, including active audience participation in the show, and having our humanoid robot magician be able to act independently. The motions of the humanoid robot used in the magic show operate on an open loop system, so if an external force is applied to the robot, the robot may fall down. In the future, it will be necessary to build a stable system by implementing a system that can balance by calculating the center of gravity in real time through feedback control with the *IMU* developed in the robot.

Acknowledgments

This research was supported financially supported by the Chinese Language and Technology Center of National Taiwan Normal University (*NTNU*) from The Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education(*MOE*) in Taiwan and the Ministry of Science and Technology (*MOST*), Taiwan, under grant numbers MOST 107-2221-E-003-024-MY3, MOST 107-2634-F-003-001, and MOST 107-2634-F-003-002.

References

[1] Ajay Kapur, Michael Darling, J. W. M. J. H. D. D. E. T. 2011. The karmetik notomoton: A new breed of musical robot for teaching and performance. *International Conference on New Interfaces for Musical Expression* 228–231.

[2] Hyungpil Moon, Yu Sun, J. B. S. J. K. 2017. The iros 2016 competitions [competitions]. *IEEE Robotics & Automation Magazine* 24:20–29.

[3] Jacky Baltes, Yu Sun, H. M. 2018. 2017 competitions: Magical, manipulating, mercurial robots [competitions]. *IEEE Robotics & Automation Magazine* 25:8–15.

[4] Jaesik Jeong, Jeehyun Yang, Y. O. H. K. A. S. S. S., and Baltes, J. 2018. Robocup 2018 - tdp team zstt. *2018 Robocup Team Description Paper*.

[5] Kyle J Morris, Vladyslav Samonin, J. A. M. C. L. J. B. 2018. Robot magic: A robust interactive humanoid entertainment robot. *International Conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems* 245–256.

[6] Wikipedia contributors. 2018. Coin magic. [Online; accessed 6-September-2012].

The Innovation Potential of Sensory Augmentation for Public Space

Michel van Dartel
Centre of Applied Research for Art, Design and Technology
AVANS University of Applied Sciences
Breda, the Netherlands
mf.vandartel@avans.nl

Alwin de Rooij
Department of Communication and Cognition
Tilburg University
Tilburg, the Netherlands
alwinderooij@tilburguniversity.edu

Abstract

Potential for the improvement of public space through technology is often sought in telephone applications. However, public space exists by grace of physical interaction between people and their environment, whereas smartphones often get in the way of such interaction. In contrast, Sensory Augmentation takes physical interaction as a starting point for applications. In this paper, we therefore explore the innovation potential of Sensory Augmentation for the improvement of public space. This was done by organizing brainstorm sessions aimed to yield design concepts for the application of sensory augmentation in public space. These brainstorms brought together experts in Sensory Augmentation with various stakeholders and resulted in 34 unique design concepts that addressed social interaction, play, health, navigation, and art, in public space. These concepts, for example, included a tool for the management of private space using a personal distance-to-vibration mapping, a sense for physiological changes that are indicative of hunger, and a proposal to improve the safety of 'smartphone Zombies'. On the basis of our analysis of the 34 concepts, we conclude that Sensory Augmentation holds a broad potential to improve public space. As such, our research provides a first look into this innovation potential and may guide further research on it.

Keywords

Sensory Augmentation; Public Space; Artistic Research; Interface Design; Cognitive Science; Applications

Introduction

Sensory Augmentation (SA) applies perception theory that revolves around the idea that people perceive the world on the basis of correlations between their physical actions and the changing sensory input that results from those actions. [1] Based on this principle, also non-human sensor data can be translated into signals that are compatible with the human senses, in order to increase our ability to understand the world beyond what is "naturally" possible. [2] Interfaces that enable such translations have led to groundbreaking applications in the domain of health. For example, SA applications are being developed for people with impairments of the vestibular system that translate orientation into sound or convert image into stimulation of the tongue, providing a new sense of balance. [3] Another example, *The Enactive Torch*, is a flashlight-like box that translates the signal from a remote sensor into vibration of the box. [4] Moving this 'torch' offers the experience of 'seeing with your hand', which has been shown particularly useful for people with visual impairments. Despite successful health applications, the innovation potential of SA for other domains has barely been explored.

Public space design, the design domain that focusses on the development of places that are accessible and open to people, may provide such an application domain. Public spaces are continuously (re)developed in response to many different and changing challenges; from improving our sense of security to encouraging young people to exercise. While many of these challenges are nowadays addressed using smartphone applications, these devices have a difficult relationship with the core value of public spaces; the facilitation of physical interaction between people and their environment. In contrast to most software applications running on smartphones, physical interaction between people and their environment is the starting point for the design of SA applications. As such interaction is abundant within it, it seems that a wide range of possible applications is conceivable in the domain of public space design especially. This leads us to take a first look at the research question: *What is the innovation potential of Sensory Augmentation for the design of public space?*

To explore this research question, we have conducted a first inventory of potential applications as part of an ongoing collaboration between four partners: a specialist in IT applications for public spaces, a university of applied sciences and a research university that conduct collaborative practical and scientific research into SA, and a cultural organization specialized in interdisciplinary approaches to production and presentation.

Method

On July 4, 2018, an *interdisciplinary* group of *experts* and *stakeholders* was brought together at V2_ Lab for the Unstable Media, Rotterdam, NL, to explore the innovation potential of SA for the design of public space.

Interdisciplinary Approach

Previous research has shown that exploration of the innovation potential of SA can benefit specifically from collaboration in interdisciplinary groups that include artists and scientists. [5, 6] This is because "creative research practices emphasize the role of personal or subjective experiences", whereas "in the sciences … the subjectivity that accompanies experience is usually seen as an undesired variable that is to be controlled rather than enhanced" to obtain generalizable knowledge, [7] p. 90. Knowledge obtained through these different methods can complement each other, providing a broader basis from which to develop creative and innovative ideas. [6] Participants for the present study were selected on the basis of these assumptions.

Participants

Experts. Each partner in the ongoing research was represented by one lead researcher whom together invited four experts on the topic of SA to participate in the workshop. Just as the lead researchers, these experts all had previous experience in the application of SA. *Stakeholders.* Collaboratively, the experts identified stakeholders in several public space design challenges. These included an academic specializing in urbanism, a municipality policy developer, an artist duo specializing in interactive public artworks and a company developing interactive systems for play in public space.

Format

An introduction to the theory and practice of SA and its innovation potential by two lead researchers preceded a sequence of five parallel brainstorming sessions on specific challenges within the domain of public space. Each parallel session lasted one hour, and consisted of three groups with randomly assigned experts and stake holders. The challenges selected were based on the backgrounds of the experts and invited concepts that would facilitate or stimulate innovative forms of 1) play, 2) social interaction, 3) health, 4) navigation, and 5) art - within public space and incorporating the principle of SA. Each challenge was introduced by an expert at the start of each brainstorm, including the demonstration of an application relevant to the challenge and used as a starting point for the brainstorm. The brainstorms were moderated by two of the four lead researchers, who gave brief impulses in each of the five parallel discussions to steer the discussion towards design concepts for the application of SA in response to the challenge. Each group was urged to deliver at least one design concept at the end of each brainstorm; the maximum number of concepts was undefined. The resulting concepts were subsequently hung from several washing lines, after which they were presented and discussed in plenary. After the brainstorms, an evaluation of the concepts took place in which each participant was provided with five sticky notes; each note representing one point to award to (stick on) the design concepts that they felt held the largest innovation potential for SA in public space.

Data Processing

For the analysis, redundant concepts were removed from the sample (n = 7). For example, if a concept using the same SA application to support tennis training and another was to us it for soccer training, this would be counted as redundant. This enabled a first look at the overall innovation potential of SA in public space. Consensual assessment was used by the two lead researchers to develop a hierarchy of design concepts. That is, concepts were grouped into primary and secondary application domains (e.g., if a primary domain is "art" a secondary domain could be "narrative"). This allowed further analysis to pinpoint where (in what sub-application domains) SA may have a particularly strong potential for innovation. Moreover, consensual assessment was used to check what concepts adhered to SA principles. This was used to support the validity of the results. Finally, concepts that were awarded more than three points by the experts and stakeholders were classified as having "potential for innovation"; concepts awarded more than zero but less than three were classified as having "possible potential for innovation"; whereas concepts awarded with zero points were classified as currently having "no potential for innovation". This categorization provides further specification of what potential for innovation SA holds for these application domains.

Reporting and Documentation

Notes of the presentations and discussions were taken by a dedicated reporter (Figure 1) and formed the basis for a written report. [8] Photo-documentation was made of all the resulting design concepts, including the points that were awarded to them by the participants.

Figure 1. The reporter takes notes of a brainstorm. ©Kris Vleugels.

Results

The workshop yielded 34 unique design concepts for the application of SA for public space. (Figure 2) The concepts could be grouped into five primary application domains: 1) play (n = 6), 2) social interaction (n = 3), 3) health (n = 7), 4) navigation (n = 10), and 5) art (n = 8).

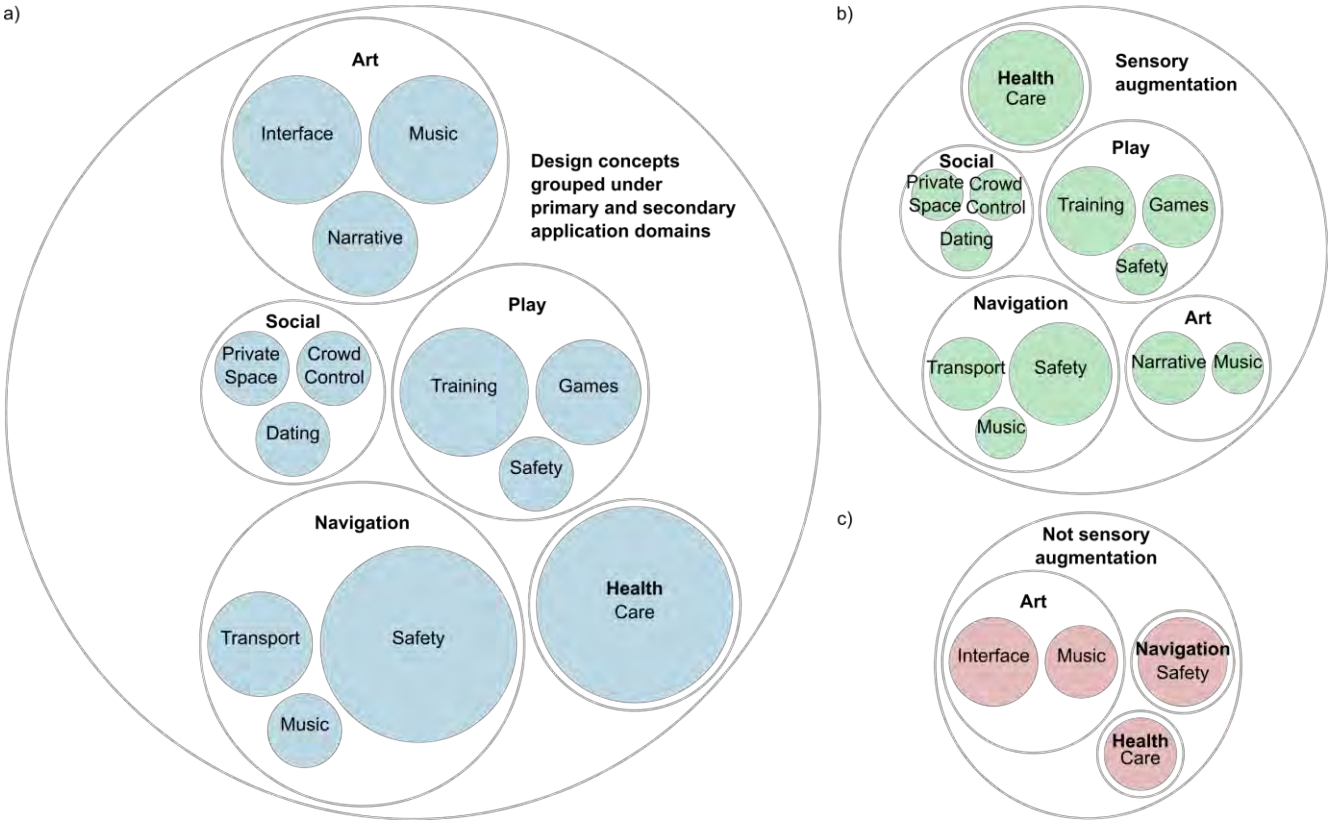


Figure 2. Visualisation of the amount of unique design concepts a) organised by their primary (bold) and secondary application domains, which b) incorporated SA principles, or c) did not incorporate SA principles.

Primary and Secondary Application Domains

Within each primary application domain, more specific secondary application domains could be identified, suggesting a broad range of application domains that can be innovated on the basis of SA principles.

Design concepts for *play* indicated a potential to innovate training (n = 3), games (n = 2), and safety (n = 1). These included augmented sports training, e.g., by using a movement-to-tactile mapping to help learn the optimal movements needed to kick a ball into an intended direction, and augmented game play, e.g., by equipping soccer players with a 360° movement sense via a Doppler-to-sound mapping so that members of an opposite team could be sensed from all directions. All concepts for *play* incorporated SA principles.

Design concepts for *social interaction* indicated a potential to innovate the management of private space (n = 1), crowd control (n = 1), and dating (n = 1). These included augmentation of sensing private space in 360° (Figure 3a) by using a distance-to-vibration mapping that indicates when someone is within your private space range (which could be made dependent on a user's orientation relative to other people), augmented crowd control by using a distance-to-vibration mapping to choreograph movements within large masses, and augmented sensing of potential partners by a physiology-to-magnetic pull mapping that generates an actual physical pull depending on physiological measures of attraction. All concepts for *social interaction* incorporated SA principles.

Design concepts for *health* all related directly to potential innovations in health care (n = 7). These included using augmented posture sensing via a position-to-vibration mapping to support attaining a correct posture as part of physical therapy, prevention on apathetic states via a combination of physical inactivity sensing and subsequent activating feedback, and support of eating habits in dementia care by sensing physiological changes that are indicative of hunger to subsequently present eating inducing stimuli (Figure 3b). The specific aim of the latter two concepts was to support elderly to be able to take care of themselves longer. Of the seven generated concepts for *health*, two did not incorporate SA principles.

Design concepts for *navigation* referred to potential innovations for improving safety (n = 7), as well as transportation (n = 2) and choosing musical experiences at festivals (n = 1). These included augmenting the ability to sense obsta-

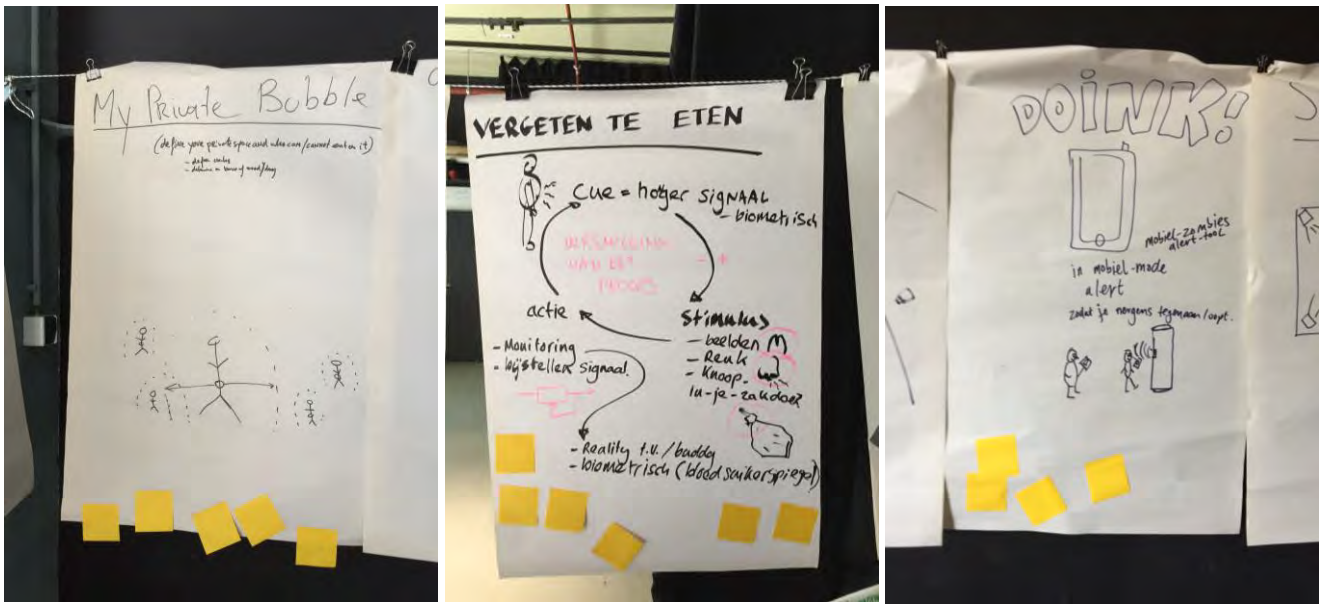


Figure 3. Three examples of design concepts; for a) *social interaction,* suggesting a potential to innovate the management of private space using a distance-to-vibration mapping is awarded five 'points' b) *health*, in which sensory augmentation is applied to dementia care by sensing physiological changes that are indicative of hunger and subsequently presenting eating inducing stimuli, and c) *navigation*, improving the safety of 'smartphone Zombies' by augmenting the ability to sense obstacles outside the user's attentional scope and is awarded four 'points'. ©Michel van Dartel

cles outside the user's attentional scope on the basis of a distance-to-object-to-vibration mapping that indicates an object in the user's path while attention is focused on their mobile phone (benefitting the safety of 'smartphone Zombies' during navigation through cities (Figure 3c)); and augmenting a user's sense of hearing via an orientation-to-live music mapping that enables users to orient themselves toward a podium at a festival by hearing the music that is playing there while navigating toward it. Of the seven concepts for *navigation*, two did not incorporate SA principles.

Design concepts for *art* in public space suggested a potential to innovate the construction of narratives (n = 2), music making (n = 3), and interfaces (n = 3). These included using SA principles to construct a novel way to navigate a narrative by mapping variable input (such as heart rate, location, time of day) to media fragments and the use of such variable input to play a musical composition in a way mapped to the ongoing weather conditions. As such, SA principles appeared to enable more situated and situationally aware forms of art in public space. However, important to note here is that of the eight concepts for *art* in public space, most concepts for music making (n = 2) and all of the interfaces (n = 3) did not incorporate principles of SA.

Expert and stakeholder evaluations

The ratings of the experts and stakeholders of the design concepts provides further indication regarding interesting starting points for making the innovation potential of SA for public space a reality (Figure 4).

As concepts categorized as having a possible potential for innovation (n = 11) or having no potential for innovation (n = 9) included concepts from each primary application domain, the evaluations indicated that design concepts from all primary application domains held a potential for innovation (n = 6), albeit to a lesser extend for the domain art. In particular, a potential for innovation was attributed to concepts focused on *navigation safety* (n = 2), for humans, i.e., augmented sensing of temperature in order to navigate the coolest route on a hot day, and for animals, i.e. location-aware conditioning of virtual borders with the aim to maintain a desired level of biodiversity; *Health care* (n = 2), focused on supporting elderly to self-care longer, i.e., via the prevention of apathetic states and supporting eating habits through SA; *Play and sports training* (n = 1), i.e., by means of a suit that uses vibrations to give a user error feedback on their posture and movements during work-outs; and *Social interaction* (n = 1), via the augmentation of sensing private space in 360°, enabling new ways to manage private space.

Some design concepts also received profuse criticism from the experts and stakeholders during the plenary discussions and, resultantly, received zero 'points' at the end of the workshop, indicating no current potential for innovation. These concepts were rated as such because these were considered either not feasible, e.g., the concepts for augmented crowd control that used a distance-to-vibration mapping to choreograph movements within large masses, or not original, e.g., a device that conveys orientation during scuba diving. This is noteworthy because neither a lack of feasibility

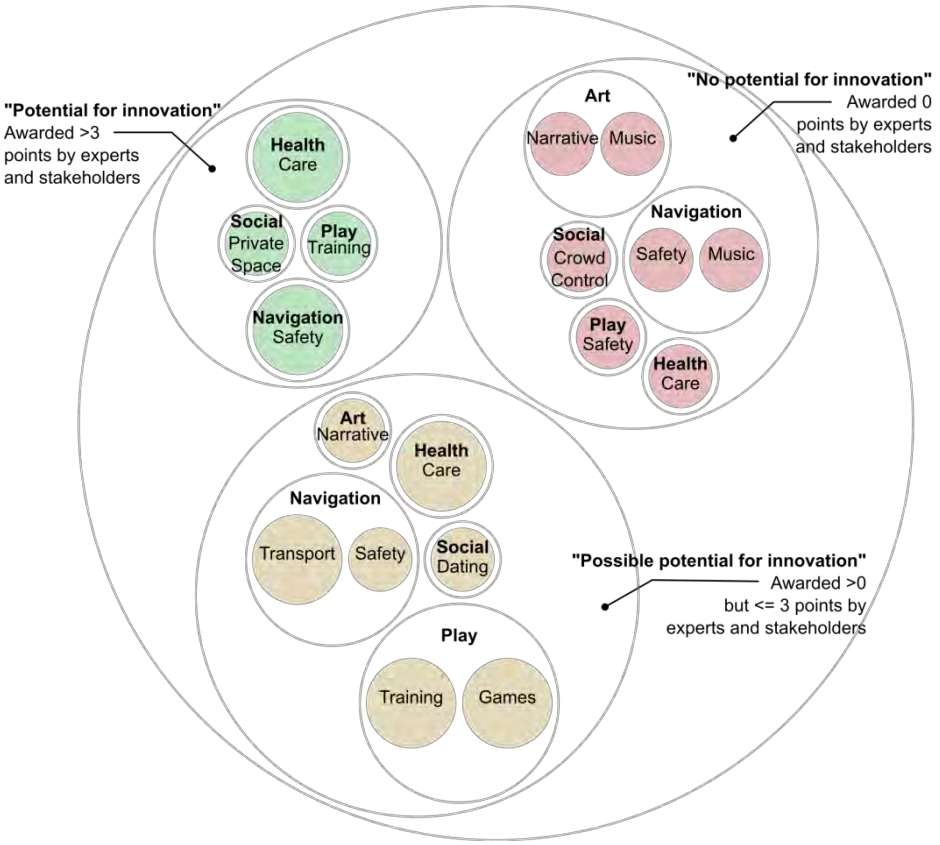


Figure 4. Visualisation of the amount of unique design concepts that incorporate SA principles organised by expert and stakeholder ratings for their innovation potential.

or novelty excludes the possibility of the concept having innovation potential in the longer term.

Overall, these findings underline the observation that there is a broad range of possible design concepts that hold potential for SA in the improvement of public space.

Discussion and Conclusion

The present study provides a first look at the innovation potential of SA for the improvement of public space. The results presented above support previous research suggesting an innovation potential of SA for the domains of play, social interaction, health, navigation and art. For all of these five domains, our findings suggest that public space should be an area of particular interest to researchers and developers exploring this potential. There, the physical interaction between people and their environment that SA require is abundant, giving rise to a wide range of possibilities for its application.

Our results also identify various secondary application domains that hold innovation potential for SA *within* the five primary domains of health, navigation, play, social interaction and art. These secondary domains may help to guide the ideation of new applications within the primary domains, including those domains of which the innovation potential for SA has already been established. For example, while the innovation potential of SA in navigation applications is already being explored, [3] our study indicates that this potential may particularly benefit navigation in public space that is based on music or that addresses transportation or safety challenges. Such an additional level of specificity in guiding the ideation and exploration of SA applications may help in 'matching' the potential of SA with existing challenges.

Another finding is that ideation with respect to the implementation of SA, with the exception of the domains of play and social interaction, sometimes leads to concepts that do not make use of SA principles. Speculatively, this may indi-cate that these domains may be more challenging to apply SA to or that other, non-SA, concepts are more tempting to apply within these domains. Alternatively, this deviation from SA principles could be explained by the fact that the domains of play and social interaction were addressed in the first two parallel brainstorms, while participants may have experienced fatigue, and resultantly may have been less focused on SA principles, in later brainstorms. These deviations from SA principles were not addressed during the discussions to facilitate the creative thinking process, since ideas that initially do not make the brief may inspire other innovative ideas later on.

Furthermore, the expert and stakeholder evaluations of the design concepts give rise to the finding that the domain of art may hold less potential for innovation than domains such as play, social interaction, health, and navigation. Of course, the sample size used in this study is not sufficient to draw generalizable conclusions from. Arguably, SA has already been incorporated within a number of (public) works of art (see [9] for a review). This finding therefore, albeit indirectly, suggests that it is more difficult to innovate on the basis of SA within the domain of art because its potential for public space is already being explored within this domain. If so, then this aligns with research that suggests that artists should play a role in the innovation process when SA is applied due to their specialized knowledge of the subject. [5, 6] So, rather than innovating the domain of art itself, artists should be involved in innovating other application domains on the basis of SA.

In conclusion, the presented research contributes that the use of SA to improve public space holds a broad potential for innovation. In particular for innovating play, social interaction, health care, navigation, and possibly also for art in public space. As most of these domains are largely unexplored both scientifically and practically, this study provides a starting point for, and guidance in, the application of SA principles for the improvement of public space.

Acknowledgements

The research reported in this paper was financially supported by the National Taskforce Applied Research and the Netherlands Organisation for Scientific Research (KIEM.CRE.03.005).The authors are grateful for the assistance of all partners involved in the consortium, which include V2_ Lab for the Unstable Media and KITT Engineering.

References

[1] J. Kevin O'Regan. *Why Red Doesn't Sound Like a Bell: Understanding the Feel of Consciousness.* (Oxford: Oxford University Press, 2011).

[2] Árni Kristjánsson, Alin Moldoveanu, Ómar I. Jóhannesson, Oana Balan, Simone Spagnol, Vigdís Vala Valgeirsdóttir and Rúnar Unnthorsson, "Designing sensory-substitution devices: Principles, pitfalls and potentials," *Restorative neurology and neuroscience* 34:5, (2016): 769-787.

[3] Sachar Maidenbaum, Shelly Levy-Tzedek, Daniel Robert Chebat, Rinat Namer-Furstenberg and Amir Amedi, "The effect of expanded sensory range via the EyeCane sensory substitution device on the characteristics of visionless virtual navigation," *Multi-Sensory Research* 27:5-6, (2014): 379-397.

[4] Tom Froese, Marek McGann, William Bigge, Adam Spiers and Anil K. Seth, "The enactive torch," *IEEE Transactions on Haptics* 5:4, (2012), 365-375.

[5] Alwin de Rooij, Michel van Dartel, Antal Ruhl, Hanna Schraffenberger, Bente van Melick, Mathijs Bontje, Mischa Daams and Michel Witter, "Sensory Augmentation: A Dialogue between the Arts and Sciences," in *Proceedings of the 6th International Conference on ArtsIT, Interactivity and Game Creation*, (2018): 213-223.

[6] Antal Ruhl, Alwin de Rooij and Michel van Dartel, "The Artistic Potential of Tactile Vision Interfaces: A First Look," in *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction*, (2017): 73-79.

[7] Michael Biggs and Henrik Karlsson, *Research in the Arts* (New York: Routledge, 2012).

[8] Arie Altena. "Expert Meeting Sensory Augmentation in Public Space" CARADT.com. https://lectorate-nakvstjoost.files.wordpress.com/2018/10/bijeenkomst-saps-v2_04072018.pdf (accessed November 27, 2018).

[9] Madeline Schwartzman. *See yourself sensing. Redefining human perception.* (London: Black dog publishing, 2011).

Authors' Biographies

Michel van Dartel is Director of V2_Lab for the Unstable Media and Research Professor at the Avans Centre of Applied Research for Art, Design and Technology (CARADT). He holds an MSc in cognitive psychology and a PhD in artificial intelligence. Alongside his work at V2_ and Avans, Michel also acts as an independent curator for art venues such as Tent, Mu and Tetem and biennials such as the Dutch Electronic Art Festival. He is an advisor to the Netherlands Organisation for Scientific Research; a member of the professional boards of the Piet Zwart Institute and Willem de Kooning Academy; a supervisory board member for the Fiber platform, a council member for DutchCulture | TransArtists; a manuscript reviewer for Leonardo; and the editor and author of numerous scientific and artistic articles and books.

Alwin de Rooij studies creativity: The thinking processes that make the creation of new, useful, and elegant ideas, solutions, and products possible. He uses scientific and artistic methods, where emerging technologies are used study creativity in new ways; and from which he develops techniques that enhance creativity. The ultimate goal of his research is to understand creativity better so that we can help people to get the most out of their own capabilities. Alwin is assistant professor at the Department of Communication and Cognition, Tilburg University, and teaches at their New Media Design program. He received a PhD in Creativity Science from City, University of London, an MSc in Media Technology from Leiden University, and a BFA in autonomous art from the ArtScience interfaculty of the Royal Academy of Art and the Royal Conservatoire, The Hague.

From here to eternity: Experimental and creative approaches to collecting and distributing new media art within regional arts organisations

Georgia Smithson

The University of Sunderland, Faculty of Arts and Creative Industries, St. Peter's Campus, St. Peter's Way, Sunderland, Tyne and Wear. United Kingdom. SR6 0DD

georgia.smithson@research.sunderland.ac.uk

Abstract

This paper is an overview of preliminary research undertaken for the creation of a framework for collecting and distributing new media art within regional art galleries in the U.K. From the 1960's practitioners have experimented using computers, and the art-form has evolved into multiple strands of production, presentation and distribution. But are we, as collectors, researchers, artists and enthusiasts facing an uncertain future concerning the integration of new media art into institutional cultural organisations? Recently, concerns have been raised by curators regarding the importance of learning how to collect new media art if there is to be any hope of preserving its past. A fear of the unknown of experimental models of curatorial activities such as collecting, preservation and documentation appear to be a barrier to some mainstream, university and municipal galleries when acquisitioning or commissioning new artworks into their collections, while methods of distribution using new media platforms are still at a very experimental stage. This paper explores that by collaboration, experimentation and the sharing of knowledge and resources, these concerns may be conquered to preserve and make new media art accessible for future generations to enjoy and not to lament over the obsolescence of what it once was.

Keywords

New media art, collecting, documentation, distribution, access, collaboration, experimentation, innovation, networks

Introduction

The introduction of the catalogue that accompanied the pioneering *Cybernetic Serendipity* international exhibition from 1968, curated by Jasia Reichardt, reveals how far technology has progressed in almost fifty years: '*Cybernetic Serendipity* deals with possibilities rather than achievements, and in this sense is prematurely optimistic. There are no heroic claims to be made because computers have so far neither revolutionised music, nor art, nor poetry, in the same way that they have revolutionised science'. [1] However, those 'possibilities' noted by Reichardt have evolved into achievements and mobile technology that could only be imagined and portrayed in the context of science fiction all but fifty years ago; the use of computers and networks have allowed for mass distribution and seemingly endless possibilities

Artists, 'influencers' and art enthusiasts utilise websites and social media platforms as online galleries for the promotion, presentation and distribution of new media art affording a huge audience reach. (Deviantart, rhizome.org, Olia Lialina's *artteleportacia.org)*. According to statistics website *Statista.com* it is projected that by 2020 there will be almost three billion users of social media creating global media culture, whether that be sharing images, blogs, music or art online. But what would happen to this ongoing documentary of the world community if social media sites decided to call it a day or Google ceased to exist? The thought process, artworks, documentation and reviews of artistic creations and collaborations would be lost unless they were stored on a hard drive or memory stick in the possession of a collector (either accidently or purposefully). With consumers becoming ever-more dependent and aligned to all things networked and digital, which of course makes for easily accessible distribution channels, it is imperative for galleries and institutions to be unafraid of the integration of new media art into their programming and collections to engage with both physical and digital audiences. Although it is generally acknowledged that the medium does pose numerous challenges to curators and exhibition staff, the omission of new media artworks in recent art history books has more than highlighted this issue.

Through the collaborative work of researchers and curators such as Beryl Graham and Sarah Cook, co-founders of CRUMB, (*Curatorial Resource for Upstart Media Bliss*), forward thinking curators Steve Dietz and

Christiane Paul, artists Cory Arcangel and Casey Reas and arts organisations, such as the V&A and the Guggenheim, there is an awareness of new media art within contemporary and traditional art organisations which has led to experimental models of curation and collecting. As Graham accurately points out 'One of the significant differences between new media and other kinds of art is that the same set of new media are used for both the art itself and the interpretation, exhibition or collections management.' [2] These notable differences can be a cause of concern for the purposes of documentation to preserve the artworks' longevity. However, research undertaken by organisations such as the *Variable Media Network* and *DOCAM* aim to combat these concerns. The intention of the *VMN* is 'to establish a process and means to address artworks created across a variety of media and materials, to determine protocols and initiatives that will bring a flexible approach to the preservation of a range of creative practices'. [3]

After considering acknowledged key issues of curatorial activities associated with new media art, this paper will examine recent, cost effective, experimental and alternative models of collecting, documenting, distribution and preservation from an interdisciplinary perspective, by mainstream and grassroots organisations, with the intention of banishing the myths that it is problematic, costly and unworthy of collecting. Cultural institutions cannot afford to ignore new media art as it will alienate their future, technical-savvy visitors and curb the reach of their virtual audience. Although some regional institutions seem to struggle with even the subject of new media art, artists and some curators are finding ever more innovative approaches to curatorial activities by trial and error which will be examined later in this paper. Artists are aware of their audience demographic and take advantage of the often free, digital and online channels and platforms available. Occasionally even the method of distribution is an integral concept of the artwork. In order to understand the integral components that the curation of new media art entails, I will break them down into four sections for the purpose of this paper: Distribution, documentation, preservation and collecting.

Experiments with creative and innovative models of collecting and distribution with Northern Gallery for Contemporary Art will further the analysis of this research. NGCA is a small regional gallery in the North East of the U.K. with a focus on commissioning and exhibiting while collecting works from exhibiting artists. NGCA will stand to benefit from this research with the aim of developing distribution networks, keeping costs to a minimum, and a clear collecting remit written within the collections development policy.

Curatorial Key Issues

Factors that raise concerns prior to addressing outdated collecting remits and Collections Development Policies specific to new media art within regional galleries include:

- Conservation
- Maintenance
- Obsolescence of technology
- Taxonomy/ classification
- Technician-ship
- Museum practice versus artistic ideals

It is accepted that the characteristics and behaviours of new media art can be many and varied, unpredictable, surprising and challenging to work with. The rethinking of curatorial activities has been examined by Graham and Cook, (2010) *Rethinking Curating: Art After New Media,* Ippolito and Rinehart, (2014) *Re: Collection, Art, New Media and Social Memory,* Paul, (2003) *Digital Art* and Hope, C. and Ryan, J.C., (2014) *Digital Arts: An Introduction to New Media.* While Graham and Cook view the challenges as opportunities to rethink curatorial practices and explore the characteristics peculiar to new media art, Ippolito and Rinehart investigate three threats to preservation: technology, institution and law, and calculate how each can assist in preservation rather than destruction.

Distribution

With so many diverse and distinct methods of distribution it could be considered that the way in which artworks are made accessible is part of the making process and central to the artworks' integrity. While researching means of distribution that could be utilised by NGCA, creative and cost-effective models have been identified, such as the *MulengaMojis* which digital artist Emily Mulenga employs. This model takes up no physical space -an important factor for an emerging artist as it is cost- free. (Ironically her 2017 *Firstsite* exhibition was titled *Taking Up Space*). She makes her new artworks accessible for one hour to allow collectors to download using Vimeo, Drop Box and Weshare. Does this limit the reach or make them more attractive to collect as they have a limited availability?

An alternative economical approach of distribution is operated by little man, based in Liverpool, U.K. who borrows space for non-exhibitions. That is to say that artist

exhibitions are installed, documented and taken down in a single day without ever opening to the public, they can only be viewed through the littlemangallery.com website or by using Instagram. Created by Gabrielle la Puente and Michael Lacey, little man allows artists and curators to develop their practice in an exhibition context without burdening themselves with the logistics of accessing and opening spaces, or the unnecessary social pressures common to artist-led activity. Their belief that engaging with art online is now common practice and that many art enthusiasts view exhibitions on the internet as opposed to physically visiting an exhibition. This in itself finds artists most engaged and supported by their audience within their social media following. Cynically this could be perceived as giving up on the physical art experience. Or is it making the artist and their work more accessible when they would not have ordinarily been given the opportunity to stage a physical exhibition? This model allows for a high turnover of artworks to be displayed and thus made accessible.

Due to the little man model's advantage of quick and logistically light installation, programming for a similar model within the physical gallery space at NGCA is being undertaken, where an audio visual 'drum' or viewing module can be utilised for the display of one artwork at a time. As it has multi-purpose functionalities for viewing AV works and pre-installed projection equipment, NGCA has the advantage of quick installation. The aim is to make new media artworks from the NGCA collection accessible for short periods of time with supporting publicity using their social media platforms, while considering the reproduction rights of the artist. Some artists are open to their works being publicised using these platforms but there is a risk that the works can be manipulated and then distributed while the original intent of the artist is lampooned, or completely diminished. The *MulengaMoji* model will be considered with the intention of making the artworks from the collection accessible to an online audience. Engagement will be captured and analysed to assess its suitability for the distribution of artworks from the NGCA collection.

Digital distribution does not come without challenges. How far can the artwork be replicated? Can it be altered? Artists such as Corey Arcangel positively encourage the replication, modification or manipulation of their works while others such as Phil Collins insist on the exact specifications of display and situation as originally prescribed by him, the artist. While some believe it to cheapen the integrity and monetary value of their work, for others, distribution is an integral component of their work: Seth Price, in his artwork *Dispersion* (2002-), which takes the form of an historical essay, considers that there must be evidence or knowledge of an artwork in order for it to be considered art, therefore without a method or methods of presenting to an audience, how could an artwork be classified as such without ever being viewed?

The Museum of London recently ventured into a new model of exhibition distribution by collaborating with London based grassroots art collective furtherfield. The 2017-18 exhibition *City Now, City Future* staged at the Museum was the result of a collaborative project with furtherfield whose focus is on arts and media community involvement projects. By working reciprocally with an organisation who have the relationships, tools and knowledge in place to distribute artworks digitally, the Museum of London benefitted as they reached a new audience rather than that of the physical museum visitor or snippets of the exhibition being uploaded to the institution website. Furtherfield also promote knowledge distribution between institutions by working with a new stream of curators who then go on to work in mainstream institutions. From a researcher's perspective, it would be interesting to investigate the effect this has on the modes of curation of mainstream institutions as to whether the new curators with 'grass roots' training use their experience to engage with an audience not usually connected with a more 'formal' organisation. When compared to the training fledgling curators experience when working with organisations such as furtherfield, commercial gallery owner, Jonathan Carroll, states that he sells to the art institutions which tend to be more adventurous in their approach to collecting. He also acknowledges that the approach of some institutions has changed dramatically. He credits this to the new tranche of institutional curators who have grown up with digital technology and art and therefore a natural choice for new acquisitions. The Stedelijk Museum, Amsterdam, is currently researching ways into making the collections accessible by the use of new mobile media. While this appears to be a relatively new experiment for institutions, artists already employ these sustainable and far-reaching methods. Institutions may take note of artists like Emily Mulenga and her *MulengaMojis* from 2012 to experiment with innovative distribution methods by the use of new media.

The new media art world has many emerging artists, therefore regional galleries with modest budgets can give 'first showings' and buy cheaply (for example, NGCA afforded Cory Arcangel his first single, UK show in 2007). Software-based artworks can easily be distributed or loaned out without the logistical headaches of shipping costs, expensive insurance and complicated assembly instructions. This ease of mobility allows for international networks to be established and utilised to the benefit of the artist and galleries alike.

Preservation strategies

While it is acknowledged that new media art is commissioned, created and exhibited (the genre features in more than one hundred specialised festivals and two hundred biennales internationally) it has not made significant inclusion into the collections of museums, galleries or private collections. One of the anxieties of curators is how to preserve not only the artwork which can be process oriented, time-based and networked, but the ever evolving hardware that is integral to the work. As Andrea Lissoni, Senior Curator of International Art (Film) at Tate, illustrates: 'In a digital landscape the environment is made of data, and how we preserve these data is a big question. This is going to be a big challenge, because so many works are now conceived as a part of something that changes'. [4]

To try and combat the 'big challenge' addressed by Lissoni, experimental preservation techniques are being tried and tested by means of case studies on artworks belonging to the Guggenheim Collection by the *Variable Media Network*. To understand the needs of each artwork, each physical component becomes a case study which is broken down into four main strategies of preservation:

- Storage and collecting *hardware*
- Emulation *recreation of operation systems- NOT the artworks itself*
- Migration *is it possible to present on an alternative platform?*
- Reinterpretation *is it possible to transfer to an alternative technological framework?*

The approach invites creators to imagine how an artwork might be translated into a new medium in the future once its current medium expires and to define their work independently from the medium, thus promoting the longevity of the artwork. The migration and reinterpretation strategies could prove problematic, as the original intent of the artist must be carefully considered as the 2013 publication, *Preservation of Digital Art: Theory and Practice* warns*: '*And neither should the works be "improved" technically or aesthetically. They should retain their original work character, behaviour, and aesthetics for as long and as faithfully as possible, and in doing so be testimony to the epoch and the conditions in which they were created'. [5]

By testing and sharing the results of artworks with varying behaviours, comparisons can be made against those with similar behaviours to promote a future for artworks not previously tested in this way. This demonstrates that although the solution to preservation appears at first complex and daunting, by working methodically through each issue, solutions can be found and documented for future use. By working alongside the creator or artist, museum and media professionals can imagine potential futures for artworks to successfully be integrated in to a collection using tried and tested methods.

Documentation

Archival specialist, Annet Dekker, sums up the position most curators are faced with in her 2014 paper *Assembling traces, or the conservation of net art:* 'Artists and museums are trying to document or conserve net art. In spite of all these efforts the reality is that many net artworks have already been deleted by their creators, are dysfunctional due to out-dated software and network changes, or are unable to perform because of incomplete hardware or hardware that has become obsolete'. [6] As the characteristics of a new media artwork are variable and not permanent or fixed, identifying the work's behaviours and strategies can assist curators and conservators in advancing the preservation of the work.

Even wall labels have recently become a bone of contention; due to the minimal amount of disruption they are intended to cause the nature of their singularity is detracting from the intensive labour, collaboration, technician-ship, and programming from a whole team that contribute to the finished product, rather than the noting of one artist name. Along with Andrea Lissoni's observation on the environment of data and how to preserve it, *Variable Media Network* Co-ordinator, Jon Ippolito, was so concerned about the negative influences of the supposedly innocuous wall label that he waged war with them in his 2008 article *Death by Wall Label* warning 'The gravest threat to the cultural survival of new media art may very well be its wall label' [7a] arguing that the fixity that a wall label imparts, for digital culture, means death. Ippolito reinforces this point by stating 'It is important to convey the behaviour of these works, rather than their material, in wall label or caption…nevertheless, this shorthand should be able to telescope when more detail is required, with the understanding that the second part of the medium line may vary with the version of the work'. [7b] Whereas the accepted norm is to use wall labels, former art museum director, Rudi Fuchs chose to show only the name of the artist and the year in which the artwork was made for his 2017 exhibition, *Excitement,* of Dutch contemporary artists at the Stedelijk. His decision was motivated by the desire for visitors to view at their own pace and have the freedom to get a feeling for the artworks themselves, not to make sure the label matched the artwork and then move on as is so often the case. Fuchs also believes the artworks do not need a title as many of them are untitled anyway.

The difference between the accompanying documentary labels while viewing an artwork and the documentation required for behind-the-scenes curatorial necessity are distinctively contrasting. A key member of the *Variable Media Network*, curator and conservationist,

Caitlin Jones, argues that the centrality of documentary evidence when writing history is invaluable. Her 2008 paper *Surveying the state of the art (of documentation)* states 'Documents related to an artwork can provide us with invaluable information about the production, provenance, exhibition and evolution of the work throughout its life and into the future, and curators, conservators and other researchers rely on it heavily'. She goes on to explain '…because it provides information such as the original technological context or artist's intent, it's unfortunate that due to a lack of consistent documentation in the past, we know far too little about many of the landmarks works of new media.' [8] So, regrettably, while they are not trained to check for the presence of integral components of the artworks, condition checkers will search for flaws in the artworks.

By the use of factual and evaluative documentation, complete checks can be made to reassure curators of preservation strategies for individual artworks. During a residency at the Daniel Langlois Foundation in 2007, Jones and media arts specialist, Paul Kuranko, surveyed the many documentation models currently use individual case studies of individual artworks, including physical models proposed by the *DOCAM (Documentation and Conservation of the Media Arts Heritage*) Project and theoretical models raised on the CRUMB Discussions List. Although it was never the intention to propose a new model, the *Variable Media Questionnaire* used a questionnaire to gather information from artists and by conducting a series of documentation case studies three distinct phases of documentation were identified:

- Collection and Creation- *data gathered on the conceptual, technical and experiential nature of the work*
- Arrangement- *the structure of the archival arrangement of the work*
- Description and Access- *components of artwork and the relationship to the collection as a whole and how the work can be accessed physically or digitally*

As NGCA is continually commissioning and collecting artworks, the intention is to work with the artists from the idea to exhibition stages to document all of the above factors while:

- Agreeing at the time of commissioning who has the rights to display, market and reproduce the artwork
- Documenting interviews with the artist regarding the key issues listed earlier
- Documenting the intention of the artist and behaviours and integrity of the artwork so it may not be reproduced or mutated
- Capturing images of installation, equipment, components
- Documenting interviews with collaborators, technicians and third parties
- Compiling data and instructions on manuals and instruction

Collecting

An excellent starting point and another example of the case study approach of experiments and collaborations between collecting institutions, arts agencies and artists is the Harris Museum and Art Gallery, Preston, (UK) whose collections include fine art, costume, textiles and archaeology. The Harris is a local authority museum and art gallery which collaborated with a local arts charity to produce *Current: an experiment into collecting Digital Art* in 2010. Curator at the time, Lindsay Taylor, in Graham wrote 'that the aim of the project was twofold: to celebrate innovative and creative use of digital media technology and to undertake a practical case study for the collection and integration of digital artworks into existing permanent collections'. [9] By understanding the principles for future and experimental collecting from a traditional, municipal perspective, this model could be translated to a university gallery such as NGCA.

Following research into the Harris' Collections Development Policy I was led to a Scoping Report written by specialist visual arts advisor, Wendy Law, commissioned by the Harris in 2009. The purpose of the report was 'to support the Harris in developing a nationally significant collection of new media work and to be undertaken in conjunction with the Harris' overall collecting policy, with new media acquisitions being integrated with existing contemporary and historic collections'. [10] The aims and objectives of the 2006 Arts Council England *Turning Point* long-term strategy to build on existing investment and the success and impact of contemporary visual arts were incorporated into the Scoping Report which was an appendix to the Collections Development Policy at that time. The new media art collection is now housed within the Photography collection which suggests that collecting new media art is still very much in its infancy.

The experiment proved successful with positive and encouraging feedback from visitors and in 2012 was followed by *Digital Aesthetic 2,* a multi-site exhibition, website and conference curated in partnership between the Harris and the University of Central Lancashire. The *Current* exhibition curator, Lindsay Taylor, has expertise in curating exhibitions and developing public collections of contemporary art, particularly in areas currently under represented in museum collections nationally. Taylor was the curator at the Harris for the duration of the *Current* project and invited professionals from Computer Arts

Society, FACT and Tate to be part of the expert panel who would eventually select the artwork to be included in their collection. The chosen artwork was by Thomson and Craighead, *The distance travelled through our solar system this year and all the barrels of oil remaining (*2011), which made use of a live internet data stream and tackled environmental issues. Support from the Contemporary Art Society and other agencies demonstrate the success of the project as its legacy lives on and is acknowledged on the museum website that photography, film and video are being used increasingly in contemporary art practice. Taylor is now curator at the University of Salford Art Collection and has acknowledged in the Collections Development Policy that there is a digital gap in museum collections- often due to concerns about the longevity of the technology required to experience the artwork. As a university it is part of their responsibility to pioneer the collecting of difficult work, to take risks and to find ways of conserving digital artworks, as part of the focus of debate and the evolving cultural infrastructure and landscape. The collection ranges from post-war British painting, print-making and photography to the new media artworks recently included into the collection, demonstrating that integration is possible by use of an experimental and innovative approach. The text below is taken directly from the University of Salford Art Collection Forward Plan 2015-2018:

We are now living in a digital world, and it is important that our art collection reflects some of the excellent artworks made by artists either about, or using digital technologies. This gap is recognised in the North West's regional museums' collections – often due to concerns about the longevity of the technology required to experience the artwork. As a university it is part our responsibility to pioneer the collecting of difficult work, to take risks and to find ways of conserving digital artworks, as part of the focus of debate and the evolving cultural infrastructure and landscape. [11]

This strategy could certainly apply to the Collections Development Policy of NGCA as the gallery has given first UK shows to artists such as Claes Oldenburg and Cory Arcangel several years prior to other galleries acknowledging recognition of the artist. As the gallery commissions work it also collects from the commissioned artists and has a volume of photographic prints as well as new media artworks of various mediums by artists such as Graham Dolphin, Dan Holdsworth and Simon Martin. Its specific collecting remit reflects the gallery's commitment to exhibiting and collecting innovative, experimental art in order to tell stories about the history of contemporary art which provides a documentary for visitors and scholars.

Summing up and concluding

Collaboration between institutions, transference, distribution of knowledge and an open mind to experimentation are conducive to the integration into collections and henceforth the preservation of new media art. As there are many diverse organisations with their own approaches to collecting, preservation, documentation and distribution it is inevitable that there will be no 'one size fits all' model to inform each of the activities associated with promoting the longevity of new media artworks. Although some collecting institutions appear apprehensive when considering acquisitioning new media art, due to the testing of more experimental and innovative curatorial practices, anxieties can be overcome. It is true that knowledge, funding, equipment and physical space are integral and essential factors to achieving successful collecting but the evidence outlined in this paper advocates that it can be achieved. If we consider the commitment of the Solomon R. Guggenheim Foundation to innovation, experimentation and collaboration, this model can be tailored to the requirements of smaller, regional arts organisations:

*Committed to **innovation**, the Solomon R Guggenheim Foundation **collects, preserves** and interprets modern and contemporary art, and explores ideas across cultures through dynamic curatorial and educational **initiatives and collaborations.*** [12]

Taking into account Steve Dietz's categorisation of the three characteristics of new media art, of *computability, interactivity* and *connectivity,* it is evident that the title *new media art* has become an encyclopaedic term for an ever expanding and evolving range of creativity and artistic practice. By exploring experimental and innovative practices and having an open minded and progressive approach to curatorial activities, this paper has demonstrated that concerns around the assumed complexity of collecting, and distribution can be alleviated. By collecting important data and detailing of thorough documentation we can strive to keep new media, digital and networked art from disappearing into obsolescence.

References

[1] Reichardt, J. ed., (1969) *Cybernetic serendipity: the computer and the arts*. Praeger

[2] Graham, B. ed., 2016. *New collecting: exhibiting and audiences after new media art*. Routledge. p. 4

[3] Depocas, A. (2003) in *Goals of the Variable Media Network* in Depocas, A, Ippolito, J, Jones, C., Eds. *Permanence*

through change: The Variable Media approach. Guggenheim Museum Publications. p. 7

[4] Tate, (2015) *Things change: Conservation and display of time-based media art.* Web, 2018 https://www.tate.org.uk/about-us/projects/pericles/things-change-conservation-and-display-time-based-media-art

[5] Serexhe, B. ed., 2013. *Preservation of Digital Art: Theory and Practice*. Springer. p. 14

[6] Dekker, A. (2014) *Assembling traces, or the conservation of net art.* Web, 2018 https://necsus-ejms.org/assembling-traces-conservation-net-art/

[7a 7b] Ippolito, J. (2008) *Death by Wall Label.* Web, 2018 http://thoughtmesh.net/publish/11.php

[8] Jones, C. (2008) *Surveying the state of the art (of documentation).* Web 2018 http://www.fondation-langlois.org/html/e/page.php?NumPage=2125

[9] Graham, B. ed., 2016. *New collecting: exhibiting and audiences after new media art*. Routledge. p. 118

[10] Law, W. 2009. A *Scoping Report Collecting New Media Art.* Harris Museum and Art Gallery. p. 3

[11] Taylor, L. 2015. *Forward Plan 2015- 2018.* University of Salford Art Collection

[12] Solomon R. Guggenheim Foundation Collections Management Policy. 2017. Section 1 *The Mission of the Solomon R. Guggenheim Foundation*. Web, 2018

Bibliography

Statista. (2018). *Number of social media users worldwide 2010-2021* | [online] Available at: https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/ [Accessed 2 Oct. 2018]

Stedelijk. (2018) *Research into the collection* [online] Available at https://www.stedelijk.nl/en/dig-deeper/research [Accessed 12 Oct 2018]

From interaction to post-participation: the disappearing role of the active participant. Introducing research framework of post-participation.

Varvara Guljajeva
Estonian Academy of Arts
Tallinn, Estonia
varvara.guljajeva@artun.ee

Abstract

This paper analyses and contextualises passive audience interaction through the lens of post-participation. It argues that the concept of post-participation helps to address the shift from an active to a passive spectator in the complex age of dataveillance, an age in which humans are continuously tracked, traced, monitored and surveilled without their consent.

By exploring interactive art history and the discourse of identity within the field, this article investigates how artworks that demonstrate no audience involvement, but still incorporate an internal system interaction with a data source, are addressed. In other words, the research tracks down the interest shift from human-machine to system-to-system interaction, and explores the reasons behind this.

Paper introduces direct and indirect post-participation, which are research tools developed for the practice-based investigation. Two case studies illustrate how the research framework of post-participation can be applied for analysing a complex relationship between an interactive system, a participative input and audience.

Keywords

Interactive art, post-participation, surveillance, interactive systems, hybrid art, practice-based research, post-digital.

Introduction

At the beginning of the 1980s, the artists were eager to involve the audience in dialog with an interactive system. Interactive art gained recognition in 1990, when Prix Art Electronica introduced a dedicated category for the discipline. [1] The pivot point took place in 2004 when Golden Nica was awarded to "Listening Post" (2001) by Mark Hansen and Ben Rubin, which had no interactive element concerning audience involvement. This occasion triggered discussion around the definition and identity of interactive art. In the end, the history of Prix Ars Electronica demonstrates how the concept of interaction has been challenged and expanded. For example, the statement of Prix Ars Electronica from 2016 regarding Interactive Art+ category, is expanding beyond direct interaction stating that the artistic interests have gone social and political, and interactivity has become pervasive. The bare excitement of novel interfaces is no longer actual. [2]

Philosophically speaking, it is clear that the audience is engaged with an artwork in mental level, too. At this point, I can agree with Ranciere and Norwich that perception is an active process. [3][4] Practically speaking as a practice-based researcher, this evaluation criteria does not leave me many research tools. For instance, Ernest Edmonds states that the principal aesthetic value of interactive art lays on the interactive experience, which is a criterion for a such art piece that has to respond to audience interaction with it.[5] Katja Kwastek makes a similar point regarding the level of engagement, when defining the discipline: "Digital artworks that require the viewer to engage in some activity that goes beyond purely mental reception are commonly designated as 'interactive art'." [1] To put it clearly and simply, an interactive artwork contains some interactive or reactive element(s) that a viewer can interact with. The in-teraction is mediated by a computer or electronic system, which is responsive to audience interaction to the extent that an artist has designed it to be. In short, the audience completes the work, which is performed by a technological medium.

Now, what happens if an artwork contains no interactive elements for an audience, but an interactive system which takes interest group behaviour or activity without their knowledge or control as an input. Can we still analyse these works as interactive ones?

Several researchers have addressed this question and different terminology has been suggested, like unaware and passive participants, along with meta-interaction by Erkki Huhtamo, Strategy of System by Ryszard Kluszczynski, and subliminal interaction by Pau Waelder. [6][7][8] In addition to conscious approaches towards updating the terminology of interactive art, there are a number of artists and theorists, who demonstrate in their description of artworks, the absence of the active audience. For example, James Coupe names his audience as an "unwilling actor" and Maciej Ozog describes the spectators of "Surface Tension" (1992) by Lozano-Hemmer as the "helpless audience". [9][10] In short, there are different proposals available on how to address this shift, which also shows that there is no clear understanding how to approach artworks that have changed their focus from an active participant to a system.

In order to analyse the paradoxical situation in interactive art, where the artworks that demonstrate no direct audience

interaction are addressed as interactive, the term of post-participation is introduced and discussed in this paper. Hence, the research framework of post-participation helps to describe, analyse and ultimately contextualise artistic practice from the perspective of audience involvement and the participative input of interactive systems.

In addition to that, the term is politically loaded, and thus, enables artists to address the problematics of privacy in the age of dataveillance. In large extent, post-participation is connected to the surveillance age, where the society has accepted constant camera and algorithm gazes.

From interaction to post-participation

In 1996, Söke Dinkle noticed a shift from participation to interaction. In her article, she explores the roots of interactive art from the perspective of audience engagement. [11] It is interesting to see how the role of a spectator has been shifting throughout the time. With the introduction of interactive technology into arts, the human-to-human interaction has been transformed into a machine-to-human one.

When it comes to the yet another shift in the role of the audience today, to the dialog between system and user has been added a dialog between two systems where the user(s) serve not an active, but a passive role of input. An art piece can be completed by the data we are generating, sensor data, and more indirect inputs that the public has no control over. Hence, it is appropriate to state that there is a tendency to move from interaction to post-participation in art and also in general. This situation is profoundly social and political, and not merely technological as Dinkla stated in 1996. [9]

The modern times of surveillance capitalism introduce new artistic concepts and materials. Talking about the first ones, the interest of participating and creative user has shifted to monitored and passive one. Contemporary surveillance culture dictates voyeurism and exhibitionism, which have converted into a normality today. ”Surveillance has become a common experience and practice of everyday life at the edge of the twenty-first century.” [10] According to Haggerty and Ericson, ”[w]hile surveillance is now ubiquitous, it is also diverse, multi-faceted, and employed in such a panoply of projects that it is almost impossible to speak coherently about surveillance.” [12] Hence, Ozog sees a particular importance in the role of artists working with technology, who are able to ”deconstruct and subvert the strategies, politics, and ideologies of modern electronic surveillance.” [10] In other words, the artists applying and conceptualising surveillance technologies, are the ones, who help us to realise the level and nature of surveillance today. Creatives explore and hack surveillance technology and apply real-time data sources as artistic material.

If in the 1990s and 2000s artists were mainly concerned about creating as responsive installations as possible and also novel interfaces for a spectator to interact with, then in the information age the interest has moved to the world of data. As I have stated elsewhere, post-participation goes beyond the interface; it embeds real-life elements and unaware or passive participation into an artwork. The every-day activity becomes a score of artwork; it completes the open process of the piece. The direct interaction of audi-ence is not needed anymore, the data that each of us gener-ates being in physical or cyberspace can act as a post-par-ticipative input for an interactive system. [14] Hence, a post-participative artwork does not ask for interaction from its audience; it makes use of real-time data generated by social media users, CCTV camera video feed, or other data source that we do not have control over or have no clue about. In short, such artworks are not open for direct inter-action, but for a real-time data source that makes a work of art alive. In this article, such real-time data source is named post-participative input. Similarly to an interactive work, a post-participative piece changes along with new input, only the cause for the change is not a beholder, but a selected data source - a post-participative input. A spectator is placed in a position to be surveilled or be an observer while the system tracks others or also him/herself. It con-stitutes the duality of spectator: being observed and an ob-server at the same time.

Often the term of post-participation can be applied for the works that fail to be categories as interactive ones, for example, ”Listening Post” by Hansen and Rubin, which of-fers no interaction to its audience. However, the artwork is open and never the same, since the messages that appear on the 231 small displays and that are read out loud by the computer system come from the chat rooms and forums on the Internet. [13] According to Kluszczynski, ”Listening Post” can also be described as the Strategy of System. He has introduced this term in order to explain artworks that demonstrate system interaction and leave the audience without any interaction element. Kluszczynski refers to two types of Strategy of System: first, is a group of people online unaware of their input role as a data source for the interactive system. The work’s output system is connected with the audience, though, which is a radical difference with an interactive artwork in the classical sense. In the case of interactive work, spectators act as an input and ex-perience the output of the work. The second type of Strat-egy of System that Kluszczynski introduces is described as ”total autonomy of technological order.” [7] It constitutes, there are no unaware or passive participants, but the work is completed by automatic data sources, like meteorologi-cal measures, which correspond or make a change in the artistic spectacle that is offered for the contemplation to the audience. In the words of Kluszczynski: ”[e]ach change of meteorological parameters results in transformations of the system in the gallery installation attributed to it. Its audi-ence, with no exceptions, comes down to the role of a spectacle’s observers.” [7] Kluszczynski makes valid points and underlines once again the fact that interaction has traveled to the system level. Definitely, the ideas and understanding of Kluszczynski resonate with post-partici-pation. However, post-participation is not about solely sys-tem interaction, but it investigates the role of the participa-tive component in the work and distinguishes several cate-gories of it.

In short, I see that post-participation opens a new space for the artworks that do not fall under the interactive art cate-gory and is more descriptive in respect to the role of the audience than suggested database or net art in Erkki Huh-tamo's article or Strategy of System by Kluszczynski. [6][7] Moreover, post-participation is a useful term for me as a researcher and artist, because it helps me understand the evolution of my practice from the perspective of audience involvement. Also, post-participation enables artists to ad-dress the problematics of privacy in the age of dataveil-lance.

Research tools: direct and indirect post-participation

When analysing my own and related artworks regarding post-participation, I have noticed either an artwork's con-nection or disconnection with an exhibition space concern-ing the origin of post-participative input. Hence, I propose using two categories of post-participation - direct and indi-rect one - when discussing the post-participative art prac-tice.

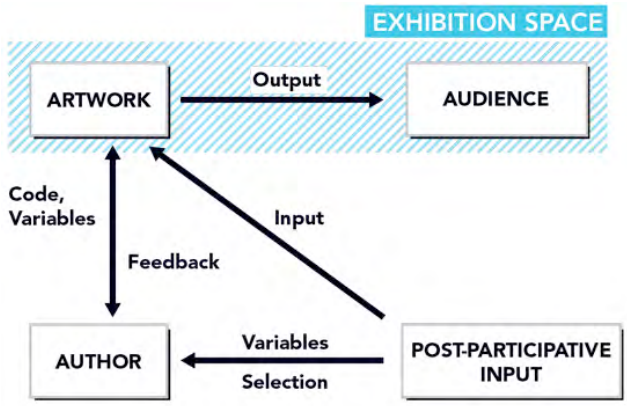


Figure 1. relationships in the indirect post-participative artwork.

An indirect post-participative artwork has no connection with the physical space where it is displayed. The figure 1 above demonstrates relationships within an indirect post-participative artwork. In the schema is shown that the audi-ence in the exhibition space are offered to perceive only the output of the interactive system, which results in the post-participative input responsive artwork. The post-par-ticipative input itself is separated from the exhibition space and is located outside of it. For example, such input could be unaware of their participation online users or passersby registered by a tracking system, which is located in differ-ent place from the artwork. In other words, a presence, movement or any other action performed by the audience in the exhibition space is irrelevant. The artwork is com-posed of an internal computer system that is open to the post-participative data source that is located either online or outside the exhibition space. Therefore, an indirect post-participative installation does not look for any input from the audience but scans the dedicated area of interest con-stantly. At the same time, it has a connection to a real-life element.

In short, the figures visualise the passive role of the audi-ence and post-participative input: the first, perceiving the output from the artwork, and the second, acting as input for the artwork. The only dialogue here is between the artwork and author, which mostly happens during the creation pe-riod and when customising the installation for a certain lo-cation or new input. The difference is in the origin of post-participative input, which the figures 1 and 2 aim to com-municate.

In terms of contrast, a direct post-participative piece has a connection with its physical location (see Figure 2). It means that the artwork, audience and post-participative in-put share the same space and time. Other relationships are the same compared to the figure of indirect post-participa-tion. The schema below demonstrates that all three compo-nents are located in the same space and the audience with-out its knowledge or will becomes the input of the artwork. It is important to mention that in the case of direct post-participation the audience does not always form part of the input. The post-participative input can also be an animal one, if they are part of the artwork.

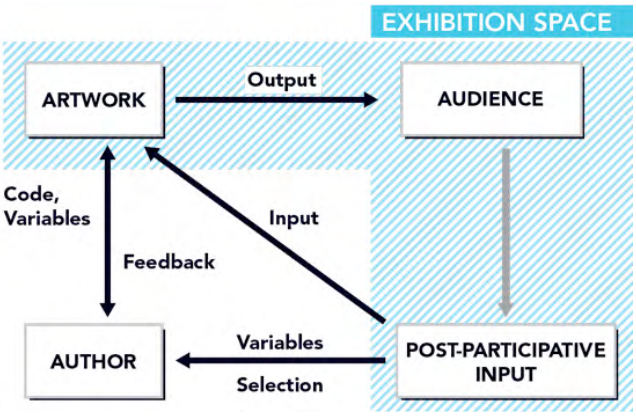


Figure 2: relationships in the direct post-participative artwork.

Moving further, a direct post-participative installation looks for audience participation whether it is voluntary or not, conscious or not. However, active participation is not the aim of the work. By entering the exhibition space, a spectator becomes the interest of the artwork by default. Like Maciej Ozog explains when analysing Rafael Lozano-Hemmer's work: "The viewer-interactor cannot influence the system; she can only refrain from interacting by avoid-ing a meeting with the digital gaze." [10] Or Erkki Huh-tamo refers to a beholder as an unaware participant when analysing David Rokeby's artworks that deal with surveil-lance and an observing camera image. [15] In other words, there is no need to be an active participant. Just the act of entering into the scanning territory of installation consti-tutes the acceptance of participation in the artwork as an input.

Indirect post-participation case study: The Rhythm of City

"The Rhythm of City" (2010) demonstrates indirect post-participation by applying real-time geo-locative social me-dia data of Twitter, Flickr, Youtube, Foursquare, and Insta-gram as a score of 10 modified metronomes (see figure 3). Online users of certain cities are participating in the art-work through their everyday virtual communication with-out being aware of the fact that they have a significant role in the installation. They are taking part in composing the artwork's score that updates its rhythm every other minute. As a result, the audience is confronted with a unique, un-predictable and continuous performance.

The work is in a constant flux mirroring the digital pace of life, and thus, the digital inhabitants of social media post-participating in composing the rhythm of each metronome. At the same time, the work has no responsive connection with the exhibition space and its audience. Hence, by bene-fiting from contemporary personal data and metadata ag-gregation possibilities, indirect post-participation draws on the strategies of dataveillance. User-generated big data do not stand for the data anymore, but rather for constant and involuntary participation, which in this paper is describe as post-participation. In the case of "The Rhythm of City", the real-time geo-located activity of social media users is translated into the tempo of a metronome, which indicates that the installation is post-participative.

Figure 3. Rhythm of City (2010) by Varvara & Mar in Elektron-ika festival, Belo Horizonte, Brazil (2011).

With this art project, the idea was to explore a different method of interaction that goes beyond the audience click-ing on a menu bar, pushing a button or contributing to any content. I am talking about an artistic interpretation of the virtual social activity and underlining the fact of post-par-ticipation and dataveillance in the digital age. Thus, the in-tention is to translate the post-participation of target groups on the internet to the physical motion of a metronome, and therefore, through this to describe the urban landscape in a novel way. In addition, my concerns revolve around the malleability of the digital world in relation to the physical one, and the interpretation of digital social data for artistic purposes.

Concerning the inspiration for this piece, several cultural studies have demonstrated that a city and its culture can be described by the speed of inhabitants and services, and its location. [16][17] These findings, like a positive correla-tion between the walking speed and the size of the city by Bornstein & Bornstein in 1976, inspired me to research what would be the pace of life in a city, not on its streets but rather in its digital dimension.

Technically speaking, social media services have their APIs that allow specific access to their users' data to third parties (so-called developers category). The fact is that this technology opens a door for various applications to make use of these data. Most of the business models of startups are based on the users' data acquired from different appli-cations by mostly using APIs. Of course, the ones who pro-duce data have no idea where and how the data are applied. Shoshana Zuboff describes such a paradigm as surveillance capitalism. In her words, "big-data is both a condition and expression." [18]

Talking from an artist perspective, social media data are fascinating, political, and concept-rich artistic material. What is more important, they also allow to look at and highlight a different participation model, which in this case is indirectly post-participative, since the users have no longer control over it and often have no knowledge about their participation. The indirect category is expressed by the fact that the artwork is not bound to the physical loca-tion of the exhibition but takes place on the territory of so-cial media in the selected areas. To be more precise, since the post-participative input of "The Rhythm of City" does not share the exhibition space with the installation and its audience, it represents indirect post-participation.

When it comes to related artistic practices, Hansen and Ru-bin introduced in their artwork "Listening Post" an early approach in culling data from the forums for an artistic purpose. The input for the interactive system of "Listening Post" are the users of 5,000 forums and blogs, who are not physically present in the exhibition at the same time. Hence, the artwork demonstrates a disconnection between its input and the audience, which is the precondition for the indirect post-participation. In other words, a spectator can-not influence the artwork in any way.

Another well-known artist in interactive art is David Rokeby, who has been using video as a creative medium and voyeurism as a conceptual departure point from the early 1990s in works such as "Watch" (1995–2008). [19] By separating moving from still parts in the camera image, the artist is able to play with the image layers and filter out humans, which enables him to confront the audience with the problematics of surveillance. In the words of the artist: "In 'Watch', public sections of the exhibition gallery or of exterior public space, separate from my installation, are watched by surveillance cameras. These images are pro-cessed in real-time and projected onto the wall of the in-stallation space." [19] The duality of a spectator: observing and being observed, are the conceptual parts of the art in-

stallation. “Watch” demonstrates the separation between the space that is watched and the gallery space where the other is observed by the audience, which is one of the char-acteristics of indirect post-participation. Of course, people, who are monitored, and thus, integrated into the artwork have no idea about their role, which is another requirement of the term introduced. Hence, “Watch” (1995–2008) by David Rokeby can be described as indirectly post-partici-pative artwork.

In the end, artists are also very much aware of the dark side of the online world and aim to tackle this issue in their practices. In particular, audience’s post-participation in an art installation is often used to underline the paradigms of the surveillance age. To be more precise, indirect post-par-ticipative artworks highlight, in significant extent, dataveil-lance and the application of contemporary complex sur-veillance strategies online.

Direct post-participation case study: Budgie Waltz

“Budgie Waltz” (2012) introduces an animal component to the discourse of post-participation. As mentioned previ-ously, a post-participative input can also be animal one, and thus, the following artwork illustrates this claim. With this art project I feel and test the borders of the conceptual term; however, I believe it also represents a research evolu-tion. Here, with the example of budgerigars, I explore what happens if the artwork is completed by the post-participa-tive input of birds instead of humans, leaving the audience only in the passive role of observer.

Figure 4. Budgie Waltz (2012) by Varvara & Mar at the Verbeke Foundation.

The art project consists of budgies creating a piano play by entering and leaving their birdhouses. Each entrance to a birdhouse is equipped with a light sensor, which is trig-gered by a bird entering or leaving the house. The sensor activates the correspondent solenoid, which pushes down a specific key on the Berlin piano, and thus, produces a note. In other words, “Budgie Waltz” draws on the budgerigars’ life pace and converts it into a piano play using a real mu-sical instrument. “Budgie Waltz” registers every entry to the birdhouse by budgies. In a way “Budgie Waltz” aims to come as close as possible to the post-participative input and embrace it into the artistic process. Thus, without knowing and continuing their normal life, the birds become a part of the art installation.

In “Budgie Waltz” was simulated smart home situation by equipping the birdhouse with the sensors that registered each entry and exit of a bird and translated it into a piano play. In this artwork, the role of post-participant has been transferred to the birds, and thus, a spectator becomes a witness of direct post-participation instead. If in the case of indirect post-participation the participation process can be felt abstract because of its disconnection from the exhibi-tion space, then direct post-participation brings the process much closer to the audience.

The topic of surveillance is one part of the concept, which is surprisingly translated into a piano play as a reference of not knowing what happens with these data subsequently. In this art project, the monitoring and tracking have travelled from a street and social media to home. As an ironical metaphor, the budgerigars become the actors of humans. Every time a bird enters or leaves the birdhouse, the piano key goes down and produces a sound. Like in a smart home, every time one asks to make a coffee, brushes teeth, vacuums the home or watches TV, he or she leaves a data trace behind. In the article “The House That Spies on Me”, Kashmir Hill and Surya Mattu discuss in detail what kinds of data get sent out constantly from their smartened-up home as an experiment. In their words, “[g]etting a smart home means that everyone who lives or comes inside it is part of your personal panopticon.” [20] And this personal panopticon is used for spying by many parties, like ven-dors, third parties and intelligence agencies of several states, the USA for example. [21] Hence, my idea is to ap-proach this problematics and paradigm of today with a non-linear artistic expression involving budgerigars, or more precisely, making artwork from existing birds living in their huge cage. I believe budgies forward the metaphor of being spied on at home and the surveillance state per-fectly.

In addition to monitoring, an unpredictable score, which follows the everydayness of birds, is a part of the artistic thinking. Hence, the birds dictate the rhythm and pitch of the piano performance. Since coming in and going out of their houses is a part of the standard behaviour of budgies, it also allows me to discuss their rhythm of being. The use of the pace of life concept, which began with “The Rhythm of City”, refers to my continuous interest towards the tempo of everyday life, like in all my artworks described so far. “Budgie Waltz” is an art installation that invades the cage of budgies and translates the life of birds into a musi-cal score, which has a reference to “Baltic Sea Radio” (2012) that is also concerned with a sound score in flux. Ultimately, with “Budgie Waltz” I aim to go beyond hu-man-based or human-generated data and activities and use the birds’ behaviour instead.

What is more important, apart from converting a birdcage into an artwork, is that I have also applied it as a research lab. Since I worked for the first time with birds, there were

many things to discover. First of all, I have understood with "Budgie Waltz" that the birds not only become an art-work but the whole of their existence converts into it. It was a novel experience for me that I had not felt in my pre-vious artworks. Second, in the "Budgie Waltz" project I managed to get closer, as an artist and researcher, to the post-participative input than I could ever have achieved with humans, I believe. Moreover, the whole post-partici-pation concept is elevated to the stage-like scenario: the everydayness of birds is right there and observable for the audience. The post-participative input shares the same space as the artwork, and therefore, I am talking about di-rect post-participation in the case of "Budgie Waltz". In the end, I think with this artwork I have succeeded in underlin-ing the core of post-participation in the brightest colours: a natural and undisturbed behaviour of a subject is embedded into an artwork as a direct post-participative input. Of course, the sensor system was noticed by the birds when it was installed in the birdhouse. But after a certain time, the upgraded living facilities became normality for them.

Concerning the audience experience, the role of observer is offered to a spectator, who is able to sense the connection between the ever-changing piano play and budgies' behav-iour, and thus, discover the post-participation mode in the artwork. Obviously, the presence of people, especially if we talk about a large number of visitors, can affect the birds' behaviour. But again, it is something that is out of my research interest range, and it is part of the game: the artwork follows the budgies' pace of life. Moreover, in the foundation, there are always visitors, and the budgerigars are used to that. However, what is more important is that the audience members are not simply observers, but rather witnesses of the direct post-participative process, which is brought as close as possible to them. I would like here to borrow Juha-Heikki Tihinen's words when he analysed Uku Sepsivart's artwork "Michelangelo's Assignment" (2017) where the birds were gradually destroying a replica of Michelangelo's sculpture made of fat: "The viewer can have the experience of becoming animal. Become animal, just for a moment, it's worth it!" [22] Drawing on Jacques Derrida's thoughts on how humans try to differ from ani-mals, by confronting the audience with the animals in the direct post-participation process inside the artwork, the metaphor is actually turned into recognition. [23]

To sum up, "Budgie Waltz" illustrates my exploration to-wards the integration of animal direct post-participation into the artwork. I have reduced the distance between the direct post-participative input and the interactive system so drastically that it is difficult to distinguish whether the birds are part of the artwork or the artwork is a part of the birds' life. In other words, there are no physical or mental borders between the artwork and its scanning area. I am saying this because from the audience's point of view, the scanning area, which is the bird's cage, is located in the territory of the artwork, and thus, perceived as a part of it. In the end, this was the reason and research interest behind using birds as a direct post-participative component.

The helplessness of audience to master their interaction with a direct post-participative artwork is definitely a com-mon characteristic among the artworks discussed here. It means, the emphasis is on the system and not on the audi-ence. Some artworks, like "Zoom Pavilion" (2015) by Lozano-Hemmer, "Desire of Codes" (2005) by Seiko Mikami and "Watched and Measured" (2000) by David Rokeby, demonstrate the dominance of the system over a spectator very vividly. I can see artists using surveillance technology in the gallery and also in public space. Mostly are applied various cameras, which act as an image input for increasingly powerful algorithms that are able to track and recognise. The societies of control that was described by Deleuze is our reality, and it is supported and encour-aged by the development of technology greatly. [24]

Conclusions

The solution to the identity crisis of interactive art has been offered by extending the field name, like adding hybrid and +. However, the unsolved question remains: how do we de-fine these kinds of works that are not interactive towards their audience, but still incorporate an internal system in-teraction with a data source?

The paper has discussed current problematics of interactive art, which have started from 2004 already, and offers a pos-sible solution to address the artworks that incorporate pas-sive audience participation as post-participative ones. What is more important, the term proposed resonates strongly with the post-digital and surveillance age, which help the artists to conceptualise, and also, contextualise their works that undergo post-participation description. Post-participa-tion occurs at a time when interactivity in itself ceases to be novel, and the focus has shifted from the spectator to the data being processed by the artwork as a self-sufficient sys-tem.

As case studies have demonstrated, post-participation is a research tool for understanding the evolution of artistic practice from the perspective of audience involvement. Also, the notion of post-participation helps to describe, an-alyse, and in the end contextualise, artistic practice from the perspective of audience involvement and the participa-tive input of interactive systems.

In conclusion, it is possible to say that the technological age has had a strong influence on the audience participa-tion in art. With the advent of digital technology, the inter-activity has been explored. And today, in the age of dataveillance, active audience participation has been con-verted to passive one. There is a shift from human-com-puter to system-to-system interaction. In the foreground is the dominance of the system and in the background, help-less audience. Such transformation is obviously socially and politically loaded. Therefore, I believe post-participa-tion is a new kind of participation that has been introduced by post-digital times we are living in.

References

[1] Katja Kwastek, *Aesthetics of Interaction in Digital Art (*Cambridge: MIT Press, 2013), 8.

[2] Christophe De Jaeger, et al., "Transcending the Medium," in *CyberArts 2016,* ed. Hannes Leopoldseder, Christine Schöpf and Gerfried Stocker (Linz: Hatje Cantz, 2016), 54–91.

[3] Jacques Ranciere, *The Emancipated Spectator*. First Engl. (London: Verso, 2009).

[4] Kenneth H. Norwich, "Perception as an Active Process," *Mathematics and Computers in Simulation* 24(6), (1982): 535-553.

[5] Ernest Edmonds, "The Art of Interaction", *Proceedings of the 2010 International Conference on The Interaction Design*. (Swindon, UK: BCS Learning & Development Ltd. (Create'10), 2010): 5–10.

[6] Erkki Huhtamo, "Trouble at the Interface 2.0. On the Identity Crisis of Interactive Art (2007)", NeMe website, accessed December 16, 2018, http://www.neme.org/591/trouble-at-the-interface-2

[7] Ryszard W. Kluszczynski, "Strategies of interactive art," *AESTHETICS & CULTURE* 2 (2010).

[8] Pau Waelder, "Arte Interactive: Nuevas Estrategias en la Relacion Dialogica entre el Espectador y la Obra de Arte," (Master thesis, Universitat de les Illes Balears, 2008)

[9] James Coupe, (2013) *On the Observing of the Observer of the Observers* (Lancaster: Phillips Museum of Art, 2013).

[10] Maciej Ozog, "Surveilling the Surveillance Society: The Case of Rafael Lozano-Hemmer's Installations," in *Conspiracy Dwellings. Surveillance in Contemporary Art,* ed. Outi Remes and Pam Skelton (London: Cambridge Scholars Publishing, 2010), 95–112.

[11] Söke Dinkla, "From Participation to Interaction: Toward the Origins of Interactive Art," in *Clicking in: Hot Links to a Digital Culture,* ed. Lynn Hershman-Leeson (Seattle: Bay Press, 1996), 279–290.

[12] Richard V. Ericson and Kevin D. Haggerty, "The New Politics of Surveillance and Visibility," in *The New Politics of Surveillance and Visibility*, ed. Richard V. Ericson and Kevin D. Haggerty (Toronto: University of Toronto Press, Green College lectures, 2006), 12.

[13] Mark Hansen and Ben Rubin, "Listening Post," in *CyberArts 2004,* ed. Hannes Leopoldseder, Christine Schöpf and Gerfried Stocker (Linz: Hatje Cantz, 2004), 112–117.

[14] Varvara Guljajeva, "From interaction to post-participation: the disappearing role of the active participant," (Ph.D. diss., Estonian Academy of Arts, 2018.)

[15] Erkki Huhtamo, "Silicon remembers Ideology, or David Rokeby's metainteractive art," in *The Giver of Names*, ed. Anne McPherson and Debarah Esch (Ontario: Guelph, 1998), 16–30.

[16] Marc H. Bornstein and Helen G. Bornstein, "The pace of life," *Nature* 259*,* (1976): 557–559.

[17] Robert Levine, "The Pace of Life in 31 Countries," *Cross-Cultural Psychology* 30(2)*,* (1999):178–205.

[18] Shoshana Zuboff, "Big other: surveillance capitalism and the prospects of an information civilization," *Journal of Information Technology* 30(1), (2015): 75–89.

[19] David Rokeby, "Watch (1998-2005)," David Rokeby website, accessed April 12, 2019, http://www.davidrokeby.com/watch.html

[20] Kashmir Hill and Surya Mattu, "The House That Spied on Me," *Gizmodo,* February 7, 2018, accessed December 16, 2018, https://gizmodo.com/the-house-that-spied-on-me-1822429852

[21] Spencer Ackerman and Sam Thielman, "US intelligence chief: we might use the internet of things to spy on you," *The Guardian*, February 9, 2016, accessed March 13, 2017, https://www.theguardian.com/technology/2016/feb/09/internet-of-things-smart-home-devices-government-surveillance-james-clapper

[22] Juha-Heikki Tihinen, "Flying Michelangeos and Other Animal-Artists," *KUNST.EE* 1, (2018), 91–93.

[23] Jacques Derrida and David Wills, "The Animal That Therefore I Am (More to Follow)," *Critical Inquiry* 28(2), (2001): 369–418.

[24] Gilles Deleuze, *Two Regimes of Madness: Texts and Interviews 1975–1995* (New York: Semiotext(e) (Foreign Agents), 2007).

Multi-viewpoint Strategies: Ambisonic Auralization and Localization through Walking and Listening as Places of Negotiation in Conditions of Hybridity and Change

Steven Devleminck[1], Boris Debackere[2], Toon Van Waterschoot[3]
[1]KU Leuven, Dept. of Computer Science, CW, BE-3000 Leuven, Belgium, steven.devleminck@kuleuven.be
[2]LUCA School of Arts, BE-1050 Brussels, Belgium, boris.debackere@luca-arts.be
[3]KU Leuven, Dept. of Electrical Engineering, ESAT-STADIUS/ETC, BE-3001 Leuven, Belgium, toon.vanwaterschoot@esat.kuleuven.be

Abstract

This research introduces the concept of 'liquidity' as a framework through which to observe the ways that the lived-in world and particularly society and culture are experienced and discussed as social subjects. It has become apparent that this notion of 'liquidity' plays an important role in the generation of novelty, that is, to generate new insights and meanings. Recent studies by Bhabha (1994) or Bauman (2007) identify an apparent shift in the way we experience and deal with modern society replacing the rigid cognitive frameworks by more 'fluid' interactions. To understand and to deal with this new concept, a cartography of these liquid times is installed through the design of an artistic Ambisonic sound localization and auralization project. The cartography follows in depth two specific trajectories. What are the merits of a 'point of view' within a liquid society? What type of auralized experiments can be introduced? The scientific and artistic aim is to establish a multi-viewpoint approach (walking, listening and seeing through a state of the art technology) replacing single viewpoint categorization, a concept also to be applied to the reading of the artworks itself.

Keywords

liquid, cartography, multi-viewpoint, sound, localization and auralization, technology, multi-sensory integration

Introduction

This proposal introduces an artistic and scientific project on sound localization and auralization through the hardware development of headphones with a real-time decoder for Ambisonic audio files built in. The 4-channel B-format is translated into a binaural output according to the head position of the listener.

Designing a sound experience with a continuous sphere of Ambisonic audio, this project researches how to establish for the listener a multi-viewpoint experience. The approach is inspired by the dynamic concept of the Flâneur as introduced by Baudelaire, replacing single viewpoint categorization. This concept is re-appropriated for its capacity to connect with the different formulations of change, to indicate a common ground or effect of moving, as an area for creation or discovery.

The research embraces the concept of Liquid Modernity introduced by sociologist Zygmunt Bauman as a framework through which to observe the ways that the lived-in world and particularly art, culture and technology are experienced and discussed as social subjects. The project seeks to define a 'liquid' form of analysis (artistic and scientific) to apprehend the complexity of transforming cultural values. Being liquid or flaneur through sound localization and auralization is proposed as a method or strategy, replacing the isolated and solitary point of view with a multi-viewpoint theoretical and practical approach to deal with and endure new comprehension and meaning.

With the construction of the framework and the concurrent technology, it has become apparent that this notion of 'liquidity', defined as a hybrid position, plays an important role in the generation of novelty, that is, to generate new insights and meanings. It is this hybrid position, shifting between two or more viewing positions, including aural tracking, that should allow us to reveal a more complete picture, world view. By rapidly moving from one model to another the boundaries between the two become blurred, they become permeable, transferring characteristics from one model into the other and vice versa. This feature of shifting perspective is one characteristic of the 'liquid' framework and enables us to enhance meaning by transferring concepts and ideas from one system to another and additionally allows us to discover new connections and relations between them.

A second feature refers to the location of action (or generation of novelty) itself. We will see that this shifting position allows us to retrieve meaning not only within the different systems but also between these systems. In other words, a result of the change of (aural and visual) perspective is that not only new relations are becoming visible and audible, relations that from within the system are invisible, inaudible (not perceived) but also that the location of this information is situated in-between the installed systems of

knowledge (maps, models, or theories). They become locations of meaning and action on their own, or we can say, on their own terms they become 'new' systems. This we could argue is a result of what Zygmunt Bauman (2007, 2011) has called the liquid modern world. Social forms and systems are no longer able to settle down and become established. As a result overall structure makes way for an infinite network of short, small projects and structures which continuously tend to permutate each other. In order to understand the entire system we need to understand the series of infinite smaller structures and their in-betweens. If we now connect to Deleuze's rhizome with no beginning or end, then, we are able to extract a third element of his rhizomatic structure, being the middle or in- between. Also for Deleuze it is this middle (the coming and going) that allows for change and movement where the action takes place and new ideas are born. For Deleuze: "The middle is by no means an average; on the contrary, it is where things pick up speed. Between things does not designate a localizable relation going from one thing to the other and back again, but a perpendicular direction, a transversal movement that sweeps one and the other away, a stream without beginning or end that undermines its banks and picks up speed in the middle.". [1] Also for Régis Debray in his book 'Media Manifestos' (1996), we should focus on the in-between: "Looking not for that which is behind, but for what takes place between, the mediologist beholds himself constrained to set up his footstool before three more dignified arm-chairs: those of the historian of technology, the semiologist and the sociologist. An uncomfortable position but inevitable.". [2]

Location of Action

Noise

For Homi Bhabha in his book 'The Location of Culture', published in 1994, it is at the boundaries of cultures, at their interfaces that meanings and values are (mis)read. However, he notices that this interface, in-between or limit is seldom addressed and often even disavowed. In other words, not only are there new locations to be discovered, locations that exist between installed systems of knowledge and that have become visible or audible through a change of perspective, we can equally argue that these map/model spaces are a possible 'new' space for negotiation. These spaces are places that allow for the re-location and re-configuring of concepts that as a result of this process of shifting perspective no longer belong to any one system and it is also a place for the new insights and concepts that were made visible/audible or that were generated in-between locations. This location of action, as defined by a 'liquid' space bears some similarities with the sociological and anthropological concept of the 'Third Space' as expressed by Homi Bhabha and which refers to a place of negotiation where cultural differences as expressed through (mis)reading meanings and (mis)appropriations can be negotiated. In his book on post-colonial cultures Homi Bhabha quotes the American anthropologist Marshall Sahlins: "We have to do not so much with functional dominance as with structural - with different structures of symbolic integration. And to this gross difference in design correspond differences in symbolic performance: between an open, expanding code, responsive by continuous permutation to events it has itself staged, and an apparently static one that seems to know not events, but only its own preconceptions.". [3] [4] In this context Homi Bhabha calls for a 'Third Space', a place where the structure of meaning becomes a complex process. This place is not representable in itself but it is a place where signs and symbols can be appropriated, or even translated, re-historicized and have become regenerated into something new. Accordingly, this new space or 'Third Space' is "the cutting edge of translation and negotiation, the in-between space - that carries the burden of the meaning of culture.". [5]

The aim of this artistic and scientific project is to become a model as well as a generator for novelty embracing and dealing with multi-viewpoint perspectives through multi-sensory integration. Historically we have seen however, that any model or map is only applicable in a limited or located context. This is also true for the proposed project. With the construction of the sound localization and auralization artwork we could argue that this partiality of 'truth' is to be found in the unstable nature of the generated content itself. The liquid nature of the systems and the shifting perspective by default install a limited and therefore unstable novelty. Each concept, through the shifting position, must be evaluated from the standpoint of all the systems, as these in-between places are in constant flux. Thus re-assessing information from different points of view by definition makes its lifespan short or temporary. The in-between space is a temporary space, a space in constant flux subsequently altering the content of the assessed concept.

Models and Mirrors

In his book 'Models and Mirrors, towards an anthropology of public events', published in 1990, the Canadian anthropologist Don Handelman discusses cultural practices and in particular the cross-cultural analysis of public events. In his anthropological work a theory and method are proposed to expand our understanding of symbolic practice including artistic/scientific artefacts. In general terms Handelman considers 'rituals', without making any reference to religion, as practices which "intentionally organize and orientate us to our horizons of being-in- the-world". [6] It is through these practices that we, as humans, have the possibility to react and respond in relation to the options and

prospects that these practices offer. In order to understand these practices of (public) events Handelman's research focuses on their design, or more precisely the logics of the (organization of) practice. In addition, Handelman asks for caution when using encompassing terms such as practice, ritual or public event as these terms (as a sort of master category) tend to exclude all differences amongst them and in doing so homogenize all these events as one simple category. Therefore, in order to include possible differences, Handelman makes a plea "[...] to imagine and to theorize public events as autonomous, as phenomena in their own right, with their own integrities of logic and design". [7]

In particular these events are set up, constructed and destined to offer us a (limited, local, partial or total, global) worldview. These frameworks are often of a multiple and multilayered nature thereby mimicking the complex interrelations that occur within society. Art as part of our culture interacts, reflects and comments upon this society and offers us alternative ways of looking and understanding. Furthermore, change, innovation, in- betweennes or middle, provisionally defined as 'liquid', prove to be driving forces in society. In addition, special attention has been given to the scientific research within (sound) engineering as an important moment in our times influencing large parts of society and as such our thinking about the world giving birth to a series of new theories, models, maps and artworks. Especially the introduction of multimicrophone sound and localization experiments has been analyzed within the fields of art and media to examine the multi-, inter-, inner-concepts related to media and art. Again, 'liquidity' has been proposed as a new framework of thinking characterized by the similar concepts of change and innovation.

Multi-viewpoint

"The explanation is obvious: The Garden of Forking Paths is an incomplete, but not false, image of the universe as Ts'ui Pên conceived it. In contrast to Newton and Schopenhauer, your ancestor did not believe in a uniform, absolute time. He believed in an infinite series of times, in a growing, dizzying net of divergent, convergent and parallel times. This network of times which approached one another, forked, broke off, or were unaware of one another for centuries, embraces all possibilities of time. We do not exist in the majority of these times; in some you exist, and not I; in others I, and not you; in others, both of us. In the present one, which a favorable fate has granted me, you have arrived at my house; in another, while crossing the garden, you found me dead; in still another, I utter these same words, but I am a mistake, a ghost". [8] We start from Borges' Garden of Forking Paths. Firstly his description of a labyrinth with multiple possible entry points and viewing positions can be directly related to the construction (or initial structure) of this research. Secondly, the story is often referred to as the first 'hypertext' novel. For Janet H. Murray in her book 'Hamlet on the Holodeck: The Future of Narrative in Cyberspace' (1997), this text is a good example of a multiform story, described as a narrative where a single situation is presented in multiple versions. The story unfolds itself as a maze with different viewing positions, different entry and end points and the possibility to choose or navigate between the infinite list of options and thus creating a different interpretation of the information. In an essay entitled 'Inventing the Medium' (published in the 'New Media Reader') Murray further comments: "Borges confronts us with the 'pullulating' moment, when we become aware of all the possible choices we might make, all the ways in which we might intersect one another for good or evil." [9]

In order to access these (multiple) local realities embedded in and part of a (possible) larger or global worldview we will reintroduce the stroller or wanderer or flâneur as a device to unravel and present evidence for understanding the increasingly complex ways in which artists (and scientists) develop, model and mirror our world. Most importantly this research is about the ways artists (and scientists) deal with, create and endure new meaning and how they comprehend and construct the world through theories, models and maps. This project will argue that theorizing, modelling and mapping implies (creating) a (series of) local world views in relation to (or even opposed to) a larger global world view and that the concept of 'in- betweenness' is central to the discourses and artworks that shape these world views. In doing so an artwork, triggering the installation of a map, model and/or theory for orientation is needed, which will be called the 'liquid' framework.

Walking, seeing, listening

In literature and philosophy many authors have addressed the character of the wanderer or walker as a tool (or even theoretical construct) for articulating local realities. The best studied example is the 'flâneur' as introduced by Baudelaire in many of his poems as part of 'Les Fleurs du Mal' (The Flowers of Evil) first published in 1857. The idea of the flâneur was inspired for Baudrillard by Edgar Allen Poe's 'The Man of the Crowd' first published in 1840, where a nameless man (the narrator) follows another person through London. This work as well as the idea of the flâneur by Baudelaire are extensively discussed by Walter Benjamin in his book 'Illuminations' (1969). The flâneur feels at home in the city and dwells the streets (anonymously) to look at and register local habits and facts within a multilayered, global entity. A good example for this shift from global or general observations to detailed descriptions can be found in Poe's work: "At first my observations took an abstract and generalizing turn. [...] Soon, however, I descended to details, and regarded with

minute interest the innumerable varieties of figure, dress, air, gait, visage, and expression of countenance." (1840). Bit by bit, the flâneur is able to analyze, categorize and define the different entities that he is overlooking in an attempt to construct the whole, the initially unreadable: "IT WAS well said of a certain German book that "er lasst sich nicht lesen"-it does not permit itself to be read. There are some secrets which do not permit themselves to be told.". [10] Both the characters of Baudelaire and Poe feel comfortable in a fluid, liquid surrounding and their trajectory or path is mainly guided by the interest in seeing, discovering new things, a search for novelty in an active way by walking. As such, the walking becomes an allegory for the intellectual endeavour or processes during the search. For James V. Werner this active process differentiates the walker from the observer and creates a fluid and observational viewpoint rather than a static one, that "allows (indeed compels) him almost completely to 'read' his environment, nearly to transcend the boundary between interpretation and experience [...]". [11] Also for Burton (2010), the flâneur 'strives to be both all-seeing and invisible' and unlike the observer he will do this in an active manner.

Just as in the London or Paris city settings as described by Poe, Dickens (Night Walks) and Baudelaire, this research is constructed as a map or city maze where the reader or walker can walk through actively in search of those connections which interest or trigger him/her most. Or, in a Deleuzian sense a nomadic travel generating a series of 'close-range' visions in a multiple, variegated environment. [12] Well aware of the multiple and subtle differences between the flâneur, observer or walker as discussed by Deleuze, Benjamin, De Certau or the 'dérive' by Debord amongst others or in the literature by Dickens, Poe, Rousseau or Baudelaire, the concept of walking here is introduced in the simple construct of accessing (and understanding) information on different levels, in different contexts and in different connections. This research does not focus on the flâneur but rather adopts the metaphor of walking as a means to access information in a gradual (local) way in the hope to understand or unravel the total (global). The city or landscape thus becomes the paper, the walker becomes the reader as a means to produce rich or thick information. One can choose to walk intuitively or one can choose to walk following a fixed route. However, one element proper to the flâneur proves to be relevant to the content of the research, mapping or modelling involves a viewing position. Are we in or outside a given system, do we take part or simply observe, do we look from within or above?

Thickening

Just as in cooking a thickener is used to thicken (or increase the viscosity) of fluids, the concept of thickening as described by Clifford Geertz will be used in an attempt to thicken our liquid knowledge society as discussed by Bauman. This act of thickening can be reformulated in the context of accumulating, becoming more intense or intensifying, deepening. Seen in this way the act of thickening becomes a means to deepen the concepts discussed in the research by a strategy of revisiting the postulated 'liquid' framework. In this respect we use the word 'means' instead of 'method' as for Geertz focus should not be on techniques or procedures but on a specific intellectual effort or an elaborated activity or endeavour. This revisiting has been done in three domains (art, sociology and science) to test-drive the idea of the framework set-up to deal with the notion of novelty and change. How do artists, theorists, scientists deal with this notion of new and how this is reflected in their work in particular in the context of the powerful introduction of a liquid society. How do we position (geographically, mentally) ourselves in a given system? Do we take part in the system or do we view from above? Are we in, out or do we simply walk through. And is this mapping a static given or does it initiate certain dynamics? As discussed central is the idea of a 'multilayered' nature, being works (artistic and scientific) where different people on different levels are involved on the level of conception and/or production. Also the way in which we deal with a multi-media environment or total spectacle or model proves to be an important factor for the further development of a framework helping us to understand our lived-in world. In addition, also the way in which a 'subjective' worldview is addressed is key to understand the dynamics of change and novelty.

Furthermore it became apparent that the model/artwork in itself proved to be an interesting concept with which to deal with those 'new' worldviews. As discussed, models are only applicable in and on a local part of reality (world), here again also the grey zones between models prove to generate interesting insights in relation to novelty. How to deal with these new theories of media, how to position these 'new' media in respect to the 'old', how to tell new narratives triggered by new technological discoveries? Out of the results a first model could be identified describing these processes of change in the field of media theory and new media art. In a second stage this 'trans' idea proved to be a central element in mapping and cartography. How do we position ourselves in a given system? Do we take part in the system or do we view from above? Are we in, out or do we simply walk through.

In other words, can we model a framework to deal with our liquid society and how could this model become a generator for the new? Out of this research two other (initially unexpected) elements came to the foreground, the first questions how to interpret map, model or theory. And are these interchangeable or only applicable in certain contexts (local parts of reality)? The second installs a duality (sometimes even a paradox) by being at the same time the con-

struct for interpretation (map, model, theory) and simultaneously the object for construction (trans, change, middle). In other words 'liquid' becomes a model for the interpretation of change but at the same time is responsible for this change, being change itself.

In his landmark book 'The Interpretation of Cultures' published in 1973, the anthropologist Clifford Geertz elaborates on this concept of 'thick description'. For Geertz what a researcher/artist is faced with (except the automated routine of data collection) "is a multiplicity of complex conceptual structures, many of them superimposed upon or knotted into one another, which are at once strange, irregular, and inexplicit, and which he must contrive somehow first to grasp and then to render." [13] Furthermore, understanding (of a culture for instance) for Geertz exposes a certain normalness without reducing the particularities. It renders information accessible and dissolves its possible opacity. However, he also warns that this approach, sometimes referred to as 'seeing (hearing, sic) from the actor's point of view' or 'the verstehen approach', often may lead to a notion of fantasy or speculation and must therefore be approached with great care. As a result, a thick description is needed where case studies, events and theories can be studied in detail, by building layer after layer, so one is able to assess and evaluate the degree in which the conclusions made are also valid or convertible to other systems or situations or time frames. One must not only study the phenomena but also the context in which they take place in order for them to become understandable for a third party. This thick or multilayered description has a double function: "Such a view of how theory functions in an interpretive science suggests that the distinction, relative in any case, that appears in the experimental or observational sciences between 'description' and 'explanation' appears here as one, even more relative, between 'inscription' ('thick description') and 'specification' ('diagnosis') – between setting down the meaning particular social actions have for the actors whose actions they are, and stating, as explicitly as we can manage, what the knowledge thus attained demonstrates about the society in which it is found and, beyond that, about social life as such. Our double task is to uncover the conceptual structures that inform our subjects' acts, the 'said' of social discourse, and to construct a system of analysis in whose terms what is generic to those structures, what belongs to them because they are what they are, will stand out against the other determinants of human behaviour. In ethnography, the office of theory is to provide a vocabulary in which what symbolic action has to say about itself - that is, about the role of culture in human life - can be expressed." [14] In other words, Geertz is well aware that meaning is always changing, always in flux and rooted in a specific culture, therefore he suggests the thick description as a means to describe the phenomena together with their context through a multilayered approach. For this research, it is exactly this multilayered view through a sound localization and auralization artwork that enables understanding as well as context, where results and interpretations from one experience are being transferred and interpreted in a different context to investigate their validity.

Experiments on auditory scene perception embracing liquidity and multi-viewpoint perception

The scientific literature on the auditory perception of sound scenes is vast, and the concept of binaural spatial hearing (Blauert, 1997) turns out to play a central role in any auditory perception task. Models of auditory scene perception are generally based on the segregation of such scenes into auditory events or objects (Bregman, 1994), and are validated with psychoacoustic experiments in which subjects are presented with auditory stimuli in a controlled environment. While such models and experiments have indeed laid the foundations for our current insight into the complex mechanims of how the human auditory system is capable of analyzing, interpreting, and giving meaning to rich auditory scenes, the concepts of liquidity and multi-viewpoint perception are hardly covered in this traditional psychoacoustic framework.

From the technologist's and experimentalist's perspective, the scientific investigation of liquidity and multi-viewpoint perception requires that the subject under study be placed in a dynamic, continuous, and ecological environment and is given the freedom to move, walk, navigate and act in that environment. Such approach implies that the investigator is released from the prerogative of a controlled experimental environment, allowing the experiment to become an artistic and scientific project in which the subject under study takes the role of the flâneur.

In the experiment/artwork, subjects will be presented with binaural sound rendered in wireless headphones while walking in a multilayered physical environment. The rendered sound consists of virtual sound sources that are auralized using an acoustic model of the actual physical environment in which the subject takes the experiment. This will be achieved by making a priori spatial recordings of the scenario where the virtual sound sources are actually placed in the physical environment. These recordings will be made with a sound field microphone positioned at a discrete set of measurement positions. Generating liquidity between measurement positions is performed by interpolation of the measurements, using an interpolation method that takes into account the acoustic properties of the physical environment (Antonello, 2017) and applying principles of optimal mass transport to avoid that the energy of a moving source is artificially scattered during interpolation (Elvander, 2018). [15] [16]

Real-time dynamic binaural rendering will be performed based on the instantaneous position and orientation of the

subject retrieved using a head tracker. This approach indeed fits the objective of virtually synthesizing a truly multi-viewpoint auditory experience while walking. The rendering method will be designed based on recent insights in multi-viewpoint sound source localization which were obtained as the result of a large-scale auralization experiment (De Sena, 2017). [17] Interestingly, in this experiment it was observed that subjects presented with the task of turning towards a virtual sound source will first perform a wide-range angular "scan" of the auditory scene, followed by narrow-range movements around the presumed sound source direction. This behaviour indeed discloses the flâneur's tendency to gradually shift from global observations to detailed descriptions as discussed previously.

Conclusion

This paper sketched the setting of the research, outlining the framework of thinking from within three concrete settings, (i) new media theorie(s) and its associated artistic practices (or vice versa), (ii) the construction of models/artworks and their power to generate new meanings and insights and (iii) the crucial role of science in its generating constructive power by the means of artefacts and its philosophical implications when constructing and using these models. All discussed the current ideas of thinking in the relative fields and established the need for an alternative (new) means of interpretation. In this set up, the role of the 'liquid' framework has proven to be crucial by articulating new positions through which to interpret the different constituting elements. The concept of being in-between, in movement, dynamic, open ended, multiple entryways and multiplicity has been denoted and is the underlying overcoupling engine. As discussed, in terms of our perception, we might say the 'world' first appears for us in the form of a representation, and often in the form of models and maps. But people do not experience the world the way it is represented in maps and equally it is impossible to perceive the world in its total reality. Immanuel Kant refers to this aspect of perceiving the world as a 'regulativ Idee' (a border concept) a concept that leads our experience but that in itself is not experienceable. Where maps used to be representations of a territory installed by a nation or state, they have now also become representations of other forms of 'reality' visualizing a broader cultural debate. Therefore the mapping has been substituted by an artwork, a sound walk, including all possible references (both artistic as well as scientific), to indicate our multilayered lived-in world. Only by acknowledging these multiple points of view, here expressed through technology and art, the research has installed itself as an autonomous practice or tool that allows us to orient ourselves or to find or share common interests. As such, as Baudrillard puts it, the map even precedes the territory. In our case, the walk and binaural experience precedes reality. The work has gained an authoritative power that can overrule reality. What has been put on the map/artwork is affirmed to be real, what is left out is considered not to exist. The work has become more real than the lived experience. By the very act of condensing complex information about this world into a sound experience, art can strengthen/initiate a feeling of orientation or disorientation.

References

[1] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (University of Minnesota Press, Minneapolis, 1988), 28.

[2] Regis Debray, *Media Manifestos* (Verso, London, 1996), 18.

[3] Marshall Sahlins, *Culture and Practical Reason* (Chicago University Press, Chicago, 1976), 211.

[4] Homi K. Bhabha, *The Location of Culture* (Routledge, New York, 1994), 54.

[5] Homi K. Bhabha, *The Location of Culture*, 56.

[6] Don Handelman, *Models and Mirrors, towards an anthropology of public events* (Berghahn Books, New York, 1990), x.

[7] Don Handelman, *Models and Mirrors, towards an anthropology of public events*, xiv.

[8] Jorge Luis Borges, "The Garden of Forking Paths", in *Labyrinths: Selected Stories and Other Writings* (Penguin Books, London, 200), 187.

[9] Janet H. Murray, "Inventing the Medium", in *The New Media Reader*, ed. Noah Wardrip-Fruin and Nick Montfort (Cambridge and London: MIT Press, 2003), 3.

[10] Edgar Allen Poe, *The Man of the Crowd* (originally published in Atkinson's Casket, 1840).

[11] James V. Werner, *American Flaneur: The Cosmic Physiognomy of Edgar Allen Poe* (Routledge, New York, 2004), 154.

[12] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (University of Minnesota Press, Minneapolis, 1988), 543

[13] Clifford Geertz, *The Interpretation of Cultures* (Basic Books, New York, 1973), 10.

[14] Clifford Geertz, *The Interpretation of Cultures*, 27.

[15] N. Antonello, E. De Sena, M. Moonen, P. A. Naylor, and T. van Waterschoot, "Room impulse response interpolation using a sparse spatio-temporal representation of the sound field," IEEE/ACM Trans. *Audio Speech Language Process.*, vol. 25, no. 10, (Oct. 2017): 1929.

[16] F. Elvander, A. Jakobsson, and J. Karlsson, "Interpolation and Extrapolation of Toeplitz Matrices via Optimal Mass Transport," IEEE Trans. *Signal Process*., vol. 66, no. 20, (Oct. 2018): 5285.

[17] E. De Sena, M. Brookes, P. A. Naylor, and T. van Waterschoot, "Localisation experiments with reporting by head orientation: statistical framework and case study," *J. Audio Eng. Soc*., vol. 65, no. 12, (Dec. 2017): 982.

Bibliography

Charles Baudelaire, *Les Fleurs du Mal* (reprinted in Charles Baudelaire, Oeuvres complètes, Paris, 1961).

Jean Baudrillard, *Simulations* (Semiotext[e] & The MIT Press, Cambridge, 1983).

Zygmunt Bauman, *Liguid Times: Living in an Age of Uncertainty* (Polity Press, Cambridge, 2007).

Zygmunt Bauman, *Culture in a Liquid Modern World* (Polity Press, Cambridge, 2011).

Walter Benjamin, *Illuminations* (Schocken, New York, 1969).
Jens Blauert, *Spatial Hearing: The Psychophysics of Human Sound Localization* (Cambridge, MA: MIT Press, 1997).

A. S. Bregman, *Auditory scene analysis: The perceptual organization of sound* (MIT Press, 1994).

Richard D. E. Burton, *The Flâneur and his City: Patterns of Daily Life in Paris 1815-1851* (Manchester University Press, Manchester, 2010).

Michel De Certeau, *The Writing of History* (Columbia University Press, New York, 1988).

Guy Debord, *Society of the Spectacle* (Rebel Press, London, originally published in 1967, Paris, 2006).

Charles Dickens, *Night Walks* (Penguin Books, London, originally published as Chapter 13 of the Uncommercial Traveller, 1861, 2010).

Immanuel Kant, *Critique of Pure Reason* (Cambridge University Press, Cambridge, 1999).

Janet H. Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (The Free Press, New York, 1997).

Authors Biographies

Steven Devleminck holds a Master degree in Engineering from the Vrije Universiteit Brussel and a PhD in Art and Philosophy from the University of the Arts, London. Previously, he was the Director of the Transmedia Research Programme in Arts, Media and Design of the Leuven University College of the Arts (LUCA), and visiting Professor at maHKU, Utrecht. Currently he is the Head of the Mediated Environments Research Group at LUCA School of Arts and Professor at the Department of Computer Science at KU Leuven. His publications include books and a series of internationally published articles and conference papers. His practice based work has been shown internationally. Research interests are mediated environments, interactive technology, cartography and mapping. He is the Scientific Coordinator of the Innoviris Anticipate 'Smart Urban Community Interface Blocks' research project investigating the design of IoT toolkits for creating interactive urban interventions for both placemaking and civic purposes.

Boris Debackere is an artist and researcher lecturing at LUCA School of Arts, KU Leuven. Debackere is currently serving as the head of V2_Lab in Rotterdam, an instigator of artistic projects that interrogate and illuminate contemporary issues in art, science, technology, and society. As a media artist, his primary interest lies in the interplay of art with the social and technological space. In the field of digital art, his practice has a multimedial character with a recurring key concept: to experience the materiality and performativity of a medium that might appear to be a virtual environment. Debackere received the Liedts-Meesen new media nomination 2010, won the Georges Delete 2014 Prize for Best Original Music and Sound Design and received the 2015 Ensor Sound Design Award.

Toon van Waterschoot received MSc (2001) and PhD (2009) degrees in Electrical Engineering from KU Leuven, Belgium, where he is currently Associate Professor. He has previously held teaching and research positions at Delft University of Technology in The Netherlands and the University of Lugano in Switzerland. His research interests are in signal processing, machine learning, and numerical optimization, applied to acoustic signal enhancement, acoustic modeling, audio analysis, and audio reproduction. He has been the Scientific Coordinator of the Marie Curie Initial Training Network "Dereverberation and Reverberation of Audio, Music, and Speech (DREAMS)" and currently holds a Consolidator Grant of the European Research Council on "The Spatial Dynamics of Room Acoustics (SONORA)". He is a Director of the European Association for Signal Processing (EURASIP), a Member of the IEEE Audio and Acoustic Signal Processing Technical Committee, and a Founding Member of the European Acoustics Association's Technical Committee in Audio Signal Processing.

TransVision: Exploring the State of the Visual Field in the Age of Extreme Augmentation

Jiabao Li, Honghao Deng, Panagiotis Michalatos
Harvard Graduate School of Design
48 Quincy St. Cambridge, MA 02138 USA
stephlijiabao@gmail.com

Abstract

Human perception has long been influenced by technological breakthroughs. An intimate mediation of technology lies in between our direct perceptions and the environment we perceive. Through three extreme ideal types of perceptual machines, this project defamiliarizes and questions the habitual ways in which we interpret, operate, and understand the visual world intervened by digital media. The three machines create: Hyper-sensitive vision – a speculation on social media's amplification effect and our filtered communication landscape. Hyper-focused vision – an analogue version of the searching behavior on the Internet. Hyper-commoditized vision – monetized vision that meditates on the omnipresent advertisement targeted all over our visual field. The site of intervention is the visual field in a technologically augmented society. All the three machines have both internal state and external signal.

Keywords

Wearable; Speculative Design; Augmented Reality; Vision; Tactile Art; Soft Robotics

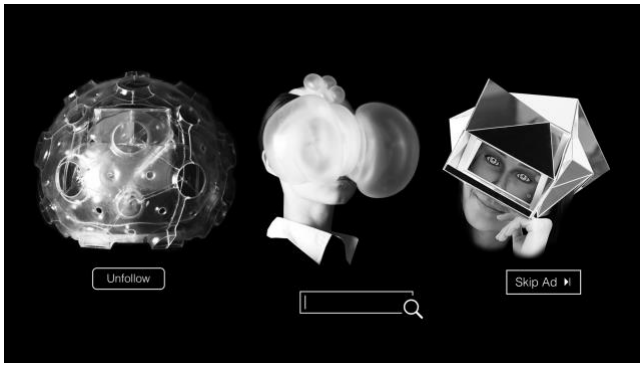


Figure 1: Hyper-sensitive vision (left), Hyper-focused vision (middle), Hyper-commoditized vision (right).

Hyper-allergenic Vision Syndrome

The modern society has observed an increase in allergies and intolerances. Hypersensitivities are emerging not only medically but also mentally. Technology has this mutual reinforcement effect that people tend to become less tolerant because they interact even less with people who have different backgrounds and opinions just because of the structure of the Internet's ability to connect selectively and to filter information. Digital media as mediator reinforce people's tendency of overreacting through viral spread of information and amplification of opinions, making us hypersensitive to our social-political environment. Similar to patterns of intolerance to signals that we see with our immune system, we also see with our mental responses to our environment, to mental stimulation, and to the distribution of the sensible. Under the current social-political media condition, we device more and more structures in order to aggressively filter this environment both in terms of digital media and in terms of physical interactions like what we eat. By creating an artificial allergy to redness, this machine manifests the nonsensical hypersensitivity devised by digital media.

Figure 2: Symptoms of Hyper-allergenic Vision Syndrome: tendency of overreact, politics of anger, filtered communication landscape, severe symptoms may include total separation and isolation from the red world.

Figure 3: Viewing American presidential election map with red allergy. Create allergy: Expand (left); Cure allergy: Shrink (right).

Figure 4: The helmet can be wear in two modes: nocebo mode and placebo mode.

Nocebo effect occurs when negative expectations of the patient regarding a treatment cause the treatment to have an even more negative effect than it otherwise would have. In this mode, the helmet is a machine that gives you the experience of sensory hyper allergy. Whenever you are exposed to red, the red expands in your visual field. This effect is similar to social media amplification: digital media has this effect, when you are looking into something that bothers you, you tend to find other people that share the same emotion, and then you exchange messages, memes, photos, and become more and more angry. That's why we are living in the politics of anger. People tend to find like-minded people, thus a trivial issue get amplified and becomes intolerable.

A placebo is given to a person in order to deceive the recipient into thinking that it is an active treatment, and it actually makes the patient feels better both psychologically and physically. In this mode, the helmet becomes an artificial cure to this allergic. Whenever one encounters red, the red shrinks. This is similar to the filtered communication landscape caused by digital media, where we can unfollow the people with different opinions, and remove them completely from our communication channel.

Figure 5: As a side effect, the helmet generates smoke and turns into a green bubble to neutralize red.

Video 1: https://youtu.be/L4rbfNRSN7s

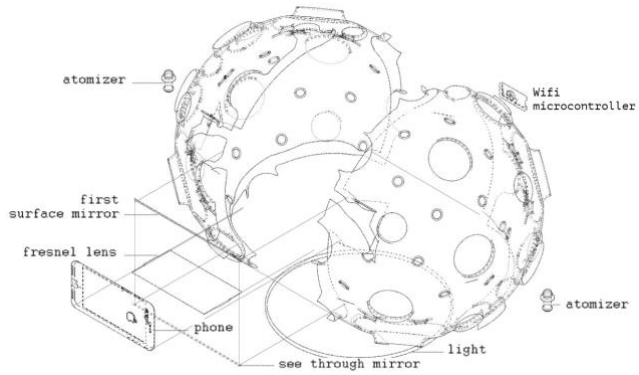


Figure 6: Construction of the perceptual machine.

The front part of the helmet contains a first surface mirror, Fresnel lens, and a see through mirror. With a phone in front, the lenses create an augmented reality experience. The shell has a 3-layer fly eyeball dome structure and is 3D printed with clear resin. An Adafruit ESP8266 triggers the light and atomizer to generate green smoke when red is detected from the phone. The App is created with Unity and OpenCV.

Figure 7: This kind of hyper allergenic environment undermines social interaction.

Overtime, this allergy becomes a form of identity. What people are allergic or intolerant to may be totally nonsensical, or do not have a scientific base, like the gluten free diet, or intolerance to certain political views. This kind of hyper allergenic environment undermines social interaction.

Everyday life becomes so intolerable, because there are so many signals that cause extreme reactions. People end up in a green room where everything is green, to isolate themselves from the red world. Everybody else in the room has the same allergy. This intolerance causes them to congregate with like-minded people to try to make everything agreeable. In fact, there are many rooms in the

world, some are totally red and some are entirely green. They are completely separated and the people inside one room never cross path with the other. Human communities become hyper fragmented and separated, they cannot find channels of communication between each other.

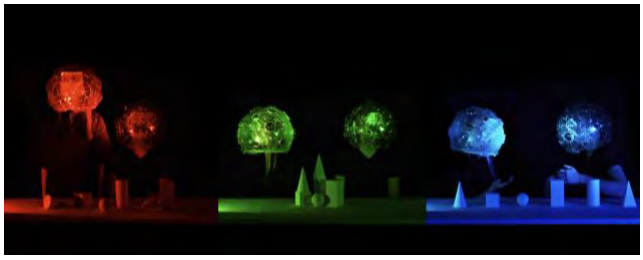


Figure 8: The red, green, blue rooms in the world. They are completely separated.

Tactile Vision

Vision works well when we have an overview of the total system, but the way we search in digital media is through little steps, from link to link — a tactile experience as we feel the landscape. We can never see it as a whole because it's not a continuous space. Instead, we look through a pinhole and build up everything without an overview. This searching function enables us to reduce the amount of chance and encounters, so we can just directly search for something in an extremely focused way and filter out everything else. This wearable is the extreme version of we possessing only one sense for one thing. With a pneumatic system made of silicon that reacts to the sensing of light in front of both eyes, the wearer gains stereovision to distinguish directions for navigating in space. Depriving all other sensory experiences and leaving only one signal channel, this hyper-narrow, focused, and filtered vision is an analog version of the searching behavior on the Internet.

Figure 9: Searching for light with tactile vision

Video 2: https://youtu.be/lOEvmTMtyHI

When surfing the Internet, there are two modes of being there: one is wondering around, which happens a lot at the beginning of the Internet. One can easily get lost in the vast landscape of information. As media becomes more efficient in delivering information, it gives us the tool — searching — to limit this wondering, hence we become more focused and targeted.

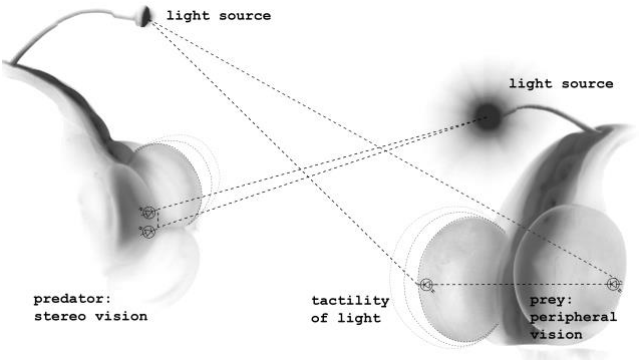


Figure 10: On each side of the eye locates a photodiode to sense the light, and a pneumatic system made with elastomer to react according to the sensor. The mask breathes gently when the light is far away and rapidly as the light gets closer.

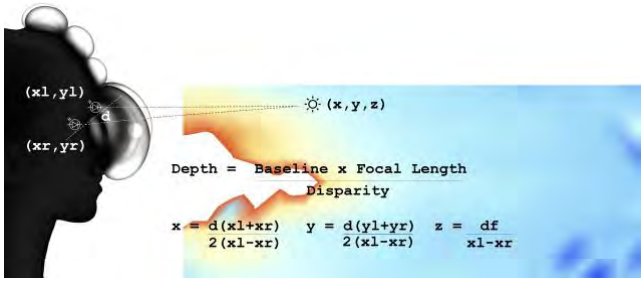


Figure 11: Like the two eyes we possess, the distance in between the two sensors forms a stereovision. Hence the location and depth of the upcoming light can be distinguished.

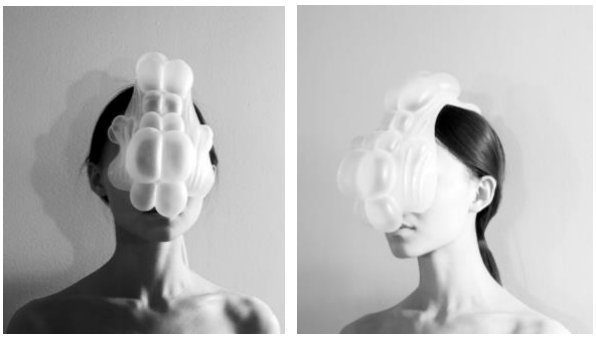


Figure 12: A pneumatic system made with elastomer that inflates/deflates in various speeds according to the intensity of light.

Figure 13: Like a dating App for cave animals.

The anglerfish lives in what is easily Earth's most inhospitable habitat: the lonely, lightless bottom of the sea. They have a piece of dorsal spine tipped with a lure of luminous flesh that protrudes above their mouths like a fishing pole, which lures the prey close enough for the anglerfish to devour them whole. Similar to the predation behavior of the anglerfish, the high intensity light sprouting from the middle of the mask is a cue, or a lure, for others to find them in total darkness. Light, the single signal here, is a communication channel and a trap. Only responding to single stimuli may be an efficient way to find things, but may also be a very easy way to get trapped or fooled. Similar to searching, when you are only interested in one thing and only looking for it, you loose the capacity to see things in context to make more informed decisions. Like moth into flame, this hyper specialized vision, with light as the only stimuli, is very efficient, but also very easy to be tricked.

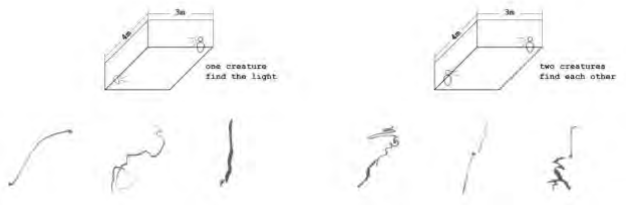


Figure 14: The participants draw the route they've passed.

We invited people to experience the tactile vision in a 3x4m room. First we let one participant try to find the light across the room. Then we let two participants try to find each other. They were asked to draw the route they've passed (fig. 14). The participants have no prior knowledge of the room and the position of the light. With the stereovision they were able to find the targets. Here are some of their testimonies: "The tactility of the elastomer and the fuzzy light kind of invite a sensory intimacy and eroticize the human relation to reality." "You really have to move in space to achieve the incremental understanding of what is your relationship to the stimuli you respond to."

Figure 15: Fabrication process: laser cut the molds from acrylic sheets, pour Ecoflex 00-30 into the molds, leave it to cure then peel off carefully, assemble the top and bottom layers together with the tubes, actuate and check for clogs and openings

Commoditized Vision

"There are ceaseless bombardments of advertising nowadays. Images are converted into endless commodities manufactured to postpone boredom; humans in turn are commoditized. [1]" "From television to newspapers, from advertising to all sorts of mercantile epiphanies, our society is characterized by a cancerous growth of vision, measuring everything by its ability to show or be shown. [2]" The commodification of the visual field requires observers that can rapidly consume visual information. The downside of this is the extreme overloading of information that has to be packed into the visual field in order to make the most out of every second when we are looking at something. It prevents us from any kinds of contemplative relationship to the world. The meditative relationship to what we are staring at is no longer possible because everything has an overlay of commercial information trying to extract value from us. The visual field becomes a commodity that has real estate value. By creating the tension between meditative state and consumptive state, the third machine contemplates on how augmenting the visual field with new technologies affects our relationship to the world in this particular social-economic context.

This perceptual machine has two modes: Make Money mode and Spend Money mode.

Video 3: https://youtu.be/5zrxeAmf8rc

Figure 16: In make money mode, the ubiquitous advertisement fills in everywhere (right). You can earn money by looking at these advertisements, but at the same time your eyes languish (left).

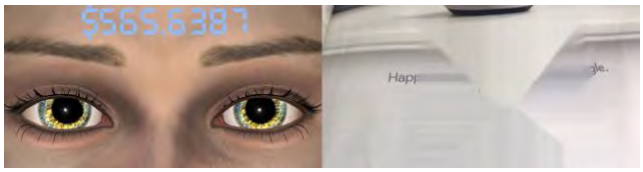


Figure 17: In spend money mode, advertisement disappears (right) and money drops accordingly, but your eyes are refreshed (left). You have some time until the money goes to zero where you don't see any commercials so that you can contemplate the world.

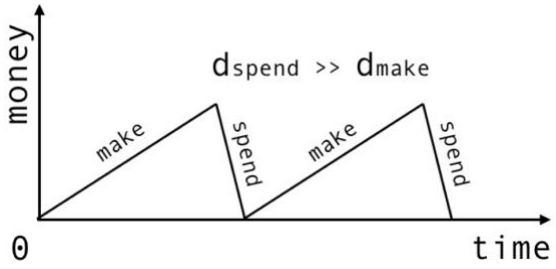


Figure 18: The gradient of the two modes are not equal.

It takes more time to make money than to spend money, so you have to look at the advertisement a lot more time in order to have a few seconds of contemplation. You have to manage your time in the world between looking at what you want and what makes money. Everyday activity becomes hampered by the fact that you have to convert vision into a moneymaking enterprise. Unfortunately, even when you have the ability to do these activities, you have to do it in a rush, because you don't have enough capitals.

Figure 19: The eye is a surface, a map, a landscape, an agency to convey the inner status of oneself

Figure 20: The reflective mirror reflects the environment. You become what you see.

Once the technology is able to colonize the site itself, we have no choice anymore. More efficient viewer becomes more efficient labor. Like Juhani said: "Perhaps, freed of the implicit desire of the eye for control and power, it is precisely the unfocused vision of our time that is again capable of opening up new realms of vision and thought… The technological extensions of the senses have until now reinforced the primacy of vision, but the new technologies may also help the body to dethrone the disinterested gaze of the disincarnate Cartesian spectator. [2]"

References

[1] Michel de Certeau, *The Practice of Everyday Life*. (Berkeley, University of California Press, 1988).
[2] Juhani Pallasmaa, *Eyes of the Skin* (London, Academy Editions, 1996).
[3] Andreas Broeckmann, *Machine Art in the Twentieth Century* (Cambridge: The MIT Press, 2016).
[4] Giuliana Bruno, *Surface, Matters of Aesthetics, Materiality, and Media* (Chicago, The University of Chicago Press, 2014).
[5] Jonathan Crary, *Suspensions of Perception* (Cambridge, The MIT Press, 1999).
[6] Madeline Schwartzman, *See Yourself Sensing* (London, Black Dog Publishing, 2011).
[7] Hito Steyerl, *The wretched of the screen* (Berlin, Sternberg Press, 2012).

Author Biography

Jiabao Li works at the intersection of emerging technology, art and design. Her work opens questions about technology's influence on human perception, identity, and emotion. Her research-based projects range from wearables, projections, drones, installations to scientific experiments. She holds a Master of Design in Technology degree with Distinction from Harvard GSD. Jiabao's work has been featured in Domus, TechCrunch, Yahoo, CCTV, Yanko Design, and The National. Her work has been shown in Milan Design Week, Dubai Design Week, SIGGRAPH, CHI, AR in Action, and PRIMER. She is the winner of iF Design Award, Fast Company World Changing Ideas Award, Future Cities Contest, ISWC Design Award, and Harvard Best Thesis Award.

Honghao Deng is a computational designer and artist. He holds a Master of Design Studies with distinction at Harvard GSD and has served as a research fellow in the City Science Group at MIT Media Lab. Recognition gained in the design and interaction community include: Golden A' Design Award, iF Design Award, Fast Company World Changing Ideas Award, 1st Place Future Cities Contest, Ubicomp/ISWC Design Award. His work has been covered by Domus, CCTV, ArchDaily, Designboom, Milan Design Week, The National, and Metropolis Magazine.

Hertzian, Disruptive, Experimental Text Physicalizations.

Marinos Koutsomichalis
Department of Multimedia and Graphic Arts
Cyprus University of Technology
30 Archbishop Kyprianou Str., PO Box 50329, 3603 Limassol, Cyprus
m.koutsomichalis@cut.ac.cy

Abstract

A series of creative text physicalizations are accounted for herein, with reference to research literature and, most importantly, to an experimental algorithmic system designed and implemented by the author. The latter concerns a series of experimental pipelines that 'understand' the input text generating keywords, that utilize them to query 3D data from WWW, and, finally, that transfigure and merge the latter so that new original artefacts are synthesized. The various physical, digital, and post-digital material affordancies of the resulting physicalizations are scrutinized in some depth and in an analytic fashion. Objects of sorts are shown to be ascribed a certain kind of emergent neo-materiality, in that they are themselves hybrid manifestations of interwoven physical and digital affairs. As such, they constitute situated inquiries of the very same (technological) paradigms that brought them forth, as well as of their cultural and ideological offshoots. Physicalizations of sorts are shown to be 'Herzian', post-optimal, and disruptive, being both the creative means towards an exploration of new kinds of materiality/objecthood, and an implicit critique of the canonical functional design schemata that largely pertain digital fabrication nowadays.

Keywords

Physicalization, Post-digital, 3D printing, Solid modeling, Digital fabrication, Natural Language Understanding, 3D Data.

Introduction

Digital fabrication has been hitherto researched in various contexts, *inter alia*: FabLabs [1, 28], DIY personal fabrication [6], 'maker' culture [32, 21], and architecture [15, 5]. The last few decades, the proliferation of assorted technologies has accelerated an ongoing trend calling for the 'datafication' of physical objects [29, 2, 7, 17], and has resulted in the formulation of various relevant communities [3, 33, 24]. Despite their disparity, however, such communities/endeavors are rather orientated towards functional, maker-oriented, decorative, or otherwise 'useful' designs. This project, instead, is rather concerned with methodologies aiming at the production of objects that are post-optimal, disruptive/critical to the capitalist user-oriented design paradigm, or simply 'weird'.

In this respect, it is more relevant to all those hybrid artistic endeavors that concern the production of non-canonical (in some respect) artefacts and in ways that may speculate non-standardized, and not necessarily functional, production paradigms. *Oiko-nomic Threads* [18], for instance, speculates the nature of labor by virtue of a hybrid system producing a textile in a self-generative fashion and employing numerical data, digitized motifs, bespoke software running on iMac computers, a hardware hacked knitting machine from the 1980s, and an individual physically operating it. Another example is *Crafted Logic*, concerning operative electronic logic gates produced by means of textile-crafting techniques and being intended as a way to "*imagine alternatives to existing realities of computational technologies*" [27]. Insofar as approaches employing natural language are concerned, of particular relevance is *Spam Architecture*, revolving around a bespoke (albeit not yet documented) algorithm that produces 3D forms from junk email [34]. The resulting forms do sustain an architectural sense of rectilinearity, yet they defy pragmatics appearing rather unconventional and somehow corrupted—if not altogether 'uncanny'. (For more approaches employing textual data in some nonlinear fashion see, for instance, [22]).

The endeavor accounted for herein pivots on a series of experiments that concern the algorithmic production of physical objects from arbitrary text, employing Natural Language Understanding (NLU) and 3D data. Physicalizations of the sort are illustrated in the following pages, as well as in [20]. Their production relies on a series of experimental pipelines. The first parses and processes the input, collapsing it to a series of keywords, or phrases that are subsequently used as queries in order to retrieve 3D-printable models from Thingiverse[1]. This is achieved by means of algorithmically manipulating the input, so that it collapses into a bag of associated words, phrases, and concepts (not necessarily just the ones that appear in the text) that may, in principle, exemplify its meaning. This is a rather involved task that employs bespoke NLU techniques so that (a) words of possible interest are identified and extracted, (b) possible semantic associations between them are resolved employing co-reference resolution tactics that depend on online databases for lexical/semantic associations, (c) occurrences among the latter are quantified and ranked, and (d) just the highest ranked ones are kept. This resulting bag of concepts can be then used to perform online

[1] `https://www.thingiverse.com` Accessed December 18, 2018

queries so that 3D data are accordingly retrieved. Following this transliteration stage, the following pipeline is rather straightforward and concerns the geometrical transfiguration and eventual synthesis of the retrieved 3D data into new original mergers. These may be, later on, fabricated using standard 3D printing technologies.

The pipelines are further discussed in [16], where the method, technical implications, and implementation specifics are elaborated upon in great detail. As explained there, the proposed algorithm, in its final contingency, is characterized by important design decisions insofar as the particular ways in which the input text would be processed, and, accordingly, regarding repercussions that would propagate through the subsequent data-retrieval and synthesis phases. To give an example of the complexities at play, consider that when verbs/verb-phrases are also taken into account by the NLU-related parts of the algorithm, the resulting bag of concept does, indeed, better summarize the original narrative, yet, at the cost of an increasing number of queries resulting to haphazard 3D data (since most available models are typically named using noun-based descriptors alone). At the very same time, it is still unclear whether constructing longer, and thus more descriptive, noun phrases would result in more, or less, relevant results. Arguably, and up to some certain extend, design decisions also adhere to an aesthetic appreciation of how objects should not look like—that is, it is both presupposed and desired that they should not resemble ordinary functional/canonical objects.

It should be noted that in its final incarnation the suggested system is already contingent and can be extensively parameterized. To boot, it has been preceded by several other experimental set-ups that are not discussed in the above mentioned article. All together they lay out an array of assorted paradigms to physicalize text in creative, non-descriptive, and non-utilitarian, fashions. This treatise zeroes in on the kinds of physicalizations these systems may result into, irrespective of the technical particularities governing their production. Such artefacts are examined herein in an analytical fashion, and are found to attain a series of interesting physical, digital, and post-digital properties, as well as to constitute themselves crystallized inquiries of the very same technologies that brought them forth in the first place.

Having introduced the article and its primary foci, the next section outlines related work, and the one after that presents several example physicalizations. A discussion section follows, where the latter are analyzed in all physical, digital, and post-digital respects. Concluding remarks follow.

Related Work

Research literature accounts for several 'datalogical' approaches to digital fabrication. Several papers elaborate on systems for the physicalization of data representing human physical activity [14, 31, 11], others compare physical—e.g. 3D bar charts and 'data sculptures'—to traditional visualizations [13], and others discuss data physicalization in general [12, 30]. Zhao and Moere elaborate on "*data-based physical artifacts*" [*sic*] that possess both artistic and functional qualities, and that aim "*to augment a nearby audience's understanding of data insights and any socially relevant issues that underlie it*" [35]. To boot, at least two notable cases of workshops that pivot on the physicalization of information have taken place in InfoVis/CHI contexts [12, 10].

The most straightforward trend in information physicalization is to simply map data directly into objects of varying dimensions. Consider, for instance, Hogan's *Vessels of Ireland's Past* series, where wooden circles of varying radii along a spit represent Ireland's emigration, immigration and murder rate over selected periods of time[2]. This is a largely chart-inspired approach that can be particularly informative and intuitive in functional contexts, as illustrated in [12]. Direct comprehensibility should not be thought of as requisite to functional physicalizations, however, as there are many cases of a largely functional scope that, nevertheless, adhere to more liberal mapping schemata.

As a matter of fact, certain traits within 'personal informatics' and the so-called 'self-tracking culture' [23] rather prioritize individuated readings of data defined by their own making, or by one's personal experiences of it. Their actual quantitative significance, then, may, or may not, be of any importance. Physicalizations of sorts suggest an abstract and primarily qualitative approach, resulting in artefacts the signification of which remains largely individual-specific and the comprehensibility of which is not necessarily a desired trait—at least not in the traditional quantitative sense associated with InfoVis related research. Consider, *e.g.*,"*Activity Sculptures*" of running activity. Quoting the authors:

> "[...] we decided to focus on sculptures of an abstract nature and which support self-reflection. [...] Comprehensibility and direct readability of the exact data at the first glance was secondary since participants used the sculptures for a longer time." [31]

There are important similarities between such approaches and the one accounted for herein, in that they are both not particularly concerned with immediate comprehensibility, and in that the resulting objects can be somewhat weird-looking. Still, while *direct* readability is not, indeed, inherent to such an endeavor's foci, *individuated*, and/or *longer-term*, readability appears to be—as the above excerpt implies. Most importantly, and comprehensibility affairs aside, that kind of physicalizations are still meant as somehow 'useful', and thus functional, artefacts that do satisfy some particular need related to self-tracking and the projection of personal information. While it is arguable to what extent the resulting artefacts constitute themselves commodities of some sort, they are typically dealt with as prototypes that may, eventually, become somehow commercialized—be them for physical products or services. As such, the canonical norms governing functional design are, to some varying extent, both in effect and of relevance in this and in other similar cases. The herein presented research, however, rather concerns physicalizations that pose questions regarding their very own hybrid materiality and the technologies that govern their own making—in a sound materialist fashion. As explained in [16], the underlying algorithms are designed not in order to facilitate the generation of objects that are descriptive, or otherwise exemplificatory,

[2] `http://tactiledata.net` Accessed December 18, 2018

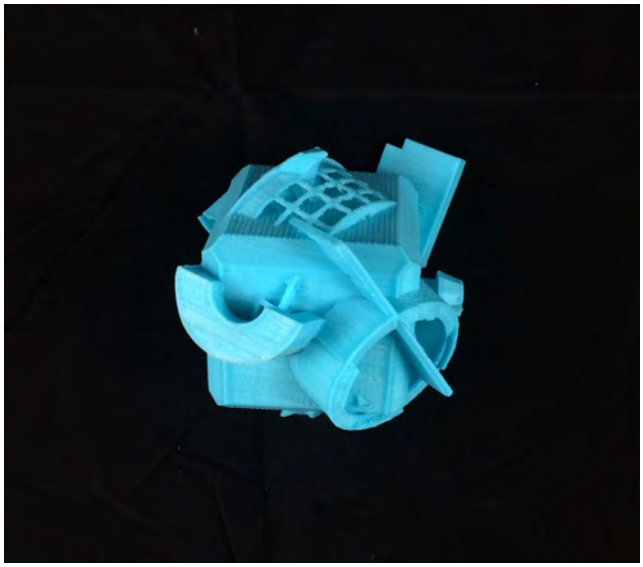


Figure 1: 3D text physicalization; largest dimension is 6cm

of the input text, but, instead, to generate ambiguous and disruptive artefacts that may fuel an interrogation of the technologies, and the data repositories, that are involved in their making. In this respect, and as to be later on discussed, such artefacts celebrate a certain kind of materialist structural introspection.

Much closer in spirit to such an approach are Nissen and Bowers' participatory data physicalization experiments [25]. One of those experiments concerns the physicalization of data representing the hand movements of crochet practitioners on a series of different occasions. Since participants cannot easily interact with the specifics of fabrication—that is, to experience the consequences of their modified behavior in the resulting artefacts—the resulting objects are rather abstract and illegible. They have observed, nevertheless, that after some certain period of time, the participants have become increasingly more interested in how their practice may inform the produced shapes, and have been even reported to change their crocheting behaviors in order to either interactively control the physicalization process at will, or to ameliorate the way they crochet with respect to the feedback physicalizations provide them with. In this research context, the authors have also become themselves reciprocally interested in crochet practice. All in all, their approach suggests, up to a certain extend, a community-driven and non functional attitude towards data physicalization. The resulting artefacts are primarily dealt with as the means to explore post-digital materiality in a situated real-life context here, rather than as 'products' to be eventually commercialized somehow.

Results

The physicalization system outlined in the Introduction has been employed on many occasions, spawning dozens of models several of which have been fabricated employing 3D printers. Figures 1–9 present a small sample of such physicalizations. The question of whether, and if so how exactly,

Figure 2: 3D text physicalization; largest dimension is 16cm

Figure 3: 3D text physicalization; largest dimension is 27cm

such artefacts may relate to their input text is examined in some detail in [16]. As discussed there, while in a few exceptional cases individuals did indeed come up with stories, or described moods that are rather evocative of the original input narrative, such physicalizations do not, in principle, exemplify the former in some significant semantic or phenomenological fashion. That said, they have been reported to trigger imagination in interesting ways and to result in particular moods, impressions, and even related clear-cut narratives that are occasionally shared across different viewers. As discussed in the above mentioned treatise, this can be attributed to the fact that they typically comprise recognizable shapes and (parts of) other objects. That is, they *are* themselves eclectic syntheses of more or less ambiguous entities with respect to the particular kinds of associations forged by their generating algorithm. The former may range from literal to non-intended, and from too-implicit to altogether dysfunctional ones.

In this way, individuated readings of such artefacts are laid out by virtue of 'connecting the dots' between arbitrary signs

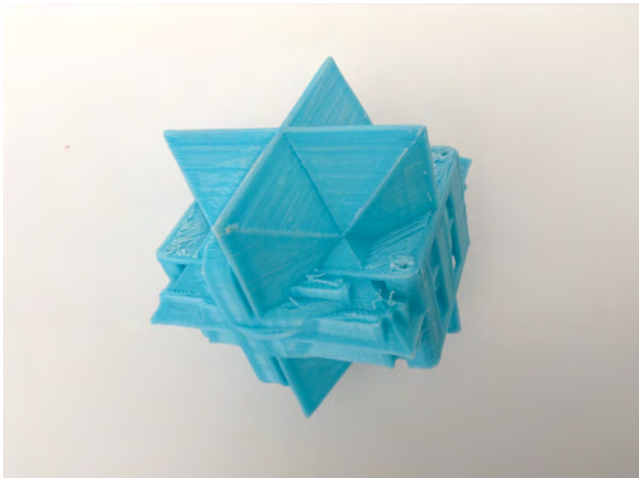


Figure 4: 3D text physicalization; largest dimension is 6cm

Figure 5: 3D text physicalization; largest dimension is 21cm

and their subjective significations, so that new (symbolical) content may be generated. It should be highlighted, however, that while the methodology of production moves intentionally into ambiguity (so that the generated objects are indeed, and up to some certain extend, semantically and aesthetically ambivalent), ascribed meaning cannot be solely attributed to interpretation schemata that are solely intrinsic to the viewer (in a Rorschach test fashion). As explained in [16], the pipelines involved have been designed with care so that the possibility of entirely haphazard transliterations is minimized, if not altogether eliminated. Accordingly, the resulting objects typically comprise more or less related integrals that, in turn, would favor (a few) possible reading(s), or kinds of readings alone—also with respect to the specifics of the particular experimental pipeline employed and the overall technical limitations of the overall method. In other words, while a certain level of ambiguity is indeed sought for (and arguably achieved) in all aesthetic, semantic and methodological respects, the resulting artefacts are not entirely equivocal (nor are they intended as such) phenomenologically.

Figure 6: 3D text physicalization; largest dimension is 12cm

Figure 7: 3D text physicalization; largest dimension is 13cm

The above mentioned article discusses extensively the visual aspects of such physicalizations but largely overlooks their textural and haptic qualities which, however, raise important phenomenological and post-digital affairs. Structurally, they are rough-hewn with a rather involved tactility. Unlike canonical everyday functional objects, or InfoVIS/CHI oriented data physicalizations, they tend to feature unnecessarily complex and rather uncanny 3D geometries,

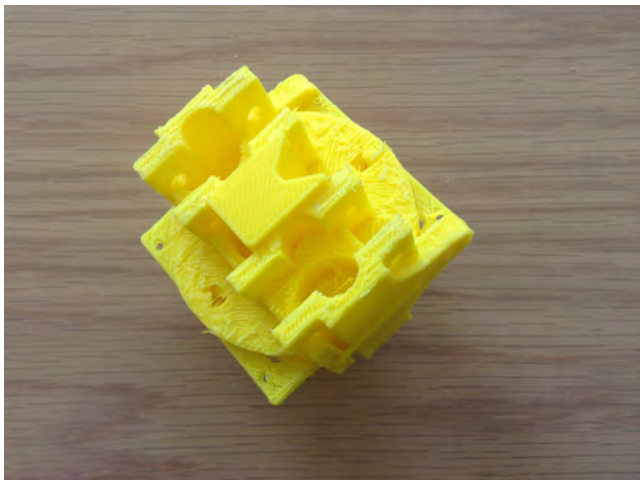


Figure 8: 3D text physicalization; largest dimension is 6cm

Figure 9: 3D text physicalization; largest dimension is 10.5cm

comprising of very eclectic props and substructures. Consider, *e.g.*, the objects in Figs. 1 and 3 that feature all sorts of haptically indefinite shapes, or the objects in Figs. 4, 8, and 9, that could be taken for as gimmicks of some sort. Indeed, they can be all 'performed'—much like fidget spinners, or rosaries—by means of holding them between one's fingertips and rotating them around various axes, of exploring their various structural cavities and haptic affordancies, or simply by holding them within one's palm. up to a certain extend this is a direct consequent of their dimensions: if they were much larger, or much smaller, that kind of affordancies would not be possible; and if the object in Fig. 2 were smaller, it would most likely afford similar performances. Still, it is also dependent on the intricacies of their geometry. Consider, *e.g.*, that even if 3D printed in different dimensions, the objects illustrated in Figs. 5 and 6 would not suggest themselves as gimmicks of sorts.

Therefore, merely with respect to their physical dimensions and structural qualities, physicalizations of the sort may suggest themselves as also attaining some kind of functionality. Such an emergent property may manifest in other ways, too. *E.g.*, the objects in Fig 5 and 7 inherently appear to suggest themselves as items to be *placed* somewhere—that is, they afford, and, in this vein, they also implicitly advertise themselves as artefacts that *should be*, exhibited and visually appreciated. Similarly, the objects shown in Figs. 1 and 4, rather call for haptic exploration, or simply to be held within one's palm.

Discussion

The material qualities these physicalizations bring forth can be examined analytically, with respect to physical, digital, and post-digital traits. At a purely physical level, as already explained, they are already ascribed with possible meanings with respect to their constituent subparts, the more or less vague associations they lay out, and the kinds of broad narratives their synthesis may suggest. At the same time, their tactility also accelerates particular haptic affordancies and may even suggest particular ways in which they can be performed, or used. That is to say, that at a very physical level they are already operate as both items to be used/performed and signs to be read/interpreted.

Their most striking physical property, however, is their being soundly different from the canonical objects we typically share our everyday lives with. Unlike alarm clocks, cellphones, mugs, laptops, and TVs, and despite being possibly ascribed some meaning or facilitating some particular mode of interaction, they are too extravagant to collapse into some well-defined use case. While their structural affordancies may suggest some more or less proper way to engage with them, as already explained, they cannot be reduced to this mode alone so that, *e.g.* the objects in Figs 4 and 9 are not gimmicks to play with, but rather 'weird' items that can be used this way too. Likewise, the possible narratives they appear to be ascribed with are always up to a certain extend ambiguous and suggest themselves as rather implicit and somewhat vague (rather than absolute). In this vein, they can be thought of as post-optimal objects, that defy stict contextualizations and that call for an immediate exploration of what they could possibly do/mean, while, at the very same time, they seem to question—or criticize—the supposed transparency of other, canonical, objects—see [4] for more into that kind of post-optimal, that is 'Hertzian', objects.

The illustrated physicalizations have even more interesting digital properties, in that albeit concretely physical—in the most literal sense of the word—they are simultaneously digital and embedded with the cybernetic encodings of their own making. Indeed, not only they soundly advertise their being algorithmically synthesized and digitally fabricated, they also solely exist as contingent manifestations of elsewhere stored digital information rather than as unique artefacts. In principle, they are always *copies*, meant to be re-produced and re-instantiated *in situ* with respect to localized digital technologies. They *are* digital information that can be archived, retrieved and re-produced at will, in the very same fashion that digital images [8] or digital audio [19] can.

Accordingly, being themselves digital content, they are also ascribed meaning on the account of the particular media that enable their reproduction and, most importantly, of the social and ideological repercussions the latter bring forth. In this particular case, and depending of course on the particular ways in which their exhibition may be contextualized, the digital concerns that are relevant herein involve, *inter*

alia, NLU, information retrieval, computational solid modeling, and digital fabrication technologies. Digital fabrication, in particular, is a rather charged, ideologically speaking, field of study/practice that remains relevant to a broad array of subcultures. It can be thought of, *e.g.* as drawing on, or implicitly calling for, (start-up) entrepreneurship, FabLab culture, DIY/DIWO fabrication, free/libre and open-source software/hardware, p2p sharing, hacking, and even political activism. In this vein, 3D printed physicalizations are often thought of as relating, or even advertising, such affairs. Note that the former are, in certain cases, discrepant with one another—in reality, there are severe ideological clashes between the various communities that are backing up digital fabrication technologies [9, pp. 25–44].

The extend to which such digital readings are accelerated depends, of course, on who, and in what context, interacts with the artefacts under scrutiny. In certain contexts, nevertheless, and when particular kinds of audiences are concerned, the above discussed digital traits seem to suggest legitimate ways in which one may interact with them— much like their physical counterparts. Certain kinds of audiences would be immediately drawn, *e.g.*, into sharing and fabricating themselves copies of these objects using localized 3D printed technologies, and others, when the context allows so, into generating their unique physicalizations with respect to own text input. Interaction schemata of the sort should not be understood as merely context-specific and context-related. They are rather brought forth but the very materiality of such physicalizations which already embed, in concrete physical terms, particular digital logics insofar as reproduction and performance are concerned. While arguably such objects cannot be immediately recognized as text physicalizations, they are immediately understood as algorithmically produced and digitally fabricated artefacts simply because of how they look, and feel, like.

All in all, we are dealing here with a hybrid kind of objecthood in that it is simultaneously physical, digital, and a synthesis thereof. Objects of the sort adhere to what Paul [26] refers to as 'neomateriality', that is, a certain kind of objecthood that incorporates networked digital technologies, revealing own coded materiality and the way in which digital processes may both perceive and shape physical aspects of our immediate environment. A post-digital perspective is ascribed herein exactly because of such a hybrid neomateriality and its phenomenological ramifications. An encounter with such an artefact is an encounter with a hybrid, multimodal, object that is both familiar (being made of plastic) and 'Hertzian', both ideological and open to ambiguous subjective readings, both intellectual and tactile, both poetic and algorithmic.

Conclusion

To summarize, the text physicalizations accounted for herein are shown to possess a hybrid materiality which is soundly physical, digital, and post-digital at the very same time. At a physical level, they are concrete objects one may visually and haptically engage with. At this level alone, and while already possessing more or less ambiguous meanings, they are also 'Hertzian' actors, defying strict categorization and established notions of optimality. They are surprising, simply because of their bold disregard towards the canonical product design norms of our times. This is a property they do share with many artworks and experimental design artefacts, of course; it is nevertheless not at all common in data physicalization milieus—especially insofar as functional InfoVIS circles are concerned.

These artefacts are also shown to be cybernetic. They are themselves digital information that has been produced algorithmically and by means of manipulating 3D and textual data, and that is meant to be reproduced and instantiated *in situ* with respect to localized digital fabrication technologies. That is, they are not unique original artefacts but rather *copies* or *instances* of a much broader digital hybrid that incorporates infinite contingent versions of themselves, reproduction technologies, and, of course, a broad set of ideological offshoots and debates. Therefore, the physicalizations discussed herein are also ascribed those ideological practices, trains of thought, and discourses, that are associated with the technologies that are responsible for their production.

Such a digital condition should not be though of as contrasting their physicality, but rather the contrary. They are not cybernetic *despite* being physical, but rather *because of*, and *in addition to*, to it. A certain kind of neomaterial, post-digital objecthood is brought forth in this fashion. These objects also celebrate a mode of reflexive inquiry insofar as their own production is concerned, in all cultural, ideological, technical, and other respects. Embedding a meaningful physical form, as well as the technological and ideological specificities of their own production, they are themselves records of their own making and explicit manifestations of broader hybrids that are responsible for similar kinds of objects. This is ascribed to their very own (neo)material properties—in the particular ways their substructural integrals are (algorithmically) synthesized, and in the unmistaken marks the 3D-printing process that has embed their bodies with.

The properties of the resulting artefacts aside, this endeavor has been also shown to celebrate an experimental approach towards the ways in which repositories of data and technologies of algorithmic manipulation may be employed. It advertises a certain trait within broader physicalization milieus that are often simply concerned with straightforward expositions, or quantifications, of data. Herein, post-digital poetics are not explored in some functional or utilitarian context, but rather as creative means zeroing in on the exploration of new kinds of materiality/objecthood and, in this way, also becoming an implicit critique of the standardized and canonical functional design schemata that largely pertain digital fabrication related affairs nowadays.

Naturally, given that the current state of affairs in digital fabrication is mostly concerned with the production of functional artefacts in some engineering, medical, 'start up', or other context, experimental 'Hertzian' approaches of sorts are often seen as (useless) curiosities by many experts. Yet, an *a priori* assumption that 3D printing (and digital fabrication in general) necessarily concern functional ends imposes significant restrictions on what is technologically feasible/easy to fabricate in those very same contexts. That is, certain kinds of

structures/forms/textures that may eventually prove 'useful' in some situated functional context would not be considered at all simply because the technical challenges their fabrication poses have never occurred pragmatically. However, the close examination of alternative experimental and 'Hertian' paradigms—such as the one accounted for herein—and of the technical, technological, and methodological quirks they bring forth can open the door to perfecting existent fabrication technologies so that it becomes possible to also consider all sorts of nonstandard and solutions to some functional (and nonfunctional) problem.

It is, accordingly, believed that experimental and 'Hertzian' approaches to digital fabrication in general, and to data physicalization in particular, should be further encouraged in various contexts, as the technological and methodological advances (or curiosities) they would resolve are expected to boost the current state of affairs not merely in digital arts related milieus, but also in all sorts of other research subareas—purely functional and applied ones included.

References

[1] Blikstein, P., and Krannich, D. 2013. The makers' movement and FabLabs in education: Experiences, technologies, and research. In *Proc. of the 12th International Conference on Interaction Design and Children (New York, NY)*, 613–616. New York, NY: ACM. doi: 10.1145/2485760.2485884.

[2] Chang, A. X.; Funkhouser, T.; Guibas, L.; Hanrahan, P.; Huang, Q.; Li, Z.; Savarese, S.; Savva, M.; Song, S.; Su, H.; et al. 2015. Shapenet: An information-rich 3d model repository. *arXiv preprint arXiv:1512.03012*.

[3] Dougherty, D. 2012. The maker movement. *Innovations* 7(3):11–14. doi: 10.1162/INOV_a_00135.

[4] Dunn, A. 2008. *Hertzian Tales*. Cambridge, MA: The MIT Press.

[5] Dunn, N. 2012. *Digital fabrication in architecture*. London, UK: Laurence King.

[6] Gershenfeld, N. 2008. *Fab: The Coming Revolution on Your Desktop—From Personal Computers to Personal Fabrication*. New York, NY: Basic Books.

[7] Groenendyk, M. 2016. Cataloging the 3D web: the availability of educational 3D models on the internet. *Library Hi Tech* 34(2):239–258. doi: 10.1108/LHT-09-2015-0088.

[8] Groys, B. 2008. From image to image-file—and back: Art in the age of digitalization. In Groys, B., ed., *Art Power*. Cambridge, MA: MIT Press. 83–91.

[9] Hielscher, S., and Smith, A. G. 2014. Community-based digital fabrication workshops: A review of the research literature. Technical Report SWPS 2014-08, University of Sussex, Brighton, UK. Retrieved January 13, 2018 from `http://sro.sussex.ac.uk/49214/1/2014-08_SWPS_Hielscher_Smith.pdf`.

[10] Hogan, T.; Hornecker, E.; Stusak, S.; Jansen, Y.; Alexander, J.; Moere, A. V.; Hinrichs, U.; and Nolan, K. 2016. Tangible data, explorations in data physicalization. In *Proceedings of the TEI'16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction (Eindhoven, Netherlands)*, 753–756. New York, NY: ACM.

[11] Jafarinaimi, N.; Forlizzi, J.; Hurst, A.; and Zimmerman, J. 2005. Breakaway: An ambient display designed to change human behavior. In *Extended Abstracts of the 23rd SIGCHI Conference on Human Factors in Computing Systems (Portland, OR)*, 1945–1948. New York, NY: ACM. doi: 10.1145/1056808.1057063.

[12] Jansen, Y.; Dragicevic, P.; Isenberg, P.; Alexander, J.; Karnik, A.; Kildal, J.; Subramanian, S.; and Hornbæk, K. 2015. Opportunities and challenges for data physicalization. In *Proc. of the 33rd SIGCHI Conference on Human Factors in Computing Systems (Seoul, Republic of Korea)*, 3227–3236. New York, NY: ACM. doi: 10.1145/2702123.2702180.

[13] Jansen, Y.; Dragicevic, P.; and Fekete, J.-D. 2013. Evaluating the efficiency of physical visualizations. In *Proc. of the 31st SIGCHI Conference on Human Factors in Computing Systems (Paris, France)*, 2593–2602. New York, NY: ACM. doi: 10.1145/2470654.2481359.

[14] Khot, R. A.; Hjorth, L.; and Mueller, F. F. 2014. Understanding physical activity through 3D printed material artifacts. In *Proc. of the 32rd Annual ACM Conference on Human Factors in Computing Systems (Toronto, Canada)*, 3835–3844. New York, NY: ACM. doi: 10.1145/2556288.2557144.

[15] Kolarevic, B. 2004. *Architecture in the digital age: design and manufacturing*. Abingdon-on-Thames, UK: Taylor & Francis.

[16] Koutsomichalis, M., and Gambäck, B. 2018. Generative solid modelling employing natural language understanding and 3d data. In *International Conference on Computational Intelligence in Music, Sound, Art and Design (Parma, Italy)*, 95–111. New York, NY: Springer.

[17] Koutsomichalis, M., and Psarra, A. 2015. Computer-aided weaving: From numerical data to generative textiles. In *Proceedings of the Conference on Electronic Visualisation and the Arts (London, UK)*, 122–123. doi: 10.1145/2641248.2641281.

[18] Koutsomichalis, M.; Psarra, A.; and Varela, M. 2014. Oiko-nomic threads. In *Proceedings of the 2014 ACM International Symposium on Wearable Computers: Adjunct Program (Seattle, WA)*, 59–64. New York, NY: ACM.

[19] Koutsomichalis, M. 2016. From music to big music: Listening in the age of big data. *Leonardo Music Journal* 26:24–27. doi: 10.1162/LMJ_a_00962.

[20] Koutsomichalis, M. 2018. Objektivisering: Text physicalization and self-introspective post-digital objecthood. In *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction (Stockholm, SE)*, 521–528. New York, NY: ACM.

[21] Kuznetsov, S., and Paulos, E. 2010. Rise of the expert amateur: DIY projects, communities, and cultures. In

Proc. of the 6th Nordic Conference on Human-Computer Interaction (Reykjavík, Iceland), 295–304. New York, NY: ACM. 10.1145/1868914.1868950.

[22] Lee, C., and Ribas, L. 2016. Exploring textual data: Transmutability as a creative concept and practice. In *Proc. of xCoAx 2016 Fourth conference on Computation, Communication, Aesthetics and X (Bergamo, Italy)*.

[23] Lupton, D. 2014. Self-tracking cultures: towards a sociology of personal informatics. In *Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: the Future of Design (Sydney, Australia)*, 77–86. New York, NY: ACM.

[24] Mota, C. 2011. The rise of personal fabrication. In *Proc. of the 8th ACM Conference on Creativity and Cognition (Atlanta, GA)*, 279–288. New York, NY: ACM. doi: 10.1145/2069618.2069665.

[25] Nissen, B., and Bowers, J. 2015. Data-things: digital fabrication situated within participatory data translation activities. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (Seoul, Republic of Korea)*, 2467–2476. New York, NY: ACM.

[26] Paul, C. 2015. From immateriality to neomateriality: Art and the conditions of digital materiality. In *Proc. of the 21st International Symposium on Electronic Art (Vancouver, Canada)*.

[27] Posch, I., and Kurbak, E. 2016. Crafted logic towards hand-crafting a computer. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (San Jose, CA)*, 3881–3884. New York, NY: ACM. doi: 10.1145/2851581.2891101.

[28] Posch, I.; Ogawa, H.; Lindinger, C.; Haring, R.; and Hörtner, H. 2010. Introducing the FabLab as interactive exhibition space. In *Proc. of the 9th International Conference on Interaction Design and Children (Barcelona, Spain)*, 254–257. New York, NY: ACM. doi: 10.1145/1810543.1810584.

[29] Rayna, T.; Striukova, L.; and Darlington, J. 2014. Open innovation, co-creation and mass customisation: What role for 3D printing platforms? In Brunoe, T. D.; Nielsen, K.; Joergensen, K. A.; and Taps, S. B., eds., *Proc. of the 7th World Conference on Mass Customization, Personalization, and Co-Creation (Aalborg, Denmark)*. New York, NY: Springer. 425–435. doi: 10.1007/978-3-319-04271-8_36.

[30] Séquin, C. H. 2005. Rapid prototyping: A 3D visualization tool takes on sculpture and mathematical forms. *Communications of the ACM* 48(6):66–73. doi: 10.1145/1064830.1064860.

[31] Stusak, S.; Tabard, A.; Sauka, F.; Khot, R. A.; and Butz, A. 2014. Activity sculptures: Exploring the impact of physical visualizations on running activity. *IEEE Transactions on Visualization and Computer Graphics* 20(12):2201–2210. doi: 10.1109/TVCG.2014.2352953.

[32] Tanenbaum, J. G.; Williams, A. M.; Desjardins, A.; and Tanenbaum, K. 2013. Democratizing technology: Pleasure, utility and expressiveness in DIY and maker practice. In *Proc. of the 31st SIGCHI Conference on Human Factors in Computing Systems (Paris, France)*, 2603–2612. New York, NY: ACM. doi: 10.1145/2470654.2481360.

[33] Toombs, A.; Bardzell, S.; and Bardzell, J. 2014. Becoming makers: Hackerspace member habits, values, and identities. *Journal of Peer Production* 5:1–8.

[34] Whitelaw, M. 2008. Art against information: Case studies in data practice. *The Fibreculture Journal* 11.

[35] Zhao, J., and Moere, A. V. 2008. Embodiment in data sculpture: A model of the physical visualization of information. In *Proc. of the 3rd International Conference on Digital Interactive Media in Entertainment and Arts (Athens, Greece)*, 343–350. New York, NY: ACM. doi: 10.1145/1413634.1413696.

Author Biography

Marinos Koutsomichalis is a scholar, artist and creative technologist. His practice is hybrid, nomadic, and ethnographic, involving field-work, creative coding, critical theory, making, lecturing, live performance, workshopping, artist/research residencies, 'Doing-It-With-Others', and hands-on experimentation with materials and technologies of all sorts. In this way, it draws on, and concerns, various subareas in arts, humanities, science, technology, philosophy, and design. His artistic corpus is prolific, yet persistently revolving around the same few themes: material inquiry/exploration; self-erasure (in/through performance and production tactics of all sorts); the quest for post-selfhood (through social, hybrid, and networked practices involving both human and nonhuman actors). He has hitherto publicly presented his work, pursued projects, led workshops, and held talks worldwide more than 250 times and in all sorts of milieux: from leading museums, acclaimed biennales, and concert halls, to industrial sites, churches, project spaces, academia, research institutions, underground venues, and squats. He has a PhD in Electronic Music and New Media (De Montfort University, GB) and a MA in Composition with Digital Media (University of York, GB), has held research positions at the Department of Computer Science in the Norwegian University for Science and Technology (Trondheim, NO) and at the Interdepartmental Centre for Research on Multimedia and Audiovideo in the University of Turin (IT), and has taught at the University of Wolverhampton (Birmingham, UK), the Center of Contemporary Music Research (Athens, GR), and the Technical University of Crete (Rethymnon, GR). He is a Lecturer in Multimedia Design for Arts at the Department of Multimedia and Graphic Arts at the Cyprus University of Technology (Limassol, CY).

Anonymous: VR Storytelling through alienation and reflexivity

Sojung Bahng, Toby Gifford, Jon McCormack
SensiLab, Faculty of Information Technology, Monash University
Melbourne, Australia
{Sojung.Bahng, Toby.Gifford, Jon.McCormack}@monash.edu

Abstract

This paper describes practice-based research in the reflexive dimensions of cinematic VR, using alienation and disembodiment as rhetorical devices. Cinematic VR currently focuses on immersive illusion rather than inducing self-awareness, but VR can also create reflexive contexts for eliciting self and social reflection. *Anonymous* is an interactive cinematic VR that explores solitude and mortality, specifically people living and dying alone. The work plays on the technical limitations of VR technology as a narrative medium to create a sense of disembodiment and alienation, eliciting embodied reflexivity.

Keywords

Virtual Reality, Cinematic VR, Empathy, Reflexivity, Alienation, Immersive Storytelling.

1. Introduction

Virtual reality (VR) technology afford immersive experiences that allows the audience to embody and identify with virtual characters or situations. It makes them feel as if they are present and immersed in the virtual environment. Such immersive environments have been argued to prime viewers for empathic experiences [1], and many artists and filmmakers have created cinematic VR intended to promote empathy [1, 2]. However, embodiment and presence do not necessarily lead to the expression of empathy.

Empathy is generally understood as the capacity to feel, or the process of sharing, another person's emotions [3]. However, empathy is not a simple identification or projection; identification and projection blur the boundary between self and other, but empathy requires simultaneous self- and other-centered perspectives [4]. The process of empathy requires knowledge of oneself and an ongoing critical awareness of knowledge and reflection upon it [5] [6].

The immersive properties of VR, which are related to embodiment and presence, can be used as an effective tool for eliciting projection or identification, but reflexive dimensions need to be considered to create the quality of empathy. The emphasis on reflexivity in immersion is closely related to perspectives of Buddhist philosophy and Brechtian approaches to theatre, critical of the fixation on identification and placing importance on developing critical distance and self-awareness for better understanding of the self and others [7][8][9].

Current cinematic VR is mainly focused on creating an immersive illusion rather than inducing awareness and reflection, but VR can also be seen as an effective tool to create reflexive dimensions for eliciting self and social reflection. Although VR technologies have developed rapidly in recent years, they cannot yet claim complete immersion in a virtual environment. There remains a fundamental duality of presence, where our presence exists simultaneously in the physical and virtual space.

We are in a virtual reality but also not in it; we are partly disembodied and alienated both from the virtual and physical space. This creates a contradictory and paradoxical sense of our existence. Those limitations can cause a sense of disembodiment and alienation, which can be used as a rhetorical device and aesthetic effect for inducing reflexive thoughts about identity and self-perception.

This practice-based research explores the reflexive dimension of cinematic VR, using alienation and reflexivity as narrative techniques. *Anonymous* is an interactive cinematic VR that addresses the issue of solitude and death, specifically addressing the "non-relationship society" [10] in South Korea, where people are increasingly living and dying alone. Because VR allows audiences to phenomenologically experience a sense of solitary space, cinematic VR is a powerful tool for inducing a sense of solitary confinement and simulating isolated situations [11]. However, reflexive contexts of solitude and alienation in cinematic VR are less explored to date.

Inherently disembodied contexts and limitations of immersion in VR can be used as *alienation effects* for eliciting an embodied reflection about solitude and death. The practical exploration of new storytelling methods using alienation and reflexivity aims to further development of cinematic VR and the reflexive understanding of social issues related to isolation, disconnection and loneliness.

2. Related Work

2.1 Embodiment and Empathy in VR

Embodiment is an important aspect of VR for the creation of empathic identification or projection. Embodiment has been used differently in various contexts due to its multidisciplinary uses and applications. In VR, the question of embodiment is chiefly related to virtual body experiences, such as how and to what extent a user perceives a virtual body representation as his or her own physical being [12].

The term "Sense of Embodiment" (SoE) was also created to explain the sensation of the body, especially in virtual environments [13].

Embodiment is related to the concept of presence. While embodiment is concerned with the relationship between one's self and one's virtual body, presence focuses on the relationship between one's self and the environment [14]. A strong sense of embodiment is the basis of "being" in VR. Numerous VR projects have aimed to elicit emotional engagement or empathic experiences through a sense of embodiment and presence; *The Machine to Be Another*, *Immersive Journalism* and *Carne y Arena* are just a few examples which we will now briefly describe.

The Machine to Be Another [15] is an investigative art experiment that uses embodiment techniques, offering users an immersive experience of seeing the world from another person's point of view. Two people using cameras and head-mounted displays (HMD) follow each other's movements by seeing their perspectives through an HMD. This is a social tool used to stimulate empathy among different people, and it is closer to real-time performance than fictional or cinematic experience.

Immersive Journalism [16] is a journalism production model that allows a first-person experience when a user's avatar enters news stories created in an immersive system. An important role of this model is to incite participants' emotional involvement in real news. Although Immersive Journalism is highly related to eliciting a sense of realism and emotional engagement, the audiences' empathic experiences were not directly considered in the research.

Carne y Arena [17] is a virtual reality installation by film director Alejandro González Iñárritu. This work requires participants to walk in a gallery space wearing HMDs, allowing them to physically experience refugees' personal journeys. The director used VR technology to allow the participants to go through embodied experiences such as walking in the refugees' feet. The use of physicality and embodiment was not only for inducing a sense of presence and emotional engagement, but also for stimulating the participants to physically understand the journey of refugees in unfamiliar social contexts.

2.2 Solitude and Isolation in VR

There are several examples of Cinematic VR representing the solitude and isolation of a confined room. *6x9* [18] by Francesca Panetta is a real-time 3D VR artwork that uses gaze interaction, simulating the sensation of being in a prison cell. Similarly, *After Solitary* [19] by Lauren Mucciolo and Cassandra Herrman is a 360°video that shares a person's experience staying in prison.

Unrest [20] by Jennifer Brea and Amaury La Burthe is 3D-rendered VR artwork combined with controller interaction that shares the perspective and experiences of someone suffering from chronic fatigue syndrome.

A 360° work called *Remain at Home* [21] by Gero A.E. Egger embodies the perception of an old person who remained at home during the war.

These works allow audiences to phenomenologically embody the sense of solitary space. However, as mentioned above, the reflexive contexts of the solitude and alienation in cinematic VR are less explored.

2.3 Reflexivity and Empathy in VR

Our emphasis on reflexivity in empathy in VR is related to perspectives of Buddhist philosophy. In Buddhist philosophy, all phenomena are considered projections of the mind, and the mind comprises physical sensations and consciousness, which construct an unfixed and causally interdependent ego [22]. From the non-dualistic ontological perspectives of Buddhist philosophy, the physical world and virtual world are not distinct, and the boundary between self and other/external world is blurred [7]. Buddhist meditative practice entails careful physical observation and reflection of the mind to realize the fixation of one's ego and expand perceptions, which can lead to self-realization and compassion for others. Empathy can be understood as a reflexive process of becoming aware of the intersubjective connections between oneself and other/external world [23, 24].

VR is a fruitful medium for representing or simulating the non-dualistic natures of external and internal spaces and of self and other. VR's reflexive dimension can be used for eliciting embodied awareness about the self as an intersubjective being. Ironically, Buddhism denies the absolute existence of ego but places importance on observing oneself, which means a deeper self being expanded to others [22, 25].

There have been studies about the correspondence between Buddhism and virtual reality; VR technologies often have been considered a medium with which to represent a matrix of interdependent events, unfixed causal individuals, and the illusions of mind from Buddhist perspectives [7]. Meditation applications exist using VR technologies or meditative VR artwork to induce the contemplative sensation of embodiment. However, reflexivity and empathy from Buddhist perspectives are not often considered in VR storytelling.

The emphasis on reflexivity and empathy in storytelling from social perspectives is closely related to Brechtian theatre. Brecht developed his aesthetic theory based on the concept of alienation, specifically for theatrical drama. He criticized the traditional narrative form that makes audiences identify with characters, thus blocking their critical thinking and self-awareness [9]. Brecht used the German term *Verfremdungseffekt*, which can be translated into "estrangement effect," "distancing effect," or "alienation effect" [26]. He used diverse alienation effects to break the illusion of drama and increase audience self-awareness and reflexivity. For example, his actors never embody themselves with characters, they ask questions of audience members, and his narrative structures are not unified or consistent [9].

Although Brecht emphasizes political liberation from social oppression, whereas Buddhist philosophy is instead focused on the liberation of the individual mind, both Brecht

and Buddhism criticize fixation on identification and put importance on critical distance and self-awareness for better understanding of the self and others. Some scholars argue that Brecht was influenced by Eastern thought, such as by Buddhism and Taoism [8]; he even reinterpreted and wrote about the Buddha's parable about the burning house to foster the will and action to escape suffering and political oppression [28]. Since the self and social reflection cannot be separated, the Buddhist and Bretchian approaches to critical distance and critical empathy certainly correspond and resonate.

In digital media, there have been various attempts to apply alienation effects. Laurel metaphorically described the modern computer as theatre, claiming that human-computer interaction (HCI) mirrors the art of improvisational theatre by promoting the creative and critical thinking in actors and audiences by allowing agents to freely interact with the given environment [29]. There has been research on interactive films and database cinema that apply several distancing effects from Brechtian film theory, such as discontinuous narrative structures, dis-unified aesthetic forms, and hypertextual choices [30].

Storytelling in cinematic VR is strongly related to storytelling in interactive theatre since the audience is in a virtual setting and can look around the environment and possibly interact with characters or the environment. Due to these characteristics, applying alienation and distancing effects from theatre can be a relevant method for eliciting self and social reflection in Cinematic VR.

2.4 Alienation and Reflexivity in Cinematic VR

The use of alienation effects in VR creates a physical reflexive dimension, which is related to the sense of disembodiment. Disembodiment in the virtual world is generally understood as the experience of an individual's identity being disconnected from his or her physical presence [31]. However, the use of disembodiment as an alienation effect is the opposite, since this application of disembodiment involves being disconnected from the virtual world, rather than from the physical world. Disembodiment can be considered a tool or catalyst with which to provoke re-embodiment, interconnectivity and re-unity through re-positing our bodies and perceptions [32, 33].

Assent [34] and *A Thin Black Line* [35] can be interpreted as cinematic VR works that use alienation and reflexivity for the quality of empathy. *Assent* by Oscar Raby concerns the story of Raby's father, who witnessed the execution of prisoners while in the Chilean Army. Raby had heard the story as a child from his father. He reconstructed both his father's and his own memories through a virtual environment. The audience could embody Raby's and his father's point of view by using gaze interaction. At the same time, audience members were alienated from the virtual environment because they could not affect the environment and their physical bodies were absent in VR.

While invited to reconstruct Raby's and his father's memories, audiences are actually alienated and disembodied from the virtual environment and the tragic historical situation in Chile. This alienation and disembodiment allows participants to consider their position and identity in a virtual environment. The audience members could critically empathize with Raby's process of reconstructing memories or historical trauma through a mixture of real and virtual, they could physically reflect the sense of helplessness and frustration of an individual alienated both socially and politically.

The artist makes deliberate use of poetic and surreal aesthetics, revealing the polygonal nature of virtual geometry, making the figures look fragmented. This poetic, non-Cartesian world assists the audience in eliciting their own memories and sensations connected to their deeper unconsciousness, fostering an empathic reflexive process.

A Thin Black Line is an interactive 3D VR documentary that uses hand controller interaction. The story concerns a young girl's experiences during World War II, specifically the bombing of Darwin in Australia. The virtual environment the artists created manifests as a pen-drawn 2.5-dimensional world. The world is non-Cartesian, and the pen-drawn aesthetics create a dream-like, surreal space. When the audience enters the virtual world, they embody the first person point-of-view of a girl. She has a virtual body, but is only represented with hands and legs. The body is also portrayed using a pen-drawn style, so the audience members partly embody her body but are also disembodied from her. They try to cognitively fill the gaps between her body and their own.

Audience members are required to interact with the environment using a controller. The interaction simulates a little girl grabbing a toy or doll, so the audience members essentially grab objects using a controller connected to a virtual hand. The interaction does not affect the story arc. Rather, it elicits a simultaneous sense of embodiment and disembodiment. When audience members try to grab a toy, it requires some concentration and effort; when they focus on grabbing a toy during the noisy war situation, it induces the physically embodied reflexivity of a little girl. The failure to grab a toy also creates a sense of the girl's frustration and helplessness during the war.

When the audience members try to re-embody their perceptions as the girl, they can connect with their own deeper selves, shaped by their own childhood memories. The sense of frustration, fear and disconnection during the war are deeply connected to the fundamental human sensations related to the fears of abandonment, disconnection and separation. Therefore, an audience's individual introspective and reflexive experiences as the girl in a virtual world elicit empathy.

3. Anonymous

3.1 The overview of the artwork

Anonymous is an interactive 3D real-time rendered cinematic VR applying gaze interaction. The story concerns the life of an old man living alone and remembering his life. The

environment and character were created using cardboard textures as if the audience were in a cardboard box. The audience plays the role of the man's dead wife, and they can observe his solitary daily life positioned as his wife's portrait. When they gaze at an object, they become the object and see his life from the object's perspective. The narrative is simple, but the way of expressing the story is unconventional and reflexive. The work constrains the audience's control and limits the immersion as storytelling techniques for eliciting embodied reflexivity.

The running time is approximately 10 mins. A brief synopsis follows:

Figure 1. Still from *Anonymous*. The perspective is from the portrait.

To honour his wife's memory, the main character prepares an annual ceremony in front of her portrait. The audience is positioned as the portrait. The soul visits the home for the ceremony. The character pulls out the portrait from a small box at night and hangs it on the wall. He fixes the rotation of the portrait. In the morning, he wakes up and goes to the toilet. A butterfly leads the audience's gaze to TV; when the audience gazes at the TV, they become the TV and see images of current news and events such as the North Korea – US summit. The audience can become the butterfly by gazing, and the butterfly slowly moves around the room watching the man's solitary daily life. The audience can also become a telephone or a light by gazing at them. At the end of the story, he performs the ritual for his dead wife, and her soul finally leaves home and goes up to the sky, becoming a star.

The work aims to elicit reflexive understanding of the problem of the "non-relationship society" and fundamental issues of solitude and death. The work was created based on a real story. A number of alienation effects – poetic cardboard visual aesthetics, glitchy character animation, sonic environment conditioning, perspective transition and disembodiment – are used to create reflexive contexts for self-reflection, which can ultimately lead to the quality of empathy.

3.2 Background: the "non-relationship society"

Anonymous addresses the issue of the "non-relationship society" in South Korea. Many old people without support from family members die alone. They are often found many days or weeks after their death. Korean society has developed a welfare system for the elderly, but the fundamental and complex issues of aging, the economic crisis and family deconstruction lead this tragedy to keep reoccurring. The issue is closely related to the problem of social isolation and poverty, but it brings up the overall issue of disconnection and loneliness in a society with many segregated individuals [10]. We all age and die, and if we could confront the problem of disconnection and solitary death, we might find better solutions through self and social reflection.

To critically reflect on the issue of a non-relationship society, *Anonymous* was developed through ethnographical fieldwork in South Korea. The importance of reflexivity in ethnographical research corresponds with the emphasis on reflexivity in empathy [36]. Because our perception of this social issue will be represented in a creative project, we thought it necessary to undertake field research, in order to better understand the reality of a social problem and reflect upon our own perceptions before creating the work.

We helped one man living alone to cook lunch and clean his house. We visited his home three times a week at 11am for two and a half weeks. As we were cleaning his home, we were able to observe his living environment in some detail, and gain a sense of his history and his memories. With his consent, we also took photos of his household objects for personal documentation purposes.

Our experiences from the fieldwork inspired us to poetically reconstruct the space, objects and character, and to design in key perceptions regarding the "non-relationship society".

3.3 Visual Aesthetics

The environment and character were created using cardboard textures. Cardboard is fragile and finite but recyclable. It was used to metaphorically symbolize the fragility and vulnerability of life, both physically and mentally, and to illustrate the mortality of human beings and the circularity of nature. This material was used in an unfamiliar way, to defamiliarize daily life and elicit reflection.

Figure 2. The Environment of *Anonymous*

A simple, child-like drawing style was used for parts of the main character and his environment, related to representations of the unconscious self that can be more easily connected to fundamental feelings of loneliness and the fear of separation we often experience as children. We tried to vitalize objects as much as possible, and the objects represent and embrace the history of Korean society and one's life in social contexts. The audience poetically reconstructs the character's life through reading and sensing the objects, leading to a poetic understanding of the character and his life.

We also used one real texture from the fieldwork: a female slipper from the house of the man we cared for. The slipper is worn out and old, and we wonder if it is his dead wife's slipper? We recreated the 3D slipper using a texture taken from the real slipper. It recalls Heidegger's comment on van Gogh's painting 'The Shoes' that shows the phenomenological being of existence [37].

A poetically constructed space can foster reflexivity that asks audiences to read the symbolic and metaphorical sensations. The virtually constructed poetic world can lead audiences to phenomenologically embody and reflect on the deeper layers of unconsciousness through alienation and disconnection.

Figure 03. Objects in *Anonymous*

The character is also created using a cardboard texture, and motion capture techniques were used to animate him. The character moves like a human being, but the cardboard construction of his body cannot perfectly handle that movement, so the animation has glitches, and the texture is often distorted and torn. His facial expression is conveyed using childish drawings, and his eyes and mouth often disappear, leaving a blank face. These imbalances or tensions between familiarity and unfamiliarity elicit emotional engagement or identification, but also make audiences observe and reflect on the environment and character.

Figure 04. A character from *Anonymous*

3.4 Sound

The sonic environment conditions our perceptions of space and materials, and spatial sound in VR is understood to strongly impact immersiveness [38]. In *Anonymous* we explored the use of spatial sound for also emphasizing isolation and disembodiment/re-embodiment.

Foley was recorded in 1st order Ambisonic format using both a Zoom H2n portable recorder for field recording in Korea, and a Senheisser Ambeo microphone for studio recordings. Music was spatialized using the Audio360 Spatial Workstation (formerly Two Big Ears).

We used a combination of sound objects and sound environments. Sound objects are traditionally used in game engines such as Unity to attach sound to game objects that move in space (for example bullets). The source audio for these objects is typically a monophonic dry (no reverb) audio file, which is convolved with Head-Related Transfer Function (HTRF) impulse response data relating to the relative angle between the sound object and the listener (including the listener's head pose as reported by the HMD in VR).

Ambisonic recordings afford more immersive sound environments, which can envelope this listener rather than being attached to a particular point in (virtual) space. This can give a much stronger sense of the geometry and materials of the virtual space than individual sound objects.

The setting of *Anonymous* is both isolated and claustrophobic – reflecting the limited living space typical for elderly people in Korea. Sound production aimed to enhance this sense of claustrophobia through use of artificial reverberence based on a small room, and with a frequency dampening consistent with the cardboard materials. This also aims at highlighting the sense of disconnection from the outside wall, whilst acknowledging its existence.

The narrative device of re-embodying physical objects in the scene was emphasized by transforming the perception of the sonic environment according to the material properties of each object.

3.4 Alienation and Reflexivity

When audiences take on the physical embodiment of the dead wife's soul, they can phenomenologically experience a position and situation of alienation and disembodiment from their normal lives. The disembodiment allows the audience to perceive an alienated body and become aware of their solitary position and lack of identity in virtual space. The unfamiliar and poetic experiences of loneliness and death might lead audiences to empathize with the old man in this work and also critically reflect on their own lives and death from the perspective of an alienated person.

When audiences gaze at, and become objects such as a TV, butterfly, telephone or light, unfamiliar and varied perceptions, which can hardly be experienced in the physical world, are created. It also enables the audience to make various connections to a solitary character. The audience can experience different layers of embodied/disembodied sensations in the environment and various levels of intimacy with the character, reflecting upon a solitary life from different perspectives.

Figure 05. Screenshots of Embodying Objects

The constraints of interaction and limited control elicit a sense of limitation and frustration but also of release. The restriction is mainly used to enable audiences to physically sense confinement and disconnection and reflect upon their alienated situation as the dead wife or soul. However, at the end of the work, the soul leaves home and goes to the sky, becoming a star; the loss of control can be connected to the feeling of helplessness or separation but also to accepting mortality and the finite limitations of life. The uncontrollable contradictory sense of disembodiment creates a bittersweet paradoxical sensation of life and death, separation and mourning.

Figure 06. Screenshots of Ending Scene

Conclusions and Discussion

We created an interactive cinematic VR work called *Anonymous* to induce self and social reflection on the issues of solitude and death. To create the reflexive dimension, we used cardboard-style poetic visual aesthetics. We also applied restrictions of immersion and interaction as alienation effects to create the sense of disembodiment, which is connected to the paradoxical sensation of an uncontrollable situation in VR. We used this disembodied alienation to elicit the embodied reflexivity on an isolated and disconnected situation but also to expand on different perceptions. It was a significant process to explore the reflexive contexts of cinematic VR through practice.

In developing the work, we faced a few technical challenges. The main challenge was positioning the camera to make audiences feel as though they embody objects. Objects too close to the camera disappear and distort due to the proximity of the front clipping plane. Moreover, if the camera perspective is significantly different from human perception, the audience may feel sick due to the perceptual differences. Camera movement also needs to be applied carefully to prevent motion sickness.

The compromise between artistic intentions and technical limitations was difficult, but the process of learning VR technologies and developing the syntax and grammar of VR storytelling has been an important component of this practice-based research. In a future study, we will explore different levels of immersion and interactivity to create various dimensions of reflexivity. We also aim to deal with other topics about society that require self and social reflection.

Acknowledgements

This project was supported by SensiLab at Monash university and the artist collective Artengine. We gratefully acknowledge the creative support of our colleagues and friends.

References

[1] Milk, Chris. "How virtual reality can create the ultimate empathy machine." How Virtual Reality can create the ultimate empathy machine"(accessed 22.10. 2015) http://milk.co/ted2015. 2015

[2] Vosmeer, Mirjam, and Ben Schouten. "Interactive cinema: engagement and interaction." In International Conference on Interactive Digital Storytelling, pp. 140-147. Springer, Cham, 2014.

[3] Kunyk, Diane, and Joanne K. Olson. "Clarification of conceptualizations of empathy." Journal of Advanced nursing 35, no. 3 (2001): 317-325.

[4] Leake, Eric. "The (Un) knowable Self and Others: Critical Empathy and Expressivism." Critical Expressivism: Theory and Practice in the Composition Classroom (2015): 149-60.

[5] DeStigter, Todd. "Public displays of affection: Political community through critical empathy." Research in the Teaching of English 33, no. 3 (1999): 235-244.

[6] Roxworthy, Emily. "Revitalizing Japanese American Internment: Critical Empathy and Role-Play in the Musical Allegiance and the Video Game Drama in the Delta." Theatre Journal 66, no. 1 (2014): 93-115.

[7] Keown, Damien. "Embodying virtue: a Buddhist perspective on virtual reality." (1998).

[8] Skilling, Peter. "On the Reception of Buddhism in German Philosophy and Literature." (2011): 144.

[9] Brecht, Bertolt. Brecht on theatre. Bloomsbury Publishing, 2014.

[10] Shin Ji-min and Jang Su-kyung. Report documents instances of lonely deaths in South Korean society. (2018). http://english.hani.co.kr/arti/english_edition/e_national/834527.html

[11] Ryan Bort. Experiencing the horrors of solitary confinement through virtual reality. (2018). https://www.newsweek.com/solitary-confinement-virtual-reality-experience-447857

[12] Kilteni, Konstantina, Raphaela Groten, and Mel Slater. "The sense of embodiment in virtual reality." Presence: Teleoperators and Virtual Environments 21, no. 4 (2012): 373-387.

[13] Slater, Mel, Daniel Pérez Marcos, Henrik Ehrsson, and Maria V. Sanchez-Vives. "Inducing illusory ownership of a virtual body." Frontiers in neuroscience 3 (2009): 29.

[14] Witmer, Bob G., and Michael J. Singer. "Measuring presence in virtual environments: A presence questionnaire." Presence 7, no. 3 (1998): 225-240.

[15] Bertrand, Philippe, Daniel Gonzalez-Franco, Christian Cherene, and Arthur Pointeau. "The Machine to Be Another: embodiment performance to promote empathy among individuals." Celebrating 50 years of the AISB (2014).

[16] De la Peña, Nonny, Peggy Weil, Joan Llobera, Elias Giannopoulos, Ausiàs Pomés, Bernhard Spanlang, Doron Friedman, Maria V. Sanchez-Vives, and Mel Slater. "Immersive journalism: immersive virtual reality for the first-person experience of news." Presence: Teleoperators and virtual environments 19, no. 4 (2010): 291-301.

[17] Alejandro G. Iñárritu. Carne y Arena (2017). https://carneyarenadc.com/

[18] Francesca Panetta. 6×9: A Virtual Experience of Solitary Confinement. (2016). https://www.theguardian.com/world/ng-interactive/2016/apr/27/6x9-a-virtual-experience-of-solitary-confinement

[19] Lauren Mucciolo and Cassandra Herrman. After Solitary. (2017). http://emblematicgroup.com/experiences/solitary-confinement/

[20] Jennifer Brea and Amaury La Burthe. Unrest. (2017). https://www.unrest.film/virtual-reality/

[21] Gero A.E. Egge. Remain at Home. (2017). https://www.gopictures.at/goinsidevr/home/remain-at-home/

[22] Wallace, B. Alan. "Intersubjectivity in Indo-Tibetan Buddhism." Journal of Consciousness Studies 8, no. 5-6 (2001): 209-230.

[23] Pagis, Michal. "Embodied self-reflexivity." Social Psychology Quarterly 72, no. 3 (2009): 265-283.

[24] Marsh, Leslie. "The Extended Mind and Religious Thought." Zygon 44, no. 3 (2009).

[25] Sleeth, D. B. "The self system: Toward a new understanding of the whole person (Part 3)." The Humanistic Psychologist 35, no. 1 (2007): 45-66.

[26] Bloch, Ernst, Anne Halley, and Darko Suvin. "" Entfremdung, Verfremdung": Alienation, Estrangement." The Drama Review: TDR (1970): 120-125.

[27] Uhde, Jan. "The Influence of Bertolt Brecht's Theory of Distanciation on the Contemporary Cinema, Particularly on Jean-Luc Godard." Journal of the University Film Association (1974): 28-44.

[28] Brecht, Bertolt. "The Buddha's Parable of the Burning House." Bertholt Brecht: Poems 1913 56 (2011): 290-92.

[29] Laurel, Brenda. Computers as theatre. Addison-Wesley, 2013.

[30] Çavuş, Metin, and Oğuzhan Özcan. "To watch from distance: an interactive film model based on Brechtian film theory." Digital Creativity 21, no. 2 (2010): 127-140.

[31] Slater, Don. "Social relationships and identity online and offline." Handbook of new media: Social shaping and consequences of ICTs (2002): 533-546.

[32] Polimeris, Spiros, and Christine Calfoglou. "Art journeying in times of globalization: The voice of disembodiment." Paper submitted for publication in the International Journal of Cultural and Digital Tourism (2015).

[33] Yurtsever, Âli, and Umut Burcu Tasa. "Redefining the body in cyberculture: Art's contribution to a new understanding of embodiment." The Real and the Virtual (2009): 1-12.

[34] Oscar Raby. Assent. (2013) http://oscarraby.net/assent/

[35] A Thin Black Line. Douglas Watkin Vernon, Ah Kee and Oscar Raby (2017) https://www.acmi.net.au/collection/works/thin-black-line/

[36] Cousin, Glynis. "Reflexivity: the new reflective practice." International Journal of Practice-based Learning in Health and Social Care 1, no. 2 (2016): 3-7.

[37] Heidegger, Martin. "The origin of the work of art." In The continental aesthetics reader, pp. 79-122. Routledge, 2017.

[38] Poeschl, Sandra, Konstantin Wall, and Nicola Doering. "Integration of spatial sound in immersive virtual environments an experimental study on effects of spatial sound on presence." In Virtual Reality (VR), 2013 IEEE, pp. 129-130. IEEE, 2013.

VR for Toegye's Ten Diagrams on Sage Learning: Experiential Space-Time based on the Concept of Eastern Philosophy

Hyun Jean Lee[1], Wonjean Lee[1], Hyungsin Kim[1], Jeong Han Kim[2]
Yonsei University[1], Seoul Women's University[2]
Seoul, Korea
hyunjean@yonsei.ac.kr, jealivre@gmail.com, hyungshin@gmail.com, jeonghan@swu.ac.kr

Abstract

In this paper, we describe a virtual reality project that creates an experience of Toegye's "Ten Diagrams on Sage Learning." First, we introduce Toegye's "Ten Diagrams on Sage Learning." Then, we present the VR design process and the current implementation stage of the first diagram of the book called the "Diagram of the Supreme Ultimate." Ultimately, people today are able to experience a similar environment, one in which the king transformed the self into the original good nature. The space-time experience in this VR will provide the users with an opportunity for self-reflection, like looking at themselves in a mirror.

Keywords

Ten Diagrams on Sage Learning, Virtual Reality, Philosophical Space-time, Experience Design, Mindfulness

Introduction

This project creates a virtual reality (VR) experience of Toegye's "Ten Diagrams on Sage Learning"(聖學十圖, called "Sunghaksipdo" in Korean), which was created around 1300 years ago. [1] Toegye was the most famous Neo-Confucianism scholar in the Joseon dynasty, and "Ten Diagrams on Sage Learning" is a kind of appeal from Toegye as a retainer to the king, who was crowned at the age of sixteen (see Figure 1). In the hope that the king would be a "sage" monarch, Toegye made the "Ten Diagrams on Sage Learning" as ten folding screens, which could be stood up surrounding the king's room, which allowed the king to look at and read these diagrams every day (see Figure 2). By doing this, the king could manage his thoughts and be positively influenced to govern the country. Toegye's "Ten Diagrams on Sage Learning" include diverse visual diagrams, such as symbols of circles and squares, and a total number of 1860 Chinese characters that explain these symbols. This work includes both the principles that form all natural things and the principles of life that dominate mind and thought with refined philosophical thoughts such as cosmology, ontology, and ethics. Regarded as a very rare and valued work in the intellectual history of the world, this work has been evaluated as the crystallization of Korean Confucianism. Unfortunately, today's public cannot understand this work properly because of its complexity and their unfamiliarity with it. Accordingly, the work needs to be illuminated again.

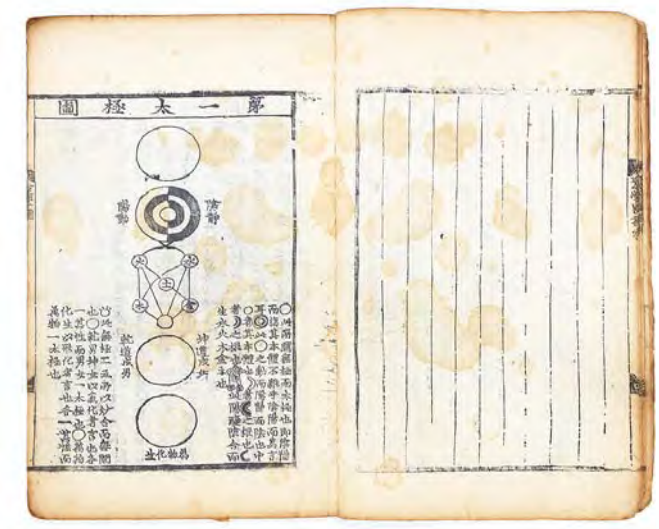


Figure 1. The original copy of "Ten Diagrams on Sage Learning" by Toegye in the form of a book

Figure 2. The folding screen of Ten Diagrams on Sage Learning by Toegye

These days, we often hear news about generational conflict, hatred toward others, parricide, reckless murder or stabbing, and rampaging overuse of one's power, so-called "gapjil," which is a neologism that refers to the arrogant and authoritarian attitude or actions of people in South Korea who have positions of power over others. In fact, this is not a problem in Korea alone. Racial, religious, generational, ideological, political, and class conflict are common problems found in many countries all over the world. Although these kinds of abnormal and unnatural attitudes may seem like extreme examples of immoral people who may have mental problems, most people would not disagree that in the current age, we live under constant

irritation and stress and that we need to deal with these negative stimuli from our everyday lives wisely. Many people may see a need for a space for reflection or meditation to recover their sense of self and the spiritual world of individuals.

Social problems can stem from misunderstandings about others, which can come from short-sighted views about relationships with others. However, Confucianism did not try to solve social problems and issues only within relationships. Rather, it attempted to teach others the value of cosmology and the principle of existence to reveal that cosmology and the theory of human relations share the same principles. The phrase "The unity of heaven and humankind (天人合一)" is the ultimate and unique ontology of Confucianism. For example, the "the five relationships (五倫)" are the human rules between diverse relationships. Affection is required in the relationship between a father and a son. Righteousness is required in the relationship between a king and a subject (君臣). The remaining three rules of necessary relationships are the distinction between husband and wife, the order of adults and children, and the trust of friends. If each of these is perceived as an outer rule that binds "me," it can feel like unwelcome pressure. However, the principle of "the five relationships" is based on "the five agents (五行)," which are the very integral and consistent systems that explain the principle of the cosmos, human relationships, and the human mind as the one rule in Confucianism. Thus, if we can understand this well enough, the phenomenon of antagonism will disappear or at least be lessened. The possibility of reinterpreting the principle of "the five relationships (五倫)" in a creative and modern way is infinitely open. The principle of "the five relationships" allows one to explore and pursue the divinity of one's existence, not simply to submit to others or society blindly. In the Western world, it is hard to find a theory that explains heaven, the cosmos, and society and the individual's inner mind in a consistent way.

Nowadays, as we seek a unified and harmonious world, understanding and interpreting the Ten Diagrams seems more needed than ever. However, the logic of the ontology of Confucianism, which we have downplayed thus far throughout modern society, could be very inspirational. It could ease the user's mind so that the user can achieve mindfulness. Nonetheless, this not the end goal we intend in our project. Our intention is to create the "Ten Diagram VR" as an experiential chance for "transformation of the self to the original good nature." Thus, the space-time experience in this VR will provide the users an opportunity for self-reflection, like looking at oneself in the mirror. The ultimate purpose of this transformation is to achieve a higher state of virtue and morality, which Heaven mandates. If the process of experiencing this VR becomes routine in one's daily life, it can serve as a ritual for an individual to achieve self-mindfulness.

We think that this kind of moral and social value could be lightened if people who experience our VR try to apply the sagacious principles to their lives. Being ignorant of human nature results in our violating our good nature unintentionally, so we suffer misfortune. We think that the meaning from Toegye's "Ten Diagrams on Sage Learning" not only works for the king, but also teaches and helps us to be good people. By accessing it, if we focus more on our original mandate and reflect on it periodically, we can also develop ourselves to manage our thoughts and begin to balance our psychological mind. By having chances to look at oneself in the mirror of old traditions and learning lessons from "Ten Diagrams of Sage Learning," we can turn this misfortune or unknown stress and hardship into happiness.

For this reason, we would like to create a similar environment of folding screens of Ten Diagrams where the king is repeatedly reading and reflecting on it, particularly with virtual reality technologies. We create the "Ten Diagram VR" as an experiential chance for "transformation of the self to the original good nature." [1] The space-time experience in this VR will provide the users with an opportunity for self-reflection, like looking at oneself in a mirror.

Figure 3. VR for Toegye's "Ten Diagrams on Sage Learning"

Virtual Reality for "Ten Diagrams on Sage Learning"

Traditional VR works are intended both to represent the real world and to simulate a newly modeled world. Through these kinds of VR experiences, we can go to other worlds that we could not otherwise visit easily, for example, experiencing a rollercoaster, or being in a war or a theatrical performance.

As we create the VR for "Ten diagrams on Sage Learning," our project team explores VR in an extended way to let the viewers experience conceptual and philosophical space-time. In this way, the conceptual and philosophical world of Eastern philosophy can be experienced more easily and closely.

Virtual reality for conceptual and spiritual experience has rarely been discussed. The paper "Virtual reality as a spiritual experience: a perspective from the cognitive science of religion" (2008) is one example that deals with religious and spiritual experience in virtual space, but it is more about Second Life rather than how VR works use VR

technology per se. [3] Recently, several VR researchers have explored the design and development of VR for the purpose of meditation. [4, 5] This VR-based meditation environment provides users an opportunity by providing an environment in which people can relax at any time. This meditation-focused VR has the limitation in that it provides only an environment. However, our project is unique in that we provide the origin and principles of cosmos and its philosophical concepts.

"Ten Diagrams" was originally published as a book and then reproduced as a polyptych, a folding screen divided into ten panels. Although this folding screen stood by itself like a 3D object, the image on each panel was 2D. Since we plan to create each panel (each diagram) as a stand-alone VR space-screen, we need to translate or transform the 2D image into a virtual 3D world. Crossing 2D and 3D worlds, we need to take into account the philosophical and conceptual meaning of Ten Diagrams, which was originally enclosed within a flat space, so that it can be effectively and experientially communicated in the 3D VR experience.

In our VR project, we use an HTC VIVE for the hardware system. We envision that the user can move around in the philosophical and conceptual space-time within the VR world and actively interpret the contents by navigating through them or by selecting the specific content and diving into it. Instead of sitting in a chair with a head-mount display, the viewer will be more active and therefore more engaged with the content. For software, we use Unity 3D.

VR of the "Diagram of the Supreme Ultimate"

Our work will be a multi-year project. Currently, we are creating only the very first diagram of the "Ten Diagrams," called the "Diagram of the Supreme Ultimate" (太極圖, "Taegukdo" in Korean). As a prelude to "Ten Diagrams," Taegukdo majestically shows the Confucian cosmology based on the ontology of "the unity of heaven and mankind." Taegukdo speaks of the creation and transformation of the physical universe, which reveals and manifests the ultimate unity within the plurality of creatures, including myself. The core issue that Taegukdo deals with is how to guide the viewer to recognize the origin of one's existence under cosmological dignity.

This first diagram is composed of five circles, within which we create five separate space-times in our VR. Each space-time appears in the order of each circle in the diagram. However, as Kalton says, "The multiple circles of the Taegukdo are really an analysis of a single phenomenon, the universe." [1, 2] To convey this, we use the form of half spheres to make a unified form throughout the five circles. Thus, in VR, each circle is shaped as a hemisphere structure, and the user(viewer) will stand in its center.

In the original 2D Taegukdo image, five circles are placed vertically. To conceptualize this, we also conceptually put the five circles (as a half sphere) in cylindrical form as a whole (refer to Figure 4). Since Taegukdo presents how the universe was created, each circle correspondingly explains each process. When you, as a reader/viewer, look at and grasp the meaning of the entire set of diagrams, you may get some sense of the forming of the universe from its creator's point of view of understanding or observing how the universe or cosmos is being created. But users in the VR system cannot see the entire world from this kind of god point of view. Nevertheless, by structuring the five circles in a cylindrical form and showing their entire structure through the navigational interface, we try to show this to the users to allow them to grasp where they are now and where to move next from one circle to another in an interactive way.

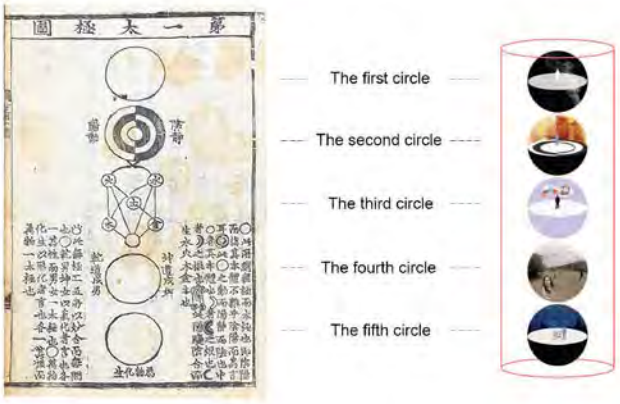


Figure 4. The design of VR for "Taegukdo" (the "Diagram of the Supreme Ultimate")

As mentioned, the most important purpose of Taegukdo is to enable each user to recognize one's origin and the cosmological dignity of one's existence. To embody this concept, we consider goals/objectives in our approach. First is individualistic acquisition through bodily experience, which is essential in Confucianism, and to facilitate this, we have created an environment where the viewers/users can concentrate on themselves (their self) from a first-person point of view. The users/viewers can walk around as the sensor area allows, look around, and choose what to look at. Second, if the subject itself and the range of the subject covered by Taegukdo can be infinitely extended, it becomes a universe, and if it can be reduced infinitely, it becomes each user's own mind. By putting our position in a macroscopic space, we provide a chance for the users to check it so that they can think of how to approach it. At the same time, each individual as human being is a small universe (a microcosms), but since the principle of human nature is not different from the principle of the universe (the macrocosms), when our minds are hurt and confused, we can look upward, or outward and expand our view endlessly, then achieve peace and calm again. Thus, we design our VR to show the homogeneous structure, a concept of "The unity of heaven and humankind."

Also in our design, the first circle starts with all black, a total black, and the last circle, which is the fifth circle, ends with black (Figure5, 7). This fifth circle shows myriad stars in the black sky by using the constellation image of Cheonsang Yeolchabunyajido(a chart of the constellations and the regions they govern, 天象列次分野之圖) (Figure 6).

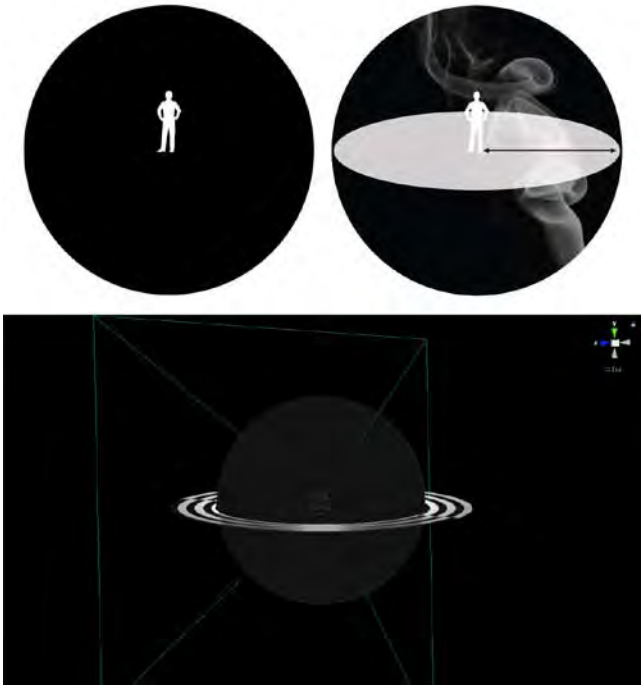


Figure 5. The VR design (upper two circle images) and its implementation in Unity 3D (down) for the first circle in "Taegukdo"

By making the fifth and the first circle similar, we make the circles in Taegukdo repeated themselves endlessly. In addition, the vast universe, which is symbolized by black, is a device that induces us to go back to the macro-perspective, away from minor conflicts that drive us to lose our human good and balanced nature. The macro-perspective view provides, therefore, a chance to gain an overview. In addition, in the VR space-time of the fifth circle, the users can float their own star into the sky and see how this star makes a connection with other stars shining in the sky. This action and scene symbolize each user who connects his or her own self with the universe.

Our overall design suggests that the viewers can achieve mindfulness through diverse approaches. The contents of the remaining nine diagrams also explain that the human mind with its microscopic view is not different from the theory of the universe as it is expressed in Taegukdo. The rest of the nine diagrams attempt to explain this similarity between human mind and the universe by using numerous detailed examples and stories. Therefore they show us the way how we get to the state of mindfulness. As the introduction for the rest of the nine diagrams, and as a guideline showing the consistency, Taegukdo functions as the very foundation from which the users can more easily grasp the entire set of ten diagrams as a logically homogeneous structure.

Figure 6. The constellation image of Cheonsang Yeolchabunyajido(天象列次分野之圖, a chart of the constellations and the regions they govern), created in the Joseon Dynasty

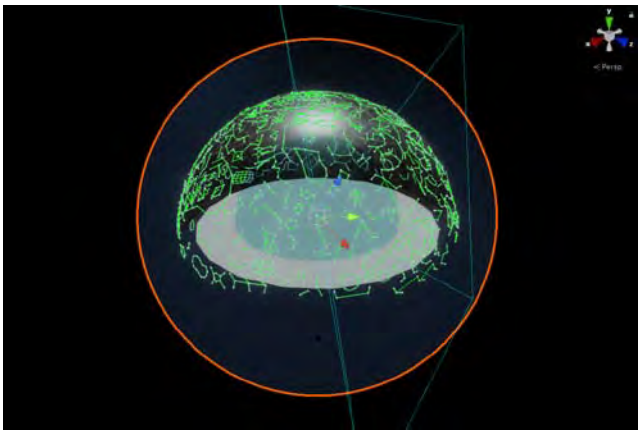


Figure 7. The VR design of the fifth circle in "Taegukdo," which shows the constellations in the black sky

Conclusion and Future Direction

Toegye's "Ten Diagrams on Sage Learning" contains the refined philosophical thoughts of cosmology, ontology, and ethics. Unfortunately, it is very difficult for the public to understand them properly because of their complexity and profoundness. Here we have summarized this on-going multi-year-funded project, which started in 2017, which creates a VR experience of Toegye's "Ten Diagrams on Sage Learning." We think that our VR project is a novel approach to creating a spiritual and conceptual experience of eastern philosophy as a VR experience as well as a media artwork. Our ultimate goal is to create a VR experience for self-reflection. Thus, we refer to it as introspective VR. This VR environment will encourage users to experience their good-natured principles and eventually examine their own mental or emotional flux via introspection. We hope to continue to create the remaining diagrams in a VR format in the coming years as we plan and refine the project and perform user testing to examine how they actually work.

Figure 8. The VR in the fifth circle in "Taegukdo", which shows the constellations in the black sky

Acknowledgements

This work was supported by the Ministry of Education of the Republic of the Korea and National Research Foundation of Korea(NRF-2017S1A5B6055825). We would like to thank our collaborative researcher team members, Jun Park, Soko Jang, Sungsil Kim. We also thank the researchers at X-media art & research Center at the ICONS(Institute of Convergence Science), Yonsei University. They are Saehae Chung, Honam Kim, Jiyun Kim, Bori Cha, Mae Hwe Kim, Joon Seok Moon, Haejin Chung, Gwang Min Hong, and Yeongju Yang. Also, we appreciate the contributions of the post-doc researcher, Joonsuk Park, and undergraduate researcher, Ilbo Chung at the 2nd brain and 3rd eye Lab, Hongik University.

References

Books

[1] Yi T'oegye. *To Become a Sage: The Ten Diagrams on Sage Learning,* trans. Michael C. Kalton (New York: Columbia University Press, 1988).

Journal article (print)

[2] Philip J. Ivanhoe, "The historical significance and contemporary relevance of the four-seven debate," *Philosophy East & West* Vol. 65, No. 2, (2015): 401-429.

[3] Ryan Hornbeck and Justin L. Barrett, "Virtual reality as a spiritual experience: a perspective from the cognitive science of religion," *Northern Lights,* Vol. 6, No. 1, (2008): 75-90.

Proceedings Paper Published

[4] Diane Gromala, Xin Tong, Amber Choo, Mehdi Karamnejad, and Chris D. Shaw, "The Virtual Meditative Walk: Virtual Reality Therapy for Chronic Pain Management," (paper based on a talk presented at the CHI '15, ACM, New York, NY, USA, 2015). *In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*,
DOI: https://doi.org/10.1145/2702123.2702344

[5] Ilkka Kosunen, Mikko Salminen, Simo Järvelä, Antti Ruonala, Niklas Ravaja, and Giulio Jacucci, "RelaWorld: Neuroadaptive and Immersive Virtual Reality Meditation System," (paper based on a talk presented at IUI '16, ACM, New York, NY, USA, 2016). *In Proceedings of the 21st International Conference on Intelligent User Interfaces*, DOI: https://doi.org/10.1145/2856767.2856796

Bibliography

Books

[1] Hyungjo Han. *The Ten Diagrams on Sage Learning, A Guidemap for Self-Salvation* (Sungnam-si: The Academy of Korean Studies Press, 2018).

[2] Jeremy Bailenson. *Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do* (New York: W. W. Norton & Company, 2018)

[3] Peter Gärdenfors. *Conceptual Spaces: The Geometry of Thought* (Cambridge, Mass: A Bradford Book, The MIT Press. 2004).

[4] Peter Gärdenfors. *The Geometry of Meaning: Semantics Based on Conceptual Spaces* (Cambridge, Mass: The MIT Press, 2017)

[5] Yi T'oegye. *To Become a Sage: The Ten Diagrams on Sage Learning,* trans. Kwangho Lee (Seoul: Hongik Press, 2001).

Websites

[6] HTC VIVE website, accessed November 10, 2018, https://www.vive.com/kr/

Hyun Jean Lee

Hyun Jean Lee is a video and multimedia artist and media theorist whose research focuses on media history and aesthetics in the relationship between art and media technology. Lee earned a Ph.D. in Digital Media program at the Georgia Institute of Technology's School of Literature, Communication, and Culture. At

Georgia Tech, she also researched emerging physical sensing and computer-interaction technologies across media arts, entertainment, and educational domains. After earning a BFA in Painting from Seoul National University in Korea, Lee, supported by a Fulbright scholarship and a Rockefeller Brothers Fund Fellowship from the Asian Cultural Council, received her MPS degree from the Interactive Telecommunications Program at New York University. Currently she is both an associate professor of Media Art at the Graduate School of Communication and Arts and a director of X-Media Art and Research Center, at Yonsei University, Seoul, Korea.

Wonjean Lee

Wonjean Lee is a researcher in Comparative Philosophy between Eastern and Western thought. She received her doctorate in Korean Confucianism, especially Toegye Yi-Hwang's philosophy, at Sungkwunkwan University in Korea. Lee seeks to trace the true nature of the idea of Korean philosophy, as differentiated from Chinese philosophy and Western philosophy. She is also interested in conveying the core of Neo-Confucian Classics to the public in easier and more intuitive ways by collaborating with other disciplinary researchers. In the various articles, she has investigated Neo-Confucians iconography, which was used in order to articulate the philosophical and conceptual concepts in the Joseon Dynasty. After earning a BA from Seoul National University in Seoul, Korea, Lee, received her Master's degree from the Department of Western Philosophy at Seoul National University and X-cultural Studies at Kookmin University. She is currently working as a researcher at the X-Media Art and Research Center in ICONS, at Yonsei University and teaches at Sejong University.

Hyungsin Kim

Hyungsin Kim is a researcher in the field of Human Centered Computing. Her research interests lie in the intersection of virtual reality technology, media arts, and wellness. She seeks to empower users by designing software to influence the way people think, learn, and act. She is interested in understanding both human beings and the interaction design of computing technologies. She holds a Ph.D. from the Georgia Tech College of Computing. In her dissertation, she investigated the effectiveness of computing technologies to enhance the dementia-screening process by presenting the design, implementation, and evaluation of the ClockMe System. She is currently working as a researcher at the X-Media Art and Research Center at ICONS and teaches media art students at Yonsei University.

Jeong Han Kim

Jeong Han Kim is a media artist working in the area of "Emergent Mind of City," which is based on convergence between cognitive science and media art. Nowadays, he explores the Big-data mining and visualization for "Collective Emotion" of cities. Kim earned his Ph.D. in cognitive science at Seoul National University and his MFA at the School of the Art Institute of Chicago. With support from the Rockefeller Foundation Asian Cultural Council, he participated in the artist residence program offered by the Lower Manhattan Cultural Council in New York City. He was also a Fulbright visiting scholar in DXARTS at the University of Washington, Seattle, U.S. during his 2014-15 sabbatical year. His works have been featured at the "Infosphere" at ZKM, the 7th International Media Art Biennial Media City in Seoul in 2012, at Whitebox in New York City, and in other selected group exhibitions. He is a professor at Seoul Women's University and a director of the B-MADE(Body-Mind Arts & Design Education) Center.

Of Insects, Wisps, and Uncertainty: A Hermeneutical Comparative Analysis of *Ori and the Blind Forest* and *Hollow Knight*

Benjamin Horn
The City University of Hong Kong
Hong Kong, China
Benjahorn2-c@my.cityu.edu.hk

Abstract

This paper is a multidisciplinary comparative analysis of two recent ludonarrative artifacts, *Ori and the Blind Forest* and *Hollow Knight*. Coming from the context of the uncertainty of light generated by the wave-particle duality paradox, and utilizing the analytical framework of game hermeneutics, this paper will argue that uncertainty acts as the central ludic and narrative impulse for both of these games. The first section will present the uncertainty inherent in the double hermeneutic and provide some brief context for the discussion of the two games. The second section will compare the gameplay experience, while the third section will contrast the narratives. The final section will conclude.

Keywords

Uncertainty, Game Studies, Hermeneutics, Ludonarratives, Hollow Knight, Ori and the Blind Forest, Comparative Game Analysis

Introduction

The world today is full of light. For over a hundred years, it has perhaps had too much light; to the point that now we research the effects of light "pollution" on our health and on the environment. Writing in 1928, naturalist Henry Beston questions the primal need for light, opining that "with lights and ever more lights, we drive the holiness and beauty of night back…[until we] will have none of it." [1] We have all but lost darkness under the deluge of illumination.

Why the need to cover the world in light? Maybe it is a part of the modern impulse towards control and order. Light and dark are frequently dichotomized, becoming representative of metaphorical impulses – good and evil, right and wrong, order and chaos. Darkness hides and conceals, creating the necessary environment for crimes and foul deeds, while light reveals, makes clear for all to see, and provides safety – at the cost of revealing oneself.

But light is anything but orderly. Scientific discoveries of the last century have demonstrated conclusively that the heart of light is uncertainty. Maxwell, Planck, and Einstein among others showed that light acts as both a particle and a wave, questioning the very nature of its being, placing it in a position of theoretical uncertainty. The models for both light as a wave and light as a particle worked at different times, but neither could fully account for the way light acts under specific situations. The duality paradox continues to underpin contemporary quantum research.

Two recent video games interrogate this thematic of light as uncertainty. *Ori and the Blind Forest* and *Hollow Knight* were released in 2017. They share many similarities – both are so-called "Metroidvanias" where the player freely explores a 2-d landscape collecting powers and items along the way. Both have naturalistic design aesthetics, with *Ori* set in a colorful forest and *Hollow Knight* taking place in an underground insect hive. And both have light as a major narrative thematic element.

This paper will compare these two games, in form and in content. It will argue that both games have uncertainty as their central ludic and narrative impulse. The first section will present the uncertainty inherent in the double hermeneutic and provide some brief context for the discussion of the two games. The second section will compare the gameplay experience of both games, while the third section will contrast the narratives. The final section will conclude.

Double Hermeneutics

Game hermeneutics, a sub-field of game studies, provides the framework for understanding the varying uncertainties that games can generate. Games are challenging to analyze because they are interactive and as a result force the player into constant interpretation and re-interpretation. If the player stops interpreting, the game stops too – gameplay necessitates the player to constantly interpret what they need to do next to keep progressing. Arjoranta (2015) notes this importance of hermeneutics for game analysis, contending that "games seem to be the only media where this hermeneutic is at the core of their being." [2] A Hermeneutical approach is therefore reasonable for game analysis.

Specifically, Arjoranta identifies two types of hermeneutics at work in game interpretation. He contrasts "game hermeneutics" that is "a more traditional type of hermeneutics, interested in games as objects that need to be interpreted in certain historical contexts" with "real-time hermeneutics", which is "more concerned with the processes of interpretation that are active when the player plays." [3] Game hermeneutics, in Arjoranta's analysis, does not refer to the sub-field, but to a specific mode of hermeneutic analysis. In this mode, the imagined player has stopped playing the game and is devoting their time outside the game to thinking about the game in terms of its historical context – perhaps comparing it to other games of its ilk. Or

maybe she is considering her strategy for next time she comes across a certain enemy or non-player character (NPC). Suffice it to say that game hermeneutics covers a wide range of reflections on the game itself.

Real-time hermeneutics, on the other hand, is that hermeneutical mode that occurs during the process of playing the game. So for instance, our imagined player may be moving her avatar across the virtual landscape until she comes to some sort of spatial obstacle, such as a river. She moves her avatar to the river's edge, only to see her avatar has stopped moving forward, even though the walking animation still plays. The player realizes – and makes the interpretation – that this river is not only an obstacle but a definite border that demarcates the limits of the game world. She turns her avatar around and goes in another direction. Should she not make this interpretation, the game would not progress, but be stuck in the borderlands.

Karhulahti (2012) understands this double hermeneutic as "possessing both the skills that correlate with challenges and knowledge that supports those skills and helps to understand the language of the game in general." [4] In his reading, the "skills that correlate with challenges" is roughly equivalent to Arjoranta's real-time hermeneutics, while "the knowledge that supports those skills" is Arjoranta's game hermeneutics. However, Karhulahti elaborates that in games, due to this double hermeneutic

> As the act of game play – the ongoing interpretation of the game – involves configuring the video game object itself, the altering interpretations affect not only the interpreter's understanding but the interpreted as well. [5]

The double hermeneutic is inherently uncertain. The protean object that we are interpreting when playing changes as we are playing – and this changes our interpretation of the thing itself, in a double feedback loop. This makes any analysis of a ludonarrative game somewhat uncertain, as there always lingers a question: would playing it another way produce an entirely different interpretation?

Uncertainty, then, defines the game both in terms of play and in terms of narrative, but it does not mean that we need lapse into total relativism. The game object may permit a range of interpretations that may be similar or different to varying extent, but even as the player changes the game object itself remains constant, thereby permitting analysis. Uncertainty may never entirely vanish, but that is no bad thing – much like our world of incandescent light, a little darkness and doubt could be beneficial.

Gameplay/Real-time Hermeneutics

Uncertainty not only informs double hermeneutic analysis, but is also a key component of the gameplay of "Metroidvanias," a sub-genre of action, adventure, and sometimes platform games. The term Metroidvania is a portmanteau formed from the names of two of the first games of this type - Nintendo's 1986 alien killing *Metroid* and Konami's 1986 *Dracula*-inspired *Castlevania*. Both games have essentially identical structures: players control their avatar through a closed 2-d space that consists of various rooms and passageways. At the start of the game, the player has very few abilities, and therefore very little way to interact with the game world. She might come across a treasure chest very early in the game, but the chest appears inaccessible – behind a wall, underwater, or on a high platform, just out of reach. But as she goes through the game, she will gain abilities that allow her to explore more and more of the game world and that simultaneously open up opportunities in earlier areas as well – finally getting her hands on that treasure chest in this example.

Both *Ori and the Blind Forest* and *Hollow Knight* have this same basic structure. In *Ori and the Blind Forest*, the players take control of Ori, a small, white, slightly luminescent cat-like creature. As Ori, your goal is to restore an orb of light to the giant tree in the center of the forest. However, in addition to this single narrative orb, there are other orbs that are common throughout the forest environment. These provide Ori with boosts to her life and energy, the two parameters that allow the player to continue playing and use special abilities, respectively. As such, retrieving these orbs is very relevant to gameplay, as it makes getting through some of the game's more difficult sections that much easier.

Figure 1. A "life cell" orb is placed tantalizingly out of reach. ©Moon Studios.

Figure 1 shows how these orbs are placed in such a way to suggest that the player *might* be able to reach them. The game has a dynamic physics system, such that with a running start, players can catapult Ori through the air. Additionally, at the start of the game, Ori can perform a second acrobatic somersault while in midair, changing direction or gaining height as the player chooses. But even with all this, this particular orb is unreachable without some of the abilities Ori obtains later. There are other orbs, however, that *are* accessible, but require practice in the timing and jumping to successfully reach. Here then, uncertainty reigns supreme, as the player constantly interrogates and re-interrogates herself – could I reach it, if I just had the skill, or if I just got lucky?

This uncertainty in object retrieval feeds into the mind of the player as she negotiates her way through Ori's forest world. The current goal is always shown as a glowing ball of light on a map that the player can call up at the touch of a button. However, the map does not reveal the route the player needs to take to reach their destination. Instead, the player must leap, run, and tumble through the forest envi-

rons. She may know where she is going, but how to get there? It may appear a simple question but Ori's world offers branching paths that may lead the player down cul-de-sacs, or to areas that she may not have the ability to access yet. This generates tense uncertainty, as the player realizes she is always on the point of going the wrong way, potentially dying and losing valuable time and progress.

Nevertheless, the map will show the player's current position, as well as target destination; something that helps orient herself. There is only one area in the game – a misty woods section – where the map is unavailable. *Hollow Knight* on the other hand, decides to take away the map entirely.

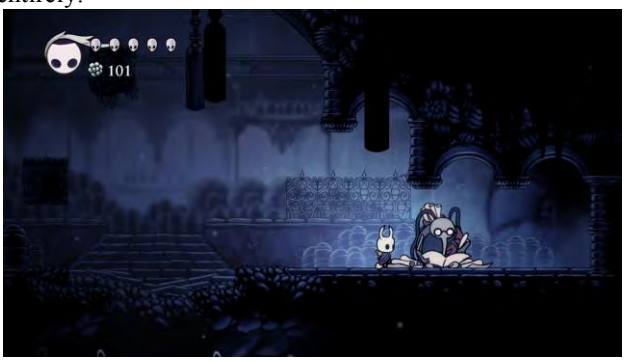


Figure 2. The Knight finds Cornifer the Cartographer somewhere inside Hallownest. ©Team Cherry.

Hollow Knight tells the tale of an insect who has no name, but is referred to in official out of game material as the Knight. Players take control of the Knight as he explores the depths of Hallownest, a once-great kingdom of bugs that has fallen into disrepair, and whose citizens have been infected with a virulent plague. As the Knight, you plumb the depths of this Hive, meeting charismatic insects and fighting numerous of the mindless infected.

Yet it is easy to lose one's way in the Hive, particularly because when the player enters a new area for the first time – she has no map. The player must find a certain cartographer insect, who for a nominal fee will produce an outline of the area for the player, which can then be filled in by exploring those rooms.

In addition, the player has no way of knowing her position on the map unless she chooses to equip a certain item –sacrificing the opportunity for using another item just to know her location. This design creates extraordinary tension each time the player enters a new area, because without a map, the player could very easily get lost, especially because of the twisty passageways of the labyrinthine hive. What a contrast to our daily experiences, where most people have smart phones that can send signals to satellites that ping us our exact location on the surface of the globe.

Additionally, while *Ori and the Blind Forest* focuses on the uncertainty that stems from movement (can I get there with my character's abilities and my personal skill level?), *Hollow Knight* uses combat to create dynamic tension. The Knight has to fight many mad anthropomorphic insects as he makes his way deeper into the hive. Some of these insects are more challenging than others, but generally every area has a suite of foes that – if the player is not cautious – can easily kill her. This stays true throughout the whole game: the Knight does not gain much health, so that the danger of dying is a constant threat. Simply whether the player can make their way through a given area, even one that has been traversed several times before is far from guaranteed. *Hollow Knight*'s uncertainty in location is thus complemented by uncertainty of combat, while *Ori and the Blind Forest* builds uncertainty through location and movement.

Narrative/Game Hermeneutics

Having discussed the ways uncertainty is developed through gameplay, the analysis will now turn to a study of the contrastive thematics of the two games. As noted above, *Ori and the Blind Forest* is the story of Ori. The game begins with Ori living an idyllic life in the forest. However, the forest soon begins to decay, causing Ori's friends to fall ill. She discovers that she must restore an orb of light to an enormous central tree, bringing the forest back into balance in the process. To do so she must first seek out and recover the natural elements.

Light is thus quite obviously a central theme of *Ori and the Blind Forest*. Ori herself comes from light, and to the light she must return. It is notable that the world itself is out of balance without the light; the forest will decay and die without it. Order can only be restored with the return of the light. However, at around the midpoint of the game, the narrative is complicated with the appearance of Kuro, a gigantic and ferocious owl.

Figure 3. Ori comes face to face with Kuro, the owl who lost her children to the light from the giant tree. ©Moon Studios.

The player learns that when the giant sentient tree with the orb of light sent out a beam of light searching for Ori, this beam of light was so bright that it burned out the eyes of the owl Kuro's infants, killing them in the process. In her grief, Kuro ripped the orb of light from the tree, sending the forest into imbalance.

What is crucial here is that the light – which Ori must restore to bring balance, harmony, and growth back to the forest – is in fact the cause of the imbalance in the first instance. The relationship between Ori, the light, and the victimized Kuro calls into question the necessity for light, and instead throws the narrative into uncertainty: maybe there is such a thing as too much light?

At the end of the narrative, Ori and Kuro must put aside their conflict to work together to save the forest and Kuro's last remaining egg. Kuro perishes in the ensuing chaos, and Ori takes Kuro's egg into her care, bringing the narrative to a close. It is important to note that this is the only available ending for the game – no choice the player makes will change the outcome. Light *must* be restored; in *Ori*, light's role is certain, even if as players it might be questioned.

Hollow Knight's narrative is far more subsumed. The game begins with the Knight simply dropping down into Dirtmouth, a small and mostly deserted village whose well affords an entrance to the Hallownest hive below. As the Knight explores Hallownest, he meets several characters who inform him, in half-explained hints and phrases, about why exactly Hallownest, once a powerful kingdom, met its ruin – a virulent infection that makes its victims aggressive and mindless.

Figure 4. The infection caused by the god of light, the Radiance, spreads through Hallownest infecting the locals. ©Team Cherry.

Through exploring the Hive, the Knight discovers that the cause of the infection is a forgotten god of light, known only as The Radiance. This god of light, as an act of vengeance for being abandoned, causes the epidemic of madness that causes the eventual destruction of the kingdom. Light in *Hollow Knight*, then, is far from being a bringer of order and certainty – light is rather conceived as the cause of an infectious disease.

What is interesting is that compared to *Ori*, *Hollow Knight* has a number of different endings that the player may experience. There are in total five endings, although two of these are related to the "Godmaster" downloadable content (DLC) that acts as a kind of epilogue to the main story. Here we will focus on looking at the three endings of the original game, without the DLC.

If the player reaches the end of the game without pursuing any of the side-content, then the Knight will take the infection into his shell, thereby saving the kingdom from further infection at the cost of his own life. However, the player may wonder if this is an effective sacrifice, given that the previous vessel for the infection – the titular Hollow Knight – could not constrain the infection from spreading. There is a suggestion in this conclusion that the virulent god of light will not be long from return.

The second ending is a variation of the first, whereby the Knight is joined by one his companions in sacrifice to contain the light. The third ending, however, presents a very different outcome: if the player has done a certain amount of side-content, then the Knight will have a chance to fight the Radiance directly, banishing the god of light in darkness forever. This ending has the Knight's companions find his broken shell in the room of the final fight, implying the Knight died to defeat the light.

Compared to *Ori and the Blind Forest*, there is a huge amount of uncertainty surrounding the conclusions of *Hollow Knight*. The fact that *Hollow Knight* has multiple ending conditions causes uncertainty in the player: did I-the-player get the "best" ending? If only I had done something differently, would things have changed? Doubt shrouds the narrative finales of this game. In the third ending, the game ends with the Knight's companion staring down at his broken body under a flickering lamp. Was the destruction of the light worth the cost?

Conclusion

This paper began by questioning the modern need to fill the world with light. It argued that light is not representative of order, but based on recent scientific findings, of uncertainty. It then showed how this thematic of light as uncertainty connects to the notion of the double game hermeneutic as a tool for analysis, utilizing this approach to contend that uncertainty acts as the main ludic and thematic force of *Ori and the Blind Forest* and *Hollow Knight*, two recent Metroidvanias. It compared the two games by showing how in ludic terms uncertainty was generated through location, movement, and combat. It then demonstrated that while *Ori and the Blind Forest* thematically positions light as bringer of order and certainty through its single ending, *Hollow Knight*'s position on light is much more uncertain and dependent on the ending that a player might experience – although all of the endings have something in common: doubt of what the future might bring.

Especially in terms of the use of uncertainty as a key tenet in game hermeneutic analysis, further work would need to explore and see if the approach could be applied to other games, but this paper would suggest that at least for ludonarrative games, the model should hold. Additionally, the ludic and narrative analyses presented here were limited in extent – more research is certainly needed for both of these brooding games.

Why would this paper recommend a model based on the shifting sands of doubt and uncertainty? Doubts are important: doubts lead to questions, and questions lead to attempts to find answers. Without doubts, in a perfectly ordered, light-filled world, there are no questions. What *Hollow Knight*, and to an extent *Ori* suggest is that what the world needs now is exactly that: a little less certainty, a little less light, and a little more darkness.

References

[1] Henry Beston, *The Outermost House: A year of life on the great beach of Cape Cod* (Macmillan, 2003.)
[2] Jonne Arjoranta, "Real-Time Hermeneutics: Meaning-Making in Ludonarrative Digital Games," (Ph.D. diss., Faculty of Humanities, University of Jyväskylä, 2015.), 60.
[3] Jonne Arjoranta, "Real-Time Hermeneutics: Meaning-Making in Ludonarrative Digital Games," 59.
[4] Veli-Matti Karhulahti, "Double Fine Adventure and the Double Hermeneutic Videogame," (paper based on a talk presented at the 4th International Conference on Fun and Games, Toulouse, France, September, 2012), 24.
[5] Veli-Matti Karhulahti, "Double Fine Adventure and the Double Hermeneutic Videogame," 20.

Bibliography/Ludology

Aarseth, Espen, "Playing Research: Methodological approaches to game analysis," (paper based on a talked presented at the Digital Arts and Culture Conference, 2003.)
Aarseth, Espen, "A Narrative Theory of Games," (paper based on a talk presented at the Conference on the Foundations of Digi tal Games, 2012.)
Akamatsu, Hitoshi, *Castlevania* (Konami, Family Computer Disk, 1986.)
Anderson, Joseph, "Hollow Knight Critique," YouTube, accessed November 30, 2018, https://www.youtube.com/watch?v=7t1mxoMIDfY
Calleja, Gordon, *In-Game: From Immersion to Incorporation* (MIT Press: 2011.)
Consalvo, Mia and Dutton, Nathan, "Game Analysis: Developing a Methodological Toolkit for the Qualitative Study of Games," *Game Studies*, Vol. 6, No. 1, accessed December 4, 2018.
Bogost, Ian, "The Rhetoric of Video Games," (*The Ecology of Games: Connecting youth, games, and learning*, 2008.), 117-140.
Costikyan, Greg, *Uncertainty in Games* (Cambridge, MA: The MIT Press, 2013.)
Farca, Gerald, "The Emancipated Player," (based on a paper pre sented at the Digital Games Research Association Conference, 2016.)
Farca, Gerald and Ladeveze, Charlotte, "The Journey to Nature: The Last of Us as Critical Dystopia," (based on a paper pre sented at the Digital Games Research Association Conference, 2016.)
Gadamer, Hans-Georg, *Truth and Method* (London and New York: Continuum, 2004.)
Gibson, Ari and Pellen, William, *Hollow Knight* (Team Cherry, Microsoft Windows, 2017.)
Konzack, Lars, "Computer Game Criticism: A Method for Com puter Game Analysis," (paper based on a talk presented at the Christian Game Developers Conference, 2002.)
Leino, Olli Tapio, "Death Loop as a Feature," *Game Studies*, Vol. 12, No. 2, accessed November 30, 2018, http://gamestudies.org/1202/articles/death_loop_as_a_feature
Mahler, Thomas, *Ori and the Blind Forest* (Moon Studios, Mi crosoft Windows, 2015.)
Okada, Satoru, *Metroid* (Nintendo, Family Computer Disk, 1986.)
Sicart, Miguel, "Against Procedurality," *Game Studies*, Vol. 11, No. 3, accessed December 4, 2018

Author Biography

Benjamin Horn is a Ph.D. candidate at the School of Creative Media at the City University of Hong Kong. His research focuses on meaning in ludonarrative video games and the methodologies around their study.

Reinterpreting Korean 'True-View' Landscape Painting Using Graphics Analysis Techniques - The Case of Jeong Seon's *Dosando*

Intae Hwang
intae@ucsb.edu
Media Arts and Technology
University of California, Santa Barbara
USA

Alenda Y. Chang
achang@filmandmedia.ucsb.edu
Film and Media Studies
University of California, Santa Barbara
USA

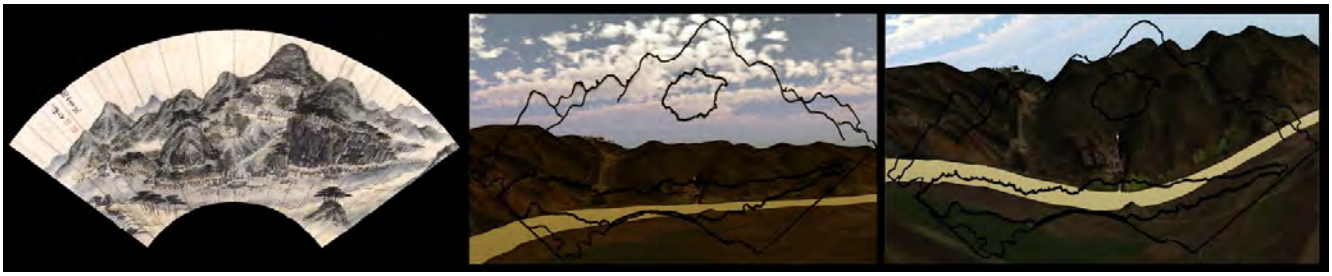


Figure 1. Korean painter Jeong Seon's *Dosan Seowon* (left), analyzing the virtual Dosan Seowon (middle), and using the fisheye-lens effect (right).

Abstract

Jeong Seon (1676 - 1759, 정선) was one of the most innovative painters in the history of Korean painting. Unlike the conventional art style of the early Joseon period, his attempts to directly observe nature and capture them in his paintings created a new art movement known as 'true-view' (*jingyeong* - 진경). Despite the name, Jeong Seon's style was not the only result of realistic observation but also a considerable modification of subjects of paintings. This study begins with reconstructing one of his landscape paintings, *Dosando* (Painting of Dosan Confucian Academy, also known as *Dosanseowondo*) in immersive virtual space to verify his distinctive implementation of observation skills. Using multiple virtual cameras, our application introduces users to how the painter incorporated natural scenery from many vantage points, not just one, sometimes creating more revealing, but physically impossible compositions. The goal of this project is to reveal Jeong Seon's subtle blending of real topographies and anamorphic distortions which normally used in modern computer graphics for movie and game making.

Keywords

Jeong Seon, Korean landscape painting, virtual reality, immersive virtual environments, anamorphosis, fisheye view, Panorama effect.

Introduction

Jeong Seon figures prominently in Korean painting history because he tried to observe and depict the landscapes of Korea without relying on dominant customs derived from Chinese painting traditions (the Ming dynasty exerted a strong cultural influence on the Joseon Dynasty). His activities as a landscape painter launched 'true-view' movement, characterized by actual visiting of subjects to

deliver scenes as the painter observed them and adopting a Western perspective technique to achieve a likeness to nature.

Starting in the late 1990s, Korean art historians began to suggest comparative analysis between Jeong Seon's works and the actual places where he painted. In those studies, site photographs confirmed that his paintings are based on factual observation. However, the painter's style is not reducible to the accurate description of natural scenery. In fact, he liked to construct his paintings by combining several sketches made from memory following actual site exploration. Therefore, to judge a work's 'true-view factor', just comparing the painting and the site photograph is not an ideal way to fully understand his style. Thus, we decided to construct three-dimensional virtual models of his paintings and find his unique screen configuration method.

In this paper, we look particularly at *Dosanseowondo* (see fig. 2). The Dosan Confucian Academy was initially built in 1557 to memorialize the most prominent Korean Confucian scholar Yi Hwang,[1] and the artist visited the site and painted it in 1734. *Dosanseowondo* was notably drawn on a fan, so Jeong Seon used different compositional techniques from what he had done before. Our application is a result of carefully reconstructing the entire area including the ritual facility by using advanced computer graphic technology. In addition, this program offers a unique experience of Jeong Seon's painting in a virtual space with Head Mounted Display (HMD).

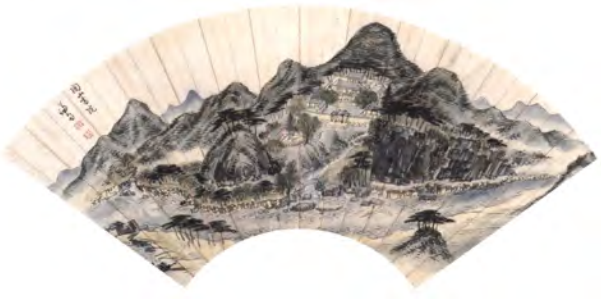


Figure 2. Jeong Seon, *Dosanseowondo*, 1734, ink and light color on paper, 21.2cm x 56.3cm, Kansong Art and Culture Foundation.

[1] Seowon is an advanced facility of Seodang (private village school) built in memory of a teacher, there is ancestral shrine for the great scholar and it is gathering place of students. Dosan Seowon was initially started its educational service as Seodang. After Yi Hwang passed away, his disciplines built several extensions to the north of the facility, it is renamed Dosanseowon.

Historical Background of *Dosanseowondo*

Jeong Seon was appointed as a magistrate of Cheongha prefecture in August 1733 for twenty months.[2] During this period, he visited several famous places near the town and left six paintings, this album is known as (Album of Gyeongsang Province, 영남첩). *Cheonghaseongeup* is a well-known painting that depicts the town where he served because the artist wanted to leave a record and use it for reminiscence. *Dosanseowondo* is one of the paintings in the same album. Unlike the other paintings, this has invited different interpretations among art historians. Currently, there are about ten paintings of the same subject. You Jaebin [1] classified this specific genre painting as two groups with the purpose. The first group was produced by the request of Namin (Southerners, Korean political faction, 남인), their scholarly background was Yi Hwang, thus this type of paintings are describing the entire part of the facility to satisfy the desire of the orderer's nostalgia. Most of them have a monumental characteristic to succeed in the academic ideology of Yi Hwang. However, the other group was considering Dosan Seowon as a scenic spot in the region, these paintings feature the commemoration of visiting and highlighting a touching place. *Hooghyejib* (후계집)[3] informs that Jeong Seon visited Dosan Seowon to sketch the nature around the facility. This poem suggests that the artist directly painted the landscape of Dosan Seowon while he was staying there. After the drawing, he was performing the ritual ceremony to the great scholar. Reflecting the contents of this poem, Jabin's argument seems persuasive. However, this fragmentary poetry does not suggest the proper intention of Jeong Seon's painting.

Related Works

Understanding paintings is a complicated process. To analyze paintings correctly, it is necessary to learn the art history and the technique of painters in addition to intuitive appreciation. In the area of computer science, analyzing the elements of painting such as color, brightness, touch, and shape can be scientifically explained. However, the correct interpretation of symbolic

[2] *Seungjeongwon ilgi (Journal of the Royal Secretariat)* "book 761, 9 June 1733", "鄭敾爲清河縣監" (Assign Jeong Seon as a magistrate of Cheongha prefecture), "book 763, 15 August 1733" "下直, 淸河縣監鄭敾" (Accept the position and depart to Cheongha). http://sjw.history.go.kr/main.do.

[3] *Hooghyejib* (1747) is eight albums of poem written by Cho Yousoo (趙裕壽, 1663~1741).

meanings drawn in the artworks is acquired by lots of appreciation of other artworks and studying artists, thus it is not easy to fully comprehend the intention of the artwork by performing simple computational analysis tool.

Despite these difficulties, however, various attempts have been made to solve the question about the unique technique of painters, which were not described by themselves. Especially, many scientists and art historians virtually produced spaces and objects which are depicted in paintings to answer their questions. The virtual camera with the same view of the painter is also placed at the fabricated space to verify what the scene was like and to see what was brought to the painting. David and Yasuo analyzed two famous paintings Diego Velázques's *Las Meninas* (1656) [2] and Parmigianino's *Self-portrait in a Convex Mirror* (1524) [3] to find out the proper positions where they stood at gaze by reconstructing the tableaux and figures as 3D models. In the case of Velázques, they identified the exact location of the characters depicted in the painting whose existence had been ambiguous and analyzed the locations of the light sources that would have been used at the time.

To scientifically analyze perspective used in paintings in Asia, we must solve more difficult issues. First, the line perspective that had been developed since the Renaissance of Italy began to enter China in the middle of the 18th century and the acceptance of new techniques by existing artists was tardy. Therefore, it is not the best way to apply current 3D rendering technique based on a line perspective to landscape paintings in Asia. Secondly, if Western paintings are mostly based on changes in the color of objects reflected by light, the main expression manner in the landscape paintings is describing outlines of form recognized by the painter, thus the computer analysis tool should be filtered (i.e. line detection, edge detection) to make the result more like the target painting. Thirdly, these paintings did not value the drawing of the visible scenes, whereas artists attempted free transformations and drastic omission within the screen based on their imagination. From this point of view, it is very meaningful that Yuka Kubo et al. [4] revealed the composition of the screen of *Ukiyo-e* paintings after the influx of Western line perspective in Japan. From a similar point of view, Park EunSoon's [5] study is searching out the traces of Western perspective as seen in Jeong Seon's paintings based on the records and various historical documents left by friends of the artist.

Vantage Point of *Dosando*

To understand the way *Dosando* was composed, it is important to carefully read *Toegyejib* (Anthology of Yi Hwang). Jeong Seon read this literature several times before visiting Dosan Seowon and understood the contents. The artist tried to bring all the components described in the writing into his painting. The space in the painting covers a large area, it is almost about 3700 meters from left side to right (blue line in fig.3).

Figure 3. Aerial map of Dosan Seowon and its neighborhood, [Source from Daum Map]

The main theme mount Dosan, besides its altitude is 278 meters, almost takes up all the space at center of the painting (see fig.2). Thus, if Jeong Seon wanted to draw exactly what he saw at a vantage point across the Nakcheon (green river crossing the field, see fig. 3), the horizontal to vertical ratio of the painting should be about 13.5:1.[4] However, the size of the painting is 56.3cm x 21.2cm, its aspect ratio is about 2.6:1. From this, we realize that Jeong Seon compressed the scene horizontally to bring all of the things he read from the literature into his painting. If not, he scaled up the scene vertically by placing mount Dosan in the middle of the painting then stretched it until the peak reaches to the top edge of the painting. There was not such a sentence directly mentioning the connection between the formation of Dosan Seowon and the Chinese philosophy of Feng Shui in Yi Hwang's writings. However, Park and Seong [6] insist that the scholar's view of nature and philosophy led to Feng Shui, the space recognition system of the time, and this played an important role in the site selection. We thought the distinct proportion of the painting is from the artist's combination of the Feng Shui idea and the impression he received from the writings of Yi Hwang. The painting is considerably designed in a direction that further emphasized the requirements of the best land in Feng Shui. [1] According to the philosophy, the best place to live should be

[4] 3700 meters divided by 278.

surrounded by mountains on all sides, the mountain at the north should block the cold wind from blowing from the north during winter. Two waterways should run from the mountain on the right and the left, then this should go out towards the mountain at the south. [8] Overall, geographical features make the place warm in winter, cool in summer, and it is easy to obtain water, but not affected by floods. Jeong Seon's modification, especially emphasizing the main subject (Dosan Seowon) and the three mountains,[5] can be seen clearly when we compare another painting of Dosan Seowon done (see fig.4) by Kang Sehwang (1713-1791). His approach is like a panoramic map features a specific area. Sehwang kindly put name tags on each building. This indicates that the purpose of this painting is to deliver site information. The vantage point is thought to be one of the hills behind Uichonri (see fig.3). In addition, he also applied a one-point perspective to maintain fixed scale between many motifs in the painting, and he set the vanishing point around the rock at the upper right corner.

Figure 4. Kang Sehwang, *Dosanseowondo*, 1751, ink and light color on paper, 26.8cm x 138cm (including calligraphy), National Museum of Korea

Those paintings are only seventeen years apart, but their approaches were quite different. We wondered how Jeong Seon solved the contradictory intentions of describing his Feng Shui idea and the visible scenes in a wise way in the painting. To verify this idea, we created the virtual Dosan Seowon using terrain data resources from *OpenTopography*.[6] The terrain mesh had to be vertically scaled up four times to make mount Dosan look as depicted in the painting (see fig. 5). Vertical enlargement, abnormal scaling of painting is a principle of landscape painting from the Song Dynasty. [7] The artist also enjoyed this remarkable composition, and it was painted taller than the actual one in the painting of rock as well as mountains.

The selected area for the virtual space covers four Ri (village, an administrative division in Korea); Booncheonri, Dongboori, Toegyeri Woncheonri, and Uichonri.[7] There are two possible vantage points (red and yellow circles in fig.3). The first one is the large field across the river, the other one is at the hill behind the field. As you can see in Figure 6, the scene from the hill (yellow circle, bottom right in fig.6) covers entire mountains described in the painting, but their shapes are smaller than the scene at the red circle. From the ground-level field (red circle, top right in fig. 6) we only have a limited angle of view. But there, we can see what the buildings look like. This means, instead of sketching the nature at a distance, Jeong Seon stood at the red circle and turned around to capture the entire area. This is the exact same technique to a panorama. Basically, it is taking multiple pictures by spinning the camera and stitching them together to generate a wide-angle picture.

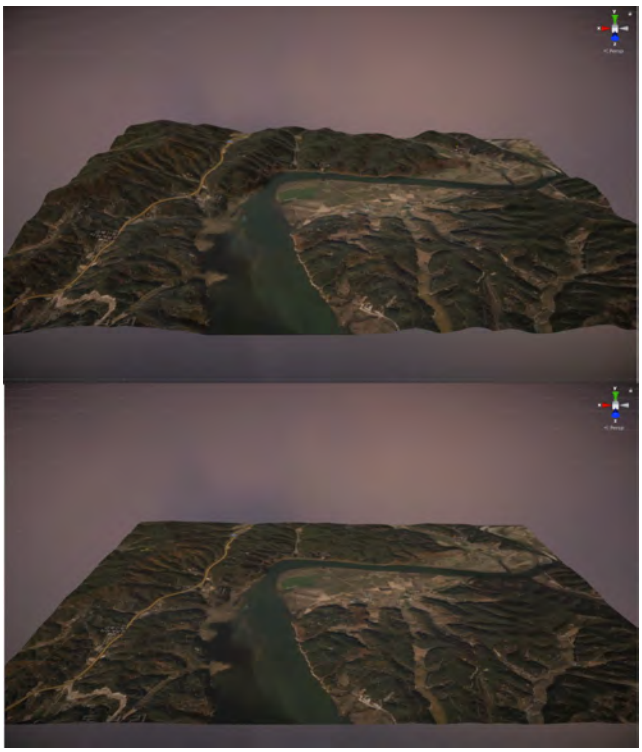


Figure 5. Virtual topographic model of Dosan Seowon

(top: four times scaled vertically/bottom: original topographic data)

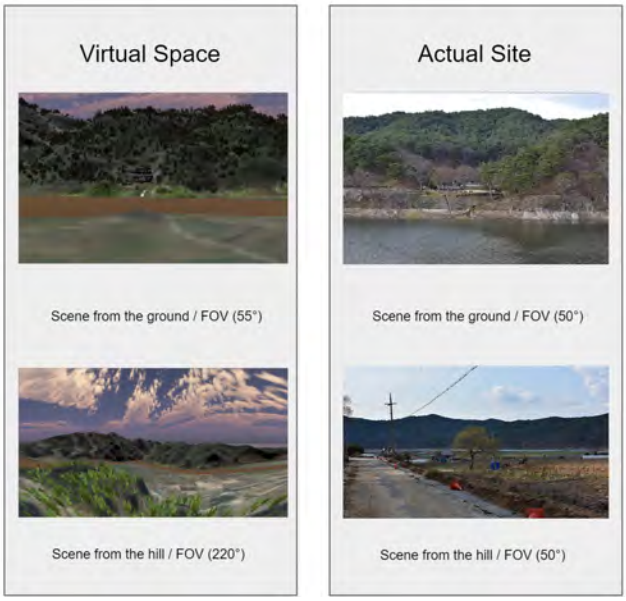
Panoramic Landscape Paintings based on Actual Observation

[5] In Feng Shui, all mountains in each direction are named as animals: the Tortoise mountain at the back of the site, and the Green Dragon mountain and White Tiger mountain facing each other on the left and right. The Red Phoenix covers the bottom side. In the painting, Mount Dosan is the Tortoise. [8]

[6] *OpenTopography*, San Diego Supercomputer Center, University of San Diego, Web. <http://www.opentopography.org/about>

[7] latitude 36.705 ~ 36.735 / longitude 128/818 ~ 128.871, Figure 3 is also the aerial view of this site.

The normal Field Of View (FOV) of humans is about 60 to 70 degrees horizontally. [9] This number is also applied to the virtual camera to get the same visual field as the artist. When we place the virtual camera at the provisional vantage point across the river (red circle in fig.3), our camera was not able to catch all subjects drawn in the painting (see top right in fig. 6). This means the FOV should be wider than 60, or the camera should be positioned further behind from the main motif. In this case, the objects in the painting become smaller, and the main motif is disappeared (see bottom right in fig.6). This composition, in which most spaces are filled with sky and rice fields, is contrary to the purpose of the painting to emphasize the Feng Shui advantage of Dosan Seowon. To solve this problem, Jeong Seon intentionally enlarged the main subject (Dosan Seowon) and compressed scene vertically in order to bring the Green Dragon and White Tiger mountain.



To recreate the unique composition of the painting in a virtual space, we equipped a panoramic function on our camera which combines images from four directions. Figure 7 shows how these cameras work in the virtual space. To capture the whole scene expressed in the painting only using a single camera, we had to position it in a long distance from Dosan Seowon. However, the scene through four virtual cameras unable us to have the main motif in a close distance. Furthermore, the shape of motifs especially Nakcheon becomes like the one in the painting with this camera setting. When we watch it at the vantage point, it should be " ㄱ" shape (see fig.5). The path of the river turns to tilde ("~") with our virtual cameras, even it runs straight in front of the facility. Jeong Seon also described the river as a wide "U" shape in the painting. This indicates that he observed Nakcheon at least more than two different directions like our virtual cameras do.

From the satellite view (see figure 3), Nakcheon flows straight from Woncheonri to Dosan Seowon, then it makes an abrupt turn before it arrives Booncheonri. Park and Seong [6] pointed out this river flow is a weak spot in Feng Shui idea. According to their argument, the soil erosion of the river becomes more aggressive during monsoon. This phenomenon would cause the area of the facility to be reduced in the long term. Additionally, the straight flow of the river also causes a low water level in a drought. This idea is indirectly mentioned in Yi Hwang's writings, and we believe the painter already knew this fact before he starts to draw.

However, this panoramic observation is not sufficient to explain the centralized configuration of Dosan Seowon. Especially the rocks next to the facility are greatly enlarged and occupied most of the center part. As we can see from the original painting, Jeong Seon intentionally enlarged Dosan Seowon and surrounding mountains, this is the third technique he chose to compensate for Feng Shui defects. This effect is similar to one of the modern camera techniques, fisheye lens.

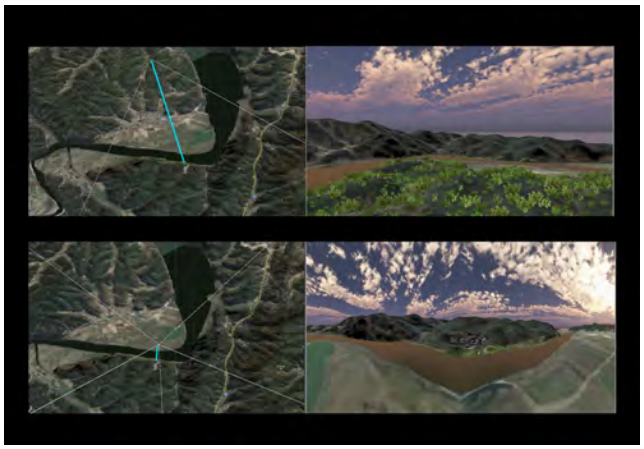


Figure 7. View from single camera with 110 degrees (top) and combined display of four cameras have 55 degrees angle of perspective (bottom) light blue color lines indicate the distance between vantage points to Dosan Seowon.

Fisheye Lens Technique to Emphasize the Subject

The fisheye view was introduced in 1906 in the paper by American physicist Robert Williams Wood who was

interested in how a fish see the outside world underwater. He began to take pictures by making small instruments to answer the question of how the world looked out of the water in the water.[8] Due to the refraction of light on the surface of the water, the lens has an angle of view of 180 degrees around its surface, but the shape of the object is distorted from the center. This fisheye effect is also achieved by physical light changes capturing a scene by the actual physical lens, but it can be easily implemented by mapping effects in computer graphics. Unity3D, 3D game engine that we used for our program, provides Fisheye Shader as one of the image effects. This image effect generates a warped image as the same view through a fisheye lens. Since we are watching Dosan Seowon and its surrounding by four virtual cameras, there were slight

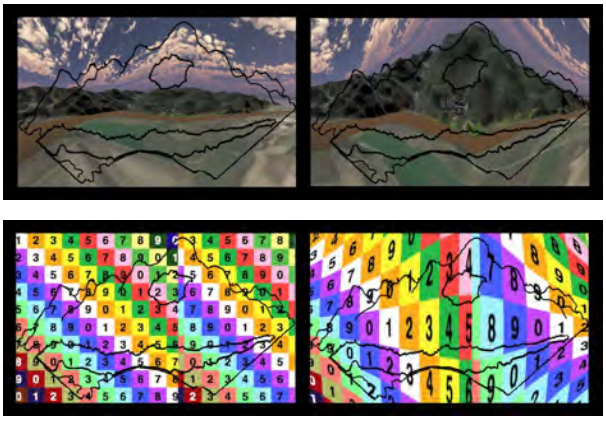


Figure 8. A virtual scene with fisheye lens effect and applying of UV checker map

modifications in this basic shader and adjusted the variables of the fisheye script to get the nearest match to the original painting. To find the best matching variable that produce the most similar features to the original painting, we first decided to find the number that generates the nearest size of the mount Dosan to the one in painting. Starting with all the camera techniques mentioned above, we adjust the deformation degree of X and Y axis on the image to expand the view at the center of the camera until the top of mount Dosan and the riverside (bottom of the mount) fit the outline of the painting. (see fig. 8 top right) As a result, the surrounding peaks and ridges were not exactly the same as the extracted outlines from the original painting. Nevertheless, they were sufficiently similar to make us believe that they were drawn based on actual observation. The Tortoise mountain (mount Dosan, 278 meters) is expressed higher than the nearby mount Yeongji (443.4 meters, see A in fig. 9), and the Green Dragon and White Tiger mountain stood more apart than the actual location. Moreover, the facility is depicted higher and larger than it is, because he applied a bird's-eye view only for this facility. As described in the previous part, the abrupt turn of Nakcheon is omitted in the painting, instead he brought Cheonyeondae (no.2 in fig.9) forward in order to hide its Feng Shui defects. This explains why the position of the river near the Chenyeondae is much different after the application of the fisheye effect. (see top right in fig. 8 and no.1 in fig.9)

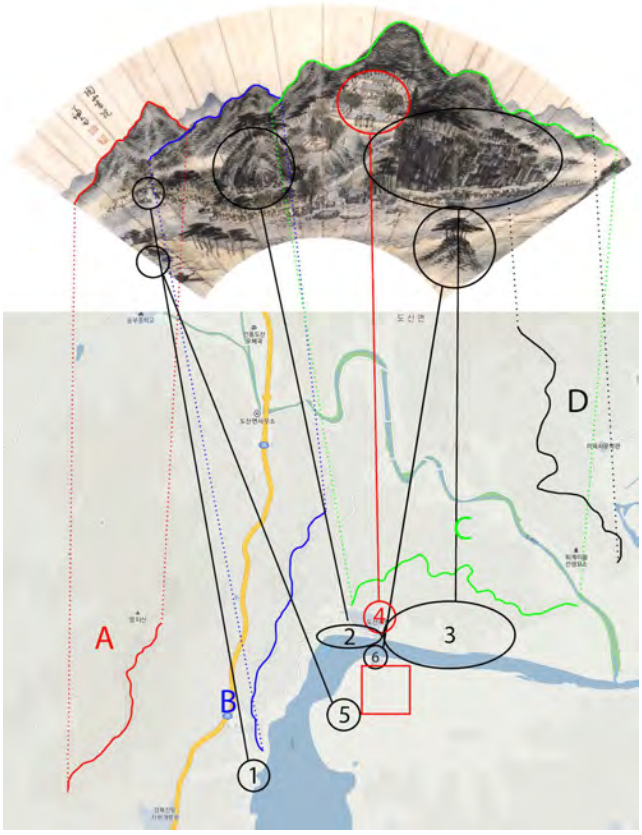


Figure 9. Matching major components on *Dosando* and map. (A. mount Youngji B.Unknown Mount C. Mount Dosan D. Mount Geonji 1. Unknown stream 2. Cheonyeondae 3. Woonyeongdae 4.Dosan Seowon 5.Unknown stream 6. Seesadan)

Through this process, we can see that Jeong Seon portrayed the actual feature of Dosan Seowon as well as the Mount Youngji and Nakcheon. About ten pieces of Jeong Seon's fan drawings remained for another three

[8] Robert W. Wood, *Fish-eye views, and vision under water,* The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science Vol.12(68), 1906, p.159-162.

hundred years after his death. However, this painting is the only one that made this bold composition to highlight the theme among them. Applying UV checker map (see fig. 8 bottoms) explains how much he transformed the nature to give more prominence to the elements of Feng Shui idea. Our program also offers an opportunity to indirectly experience this experiment through the head mount display.

Youtube Link:

https://www.youtube.com/watch?v=8c6HvSNYCJk

CONCLUSION

Our program presents an alternative attempts to analyze Jeong Seon's true-view method used one of his paintings using computer graphics techniques. Through our contemporary reinterpretation of the style of Jeong Seon, we present his unique compositional method which had been treated ambiguously among the Korean Art historians. His ingenious device defined multiple perspectives and deliberate deformation of objects against the European perspective method in the same period. In addition, our program in the artistic aspect has a great significance in that it provides a fantastic experience of realizing the scenery of the Joseon Dynasty imagined in the paintings.

References

[1] Unknown, "Seungjeongwon ilgi / Journal of the Royal Secretariat", 1623~1910, K

[1] You Jaebin, "A Study of Dosando (陶山圖)", *Korean Journal of Art History* vol.250, Art History Association of Korea, (2006). pp.193-194.

[2] Stork, David G., and Yasuo Furuichi, "Computer Graphics Synthesis for Inferring Artist Studio Practice: An Application to Diego Velázquezs Las Meninas," *The Engineering Reality of Virtual Reality 2009*, (2009).

[3] Stork, David G., and Yasuo Furuichi. "Reflections on Parmigianino's Self Portrait in a Convex Mirror: A Computer Graphics Reconstruction of the Artist's Studio," *Computer Vision and Image Analysis of Art*, 2010.

[4] Kubo, Yuka, Zhao Jie, and Koichi Hirota. "A Method for Transformation of 3D Space into Ukiyo-e Composition." *ACM SIGGRAPH ASIA 2008 Artgallery: Emerging Technologies on - SIGGRAPH Asia 08*, 2008.

[5] Park, Eunsoon. *Jeong Seon's True-view Landscape Painting and the Western Influences*, Korean Journal of Art History, No.281, Art History Association of Korea, 2014.

[6] Park, Sungdae, Seong, Donghwang. *Toegye's Feng-Shui(風水) Idea in the Sites Related Toegye*, Han'gughagnonjib, Academia Koreana, 2012.

[7] Cahill, James. *The Compelling Image Nature and Style in Seventeenth-century Chinese Painting*. Cambridge, MA: Harvard Univ. Press, 1993.

[8] Henry Fong, "Different Sites, Different Results." *Feng Shui Unzip*. September 26, 2017, http://fengshuiunzip.com/different-sites-different-results/.

[9] Arthur, Kevin Wayne. *Effects of Field of View on Performance with Head-mounted Displays*. PhD diss. University of North Carolina Chapel Hill, 2000.

Intae Hwang is a researcher, product designer, and sculptor. He holds an MFA in sculpture, an MFA in Art and Technology, and is currently a Ph.D. candidate in the Media Arts and Technology Graduate program at UCSB. His main research is analyzing perspective methodology of 18th-century Korean landscape painter Jeong Seon using technologies in computer graphics. He also works as a game developer for the Wireframe Studio in the Department of Film and Media Studies.

Alenda Chang (PhD UC Berkeley) is Assistant Professor of Film and Media Studies at the University of California, Santa Barbara. Her writing has been featured in *Ant Spider Bee*, *Interdisciplinary Studies in Literature and Environment*, *Qui Parle*, the *Journal of Gaming & Virtual Worlds*, and *Ecozon@*, and her first book *Playing Nature: Ecology in Video Games* (forthcoming Fall 2019, University of Minnesota Press), develops ecological frameworks for understanding and designing digital games. Chang is also the co-founder of the digital media studio Wireframe, which supports collaborative and cutting-edge research and teaching in new media with an emphasis on global human rights, social justice, and the environment.

Interactive Technology as Toolkit—Structure of Communication, Senseware, and Research Strategy

Bert Vandenberghe[1], Kathrin Gerling[1], Luc Geurts[1], Vero Vanden Abeele[1], Steven Devleminck[1,2]
KU Leuven[1]; LUCA School of Arts[2]
Belgium
firstname.lastname@kuleuven.be

Abstract

This research introduces a toolkit for creating interactive objects as a strategy to observe and discuss their construction and experience as scientific, artistic, and social subjects. Interactive technology as toolkit is presented to be senseware (Hara, 2009), following three specific trajectories in depth: the design and programming of interactive objects; the understanding of rich interaction; and the role of the design objects and their concurrent (scientific) models into the lived-in world. A multi-viewpoint theoretical approach investigates the concept and use of toolkits based on interdisciplinary research, replacing single viewpoint categorization. This is coupled with the concept of thickening (Geertz, 1973), as the research seeks to define a liquid form of understanding capable of approaching the complexity of artifacts that cross media and discourses, illustrated with an exemplary case study of Skweezee, a squeeze interaction toolkit.

Keywords

Human-computer interaction, lived-in world, methodology, Skweezee, interactive technology, toolkit.

Media History

The history of interactive media or artifacts is relatively short. Recent studies by for example Bruno Latour [15], or Zygmunt Bauman [2] identify an apparent shift in the way we experience and deal with modern society replacing the rigid cognitive frameworks by more 'fluid' social and cultural interactions. Lev Manovich [19] contends that the rise of the 'new' media did not lead to a fundamental rewriting of the methods analyzing art, technology and culture but only provoked an increase of medium-bound labels for different forms of artifacts. He describes a 'post-media aesthetics', where art or design objects are a form of information design triggering a certain information behaviour. However, the initial theories, relying heavily on cognitive values, neglect the affective side of information.

In recent years, new media and the associated human-computer interaction (HCI) has become established as a distinct subject through a series of theoretical approaches (developments and models) applied to digital artefacts, their uses and influences. Several authors including Lev Manovich [18], Gunnar Liestol [17], Jay David Bolter and Richard Grusin [4], Christiane Paul [21], Mark Dery [5], Lisa Gitelman [10] have debated the role played by the digital media in contemporary society and demonstrated the variety and complexity of digital domains opening the field for new development.

The research examines 'modes of transition' in various recent interaction designs and theories concentrating on the body of work which established, and exemplifies 'rich interaction' as a new framework for the interpretation of interactive objects including 'affective' dimensions–referred to as an 'interaction aesthetic'. In this paper, the practical implications of the current theoretical understanding of 'rich interaction' are investigated through the engineering of a toolkit for creating interactive objects. The paper focuses directly on the extend to which the concept of rich interaction is embodied by the technology, by testing the potential of the toolkit within the lived-in world as a new framework of understanding interaction design and the application of interactive technologies.

Design, Technology, Usage, Convergence

Today, the main outcomes of the Western model, science and technology, have become the core business of our society. This focus on technology and science has been well discussed and examined by theorists such as Lev Manovich [18], Jay David Bolter [4], Mark Dery [5], and Bruno Latour [16, 15] to name a few. According to Lisa Gitelman [10] today's new media artifacts are used as the all-encompassing example in media theory to illustrate the end of media history. She states: "the imagination of that end point in the United States remains uncritically replete with confidence in liberal democracy, and has been most uniquely characterized by the cheerful expectation that digital media are all converging toward some harmonious combination or global synergy, if not also toward some perfect reconciliation of man and machine." [10]. With the introduction and engineering of a 'toolkit', the question is asked if or how this interaction between old and new media, in short the media, establishes a 'convergence culture'. As a result, all elements building up media theory and practice, whether it concerns media production, distribution or consumption, are affected. Consequently, all our ideas and projections about a technology mould its final use and generate new trajectories and developments, which in turn trigger new reflexive and discursive processes. According Brzyski: "If inter-relationship posits engagement between terms (nations, disciplines, media) then transrelationship creates a vision of transcendence

of the system, a Utopian state of disengagement that nonetheless affirms the system as real. [...] Here as with the interterms, in order to transcend one must have something to rise above. Without the referents of nation, discipline or medium, there can be no trans-nationality, transdisciplinarity, or transmediality." [10].

For the purpose of this paper a toolkit will be defined as *a structure of communication, containing technological protocols shared/used by different people*. This interpretation is similar to the definition given by Lisa Gitelman: "I define media as socially realized structures of communication, where structures include both technological forms and their associated protocols, and where communication is a cultural practice, a ritualized collocation of different people on the same mental map, sharing or engaged with popular ontologies of representation." [10]. The protocols Gitelman is referring to consist of a series of social, economic and material relationships. As a consequence the term media so often used is not a unifying denominator with one unifying theory, rather it delineates a collection of different mediums with their distinct protocols. Thus seen in this way, media are very specific artifacts containing very specific characteristics and specific cultural assumptions. Likewise Espen Aarseth concludes: "The digital medium (singular) never existed, and chances are overwhelming that it never will [...] Like the term Internet, medium is hardly more than a convention, a term hiding a plethora of social and technical meanings and levels." [10].

For Bolter and Grusin, new media are: "refashioned and improved versions of older media. [they] can best be understood through the ways in which they honor, rival, and revise linear-perspective painting, photography, film, television, and print. [...] What is new about new media comes from the particular ways in which they refashion older media and the ways in which older media refashion themselves to answer the challenges of new media." [4]. This process of refashioning between the different media is called 'remediation' according to Bolter and Grusin. They define this concept of 'remediation' as the oscillation between two opposite forces, 'immediacy' and 'hypermediacy'. Immediacy (or transparency of the medium) makes that the medium in itself disappears so that only the represented object is presented and acts as the driving force for the innovation of new media. At the same time there exists a longing for the medium itself, making people aware of the medium, this concept is defined as 'hypermediacy'. According to Bolter and Grusin those two concepts are the result of two human aspirations, the 'desire for transparent immediacy' and a 'fascination with media or mediations'. An additional consequence of 'remediation' is that in this process not only the possibilities of the old (remediated) medium become visible, but in doing so also makes its limitations more apparent and noticeable. Historically, film demonstrated the possibilities and limitations of photography, digital photography made very specific characteristics of the analogue photography apparent. This focus on the old medium, through the new, often accounts for a revival (nostalgia) of the old. Seen in this way, the old media reinforce their place not 'despite' but 'thanks to' the new. 'Remediation' becomes a tool, a method to analyze the different media and to investigate how they refashion each other. However, within this context, media are considered to be agents and actors in themselves, remodelling, transforming and absorbing other media without any cultural, human interplay or development. Today, more than ever, we are aware that the social, political, economic and artistic fabric is central to the construction of media artifacts and consequently its history.

Toolkit

When conceptualizing a toolkit as a structure of communication, the toolkit contains technical components and protocols to be shared and used by different people. When applying this idea to a toolkit to create computational, interactive objects, the toolkit makes the range of possible relations between user actions and computed system reactions explicit. Intermediate system components encode, interpret, and decode the message–the user/object (re)action. These mechanisms are formally described and accessible as shared technical protocols.

As a 'new' medium, such a toolkit for interactive objects embodies the plurality in interactive technology. Possible connections between several components described as protocols make technical specifications such as resolution, dimension, and bandwidth explicit. With the aim of keeping possible applications of the underlying interactive technology as open as possible, the degrees of freedom–from a technical point of view–become tangible outside the circle of engineering, for example to artists and designers. By exposing its inherent technical characteristics in an accessible manner, the toolkit invites to recombine components to create interactive systems and thus to explore the possibilities of the interactive technology, like senseware [12]. Kenya Hara coined the term senseware, as "matter that stirs human creative instinct and awakens the desire to make things" [12], which he further illustrated with a stone or paper. Artificial fibers are presented as senseware, pointing at the importance of the creative process of finding novel applications for the fibers in the development of the fibers. "new materials may be attractive, but the problem we face is to discover how they can best be used. [...] Without ideas for applications, advanced materials just stagnate, with their potential left unrealized." (Ibid.). We argue that interactive technology faces similar challenges, and suggest a similar approach to tackle these. In this light, a toolkit for the creation of interactive objects is senseware.

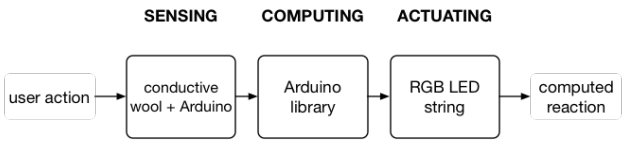


Figure 1: Skweezee as structure of communication. For each component, alternatives are available, each with their own specific technical constraints and possibilities.

As an exemplary case, we present the Skweezee toolkit[1], as a set of resources to create squeeze interactions [25]. Using the toolkit, soft physical objects can be augmented, activated, or computationally-enabled (see Figure 1). Manipulations of the soft object are manifested through the material (the squeeze), and are sensed by dedicated components. The sensed signals are then processed and result in a computed reaction through selected actuators.

The toolkit invites to look beyond existing 'old' interaction techniques and computing paradigms, such as regular buttons leading to binary or discrete computing, and to investigate what this 'new' interaction technique could be. At the same time the obtained understanding of the 'new' can can reinforce existing 'old' interaction techniques, such as the button and discrete interactions.

Interaction Part I

The element of interaction, defined as the relationship between audience and artwork, is the second characteristic of the computer influencing and shaping digital artifacts. Several authors have debated the different levels of interaction, ranging from simple to complex, from a simple mouse click or touching buttons over accessing different layers of information and thereby changing the narrative of the work to complex systems where "the user can influence the meaning or morality of the artwork [...] thus, the basic structure of the narrative." (Qvortrup referring to Eva Liestol, [17]). Seen in this way, the design of the artifact is not a static object but has the potential to change and interact depending on the user. This plurality of characteristics and different forms interactive designs can adopt excludes easy definition. Digital art and human-computer interaction (HCI) is often characterized, defined and catalogued on the basis of these primary 'technological' abilities and their relation with the user, viewer, or participator. Features such as, 'interactive', 'real-time', 'collaborative', 'generative' to name a few, can be attributed to digital artifacts, in a single configuration or in a combination of two or more specific features. As a result a uniform definition of digital, computer-based becomes unattainable. In her book 'New Media in the White Cube and Beyond' Christaine Paul reaches a similar conclusion and considers the definition of new media art and design as a result of the constant evolving technological and conceptual environments an elusive goal. She states: "The successful evasion of definitions is one of new media art's greatest assets and a main reason why so many artists, curators and practitioners in general are attracted to this art form." [22]. Charlie Gere, author of the books 'Digital Culture' [7] and 'Art, Time and Technology' [8] finds a possible additional reason why so many artists and designers like to work in the field of the possibilities brought by the digital format. In his article 'New Media Art and the Gallery' [9]: "Furthermore, such practice, in both its historical and its current manifestations, is important for its capacity to reflect our current technological condition." [9]. Technologies such as the World Wide Web, Playstation consoles, the Internet, mobile phones and so on are related to (and in a way made possible) globalization, biotechnology, artificial intelligence, tele-robotics, hacking and cyberterrorism and other phenomena. Artworks produced with these technologies help us to reflect upon media and technology and "helps us understand how our lives are being transformed by these very media and technologies." [9].

By emphasizing the active role science and technology conduct in cultural and social production, by investigating the intermediate or grey zones between media classifications and by transcending them, the construction of the toolkit can be defined as a catalyst for action and transformation as well as a mechanism providing a framework of reference in conditions of change. In this respect the toolkit as carrier for social action is not referring to the specific notions of 'transition' and (historical) assumptions generated by the (new) technologies in terms of the identification of their prophetic nature, the creation of an 'Utopian' technocratic world with new social and political orders. As Tom Gunning [11] describes: " [...] their address to a previously unimagined future. Every new technology has a Utopian dimension that imagines a future radically transformed by the implications of the device or practice." [11]. Gunning also refers to Kittler [14]: "What reached the page of the surprised author between 1880 and 1920 by means of the gramophone, film and typewriter - the very first mechanical media - amounts to a spectral photograph of our present future." [11]. According to Gunning it is this imagined future that will never be able to completely disappear, only forgotten to some degree. The research therefore is not installing an Utopian state of mind, propagated by so many media theorists, nor is it referring to an unpredictable (technological) future but instead is referring to and embedded in the contemporary art and design practice which as Annette W. Balkema (cited in [11]) optimistically stated is nowadays often preceding theory.

Interaction Part II

The presented toolkit is discussed as a framework to investigate the theoretical and practical understanding of 'rich interaction'. Wensveen et al. offered the Interaction Frogger (IF) framework [28], where the theoretical coupling between user action and a product function is described in practical characteristics. The IF framework covers feedfoward and feedback, and identifies three layers of information in a product: inherent, augmented, and functional information. The user action and layers of information can be coupled on six 'practical characteristics': time, location, direction, dynamics, modality, and expression. "Unifying action and reaction on these six aspects can be seen as an operationalization of intuitive interaction." (Ibid.) In total, the framework structures the coupling between action and function in 36 conceptual connections that allow designers to "enrich" the interaction.

Connecting components in the toolkit realizes the couplings as described in the IF framework on a technical level. For example, each connection has a technical dimension and resolution influencing the coupling. The APIs of the components thus formally expose the technical possibilities and constraints of connections and make possible couplings explicit.

[1] http://www.skweezee.net

We illustrate how the Skweezee toolkit [25] influences the couplings as described in the IF framework [28] through six examples. The table below gives an overview of the influence of sensing, computing, and actuating components on coupling in Time and Location:

	Time	Location
Sensing	Measuring frequency	Sensor configuration
Computing	Time series analysis	Vector analysis
Actuating	Response time	The screen

Measuring Frequency The Skweezee technology senses squeezes by measuring the resistance in conductive wool between several points in the object. The rate at which all these resistances are measured determines the coupling in time. For example, a complete sensing cycle within 30ms allows for a frame rate of at least 30 fps, sufficient for a fluent visual output.

Sensor Configuration Depending on the number of sensors and their placement in the 3D object, squeezes are projected in a volume, on a surface, or on a line. The physical sensor configuration thus determines to what extend differences in locality can be sensed and coupled.

Time Series Analysis Extracting features from the sensed signals over time through time series analysis offers powerful ways to enrich interaction. For example, a moving average functions as smoothing filter while a moving standard deviation reveals information regarding the stability of the squeeze: is the user holding the object, or is the squeeze changing? However, this analysis comes at a cost of time as a series of samples is required to calculate the features.

Vector Analysis While several squeeze interaction technologies depend on machine learning to distinguish squeezes (including an earlier Skweezee implementation using support vector machines (SVM) [26]), the current Skweezee implementation depends on vector analysis [25]. A direct consequence of this change of calculation method is that this simple vector analysis requires far less computational power and can run on small microprocessors. Where machine learning implementations depend on computers due to their computational requirements, simple vector analysis allows for embedded implementations: local computing and thus coupling on location.

Response Time Depending on the chosen actuators, their physical constraints define the response time. This response time adds up to the previous sensing (including measuring frequency) and computing times (for example time series analysis) and further influences the coupling in time.

The Screen Choosing a computer screen for output—as frequently in described squeeze interactions in HCI literature—decouples squeeze actions from system output on location by default. By offering alternatives to the screen, such as through electronic components, the Skweezee toolkit aims to broaden the design space for squeeze interactions by making couplings on location possible.

These six examples of how technology determines coupling in time and location are of course interconnected. For example, an increased measuring frequency does influence the impact of time series analysis, or embedded implementations through electronic components as actuators are possible because of vector analysis that runs on a stand-alone Arduino. Furthermore, sensor configurations also influence direction, dynamics, and expression—other couplings in the IF framework. We therefore argue that the interactive technology presented as toolkit serves as a framework to investigate the practical and theoretical understandings of coupling user action to system output—or the concepts of 'rich interaction' and 'interaction aesthetics'. The technical constraints and possibilities get exposed through the toolkit, ready to be explored in the creation of interactive objects.

The Fabric for Innovation

In his book 'Where good ideas come from' [13], Steven Johnson states that in order to understand the exact nature of innovation we need to study its behaviour in many different contexts. He clarifies that if we draw analogies to patterns of innovation that we can identify in other contexts or disciplines it enables us to answer questions more accurately, to understand things more comprehensively. The argument of his book is that "by approaching the problem in this fractal, cross-disciplinary way, new insights become visible." [13]. Steven Johnson furthermore minimizes the role of competition as the engine for innovation. He contends that competition overstates the role of proprietary research and 'survival of the fittest competition' and that this focus "as the standard textbooks do - distorts our view." [13]. Instead, he makes a plea for openness and connectivity as the most important parts of innovation. Innovation and creativity, should be approached in the broadest possible meaning, that is in all its subtle forms of innovation and invention, in all its "different modes of creativity: artistic, scientific, technological. [...] to suggest the cross-disciplinary vantage point [...]." [13]. In his book 'The Nature of Technology' [1], Brian Arthur constructs a framework of thinking regarding innovation which bears a lot of similarities with the concepts of Deleuze and Guattari regarding territorialization and the re-defining of meaning. When referring to innovation Brian Arthur states: "They are the expressing of a given purpose in a different set of components, as when the provision of power changed from being expressed in waterwheel technology to being expressed in steam technology." [1]. He introduces the concept of 're-domaining' as the prime characteristic to delineate those innovations which are significantly powerful in generating new insights. The process is one of constant re-expressing or re-domaining: "[...] is about the creation of new processes and arrangements, new means to purposes." [1].

According to Liestol, Morrison and Rasmussen, innovation, as a general term, "encapsulates the essence of contemporary social change." [17]. For them, innovation is the result of deconstructing, taking ideas, beliefs concepts, structures, etc. apart and assembling them again in new ways and different combinations: "Scientifically, the ethos as well as product of innovation is realized in various forms of 'disciplined multidisciplinarity"'. [17]. As a result, innovation requires an

enhanced flexibility and at the same time an augmented complexity as well. They conclude: "As innovation in this way is a process of observing and critiquing, it refers as much to the position of the observer as to the nature of the object. To recombine elements into new objects – whether they are hardware, software, middleware or meaningware – implies that we look differently, that we apply new concepts and models, and that we analyze reflexively how, why, and when to shift perspective. It may even mean that we do the virtually impossible, that is, we observe from two or more positions at once. Multidisciplinarity, one could argue, is to look simultaneously from two or more angles to fix an object in a multidimensional space of double description." [17]. The research is therefore focusing on a dual action, the first involves the understanding of squeezable interaction, modelling and mapping, the second is concerned with the very fabric of their understanding (literary theory, aesthetics, sociology, media studies, art, etc.).

State of the Art

Squeeze interactions as exemplary case throughout this paper mainly exist in the lab. In academic writing, the possibilities of squeeze interactions are being explored. In HCI literature, we find innovations on the several technical components of such systems. Nakamaru et al. present "Three Dimensional Soft Sensors with Porous Materials" [20] as a novel material to construct squeeze interactions, while Sugiura et al. developed a method to sense the deformation through 'photoreflexivity' [24]. Geurts et al. [26] discuss the use of a Support Vector Machine (SVM) to compute and distinguish 'squeeze gestures', while Weinberg [27] illustrated the use of squeeze interactions as a mechanism in 'intuitive' musical instruments as one of the first papers about this interaction technique. Stienstra et al. [23] addressed the affective compontent of squeezes in the communication with robots.

The recent line of argument regarding materiality in HCI [29] points at a yet to be explored design space within HCI. We identify under-explored dimensions of squeeze interactions in HCI research following this material approach. The toolkit as presented throughout this paper aims to contribute to this investigation.

As the current implementations of squeeze interactions mainly live in lab environments, the toolkit serves to open up the technology beyond engineering and the inner academic circle of HCI research. By presenting the underlying interactive technology to create squeeze interactions as an accessible toolkit, we invite a broader circle of makers, designers, artists, and researchers to explore 'rich' squeeze interactions, their aesthetics, and to explore the artistic and social potential of this interaction technique.

Thick Description - Methodology

Making use of a (anthropo-)sociological analysis of the toolkit has extended the notion of modes of interaction itself. It will be argued more extensively how models through their design (in general), and by extension maps or theories as frameworks for thinking and understanding only seem to work locally, or in this case partially, thereby revealing the discontinuity between an original purpose of all-encompassing truth and its lived-in reality. Acknowledging these discontinuities and local realities, theoretical discussion of 'modes of interaction' will focus on the possible relations between these different models, maps or theories by looking at their interfaces. The use and application of the toolkit we will argue is shifting perspective from within a system to a perspective (also) looking between systems. In other words, by the process of thickening as proposed by Geertz, by transferring meaning from one system to another, the process enhances the meaningfulness of the different concepts. Category based understanding, while a useful and precise tool undermines the general idea of multiple points of view, needed in our liquid culture as debated by Bauman [3, 2]. Through shifting perspective, unexploited or unexpected elements can be identified, to be argued as the first and primary action of a designing a Toolkit for squeezable interaction. In his landmark book 'The Interpretation of Cultures' published in 1973, the anthropologist Clifford Geertz elaborates on this concept of 'thick description'. For Geertz what a researcher is faced with (except the automated routine of data collection) "is a multiplicity of complex conceptual structures, many of them superimposed upon or knotted into one another, which are at once strange, irregular, and inexplicit, and which he must contrive somehow first to grasp and then to render." [6]. Furthermore, understanding (of a culture for instance) for Geertz exposes a certain normalness without reducing the particularities. It renders information accessible and dissolves its possible opacity. However, he also warns that this approach, sometimes referred to as 'seeing from the actor's point of view' or 'the verstehen approach', often may lead to a notion of fantasy or speculation and must therefore be approached with great care. As a result, a thick description is needed where case studies, events and theories can be studied in detail, by building layer after layer, so one is able to assess and evaluate the degree in which the conclusions made are also valid or convertible to other systems or situations or time frames. One must not only study the phenomena but also the context in which they take place in order for them to become understandable for a third party. This thick or multi-layered description has a double function: "Such a view of how theory functions in an interpretive science suggests that the distinction, relative in any case, that appears in the experimental or observational sciences between 'description' and 'explanation' appears here as one, even more relative, between 'inscription' ('thick description') and 'specification' ('diagnosis') – between setting down the meaning particular social actions have for the actors whose actions they are, and stating, as explicitly as we can manage, what the knowledge thus attained demonstrates about the society in which it is found and, beyond that, about social life as such. Our double task is to uncover the conceptual structures that inform our subjects' acts, the 'said' of social discourse, and to construct a system of analysis in whose terms what is generic to those structures, what belongs to them because they are what they are, will stand out against the other determinants of human behaviour. In ethnography, the office of theory is to provide a vocabulary in which what symbolic action has to say about itself - that is, about the role of culture in human life - can be expressed."

[6]. In other words, Geertz is well aware that meaning is always changing, always in flux and rooted in a specific culture, therefore he suggests the thick description as a means to describe the phenomena together with their context through a multi-layered approach. For the development of the toolkit, it is exactly this multi-layered view that enables understanding as well as context, where results and interpretations are being transferred and interpreted in a different context to investigate their validity.

Conclusion

This paper introduced a toolkit as a strategy to observe and discuss the ways that media and particularly interactive objects are constructed and experienced as scientific, artistic, and social subjects.

The research presents interactive technology as toolkit—being senseware—and follows in depth three specific trajectories: the engineering of technological components on a meta-level; the use of these technological components in the design and programming of interactive objects; and the role of interactive objects, its concurrent (scientific) models and embedded technology in the lived-in world.

The research attempts to take the theoretical and practical understanding of interactive technology beyond that of technological collaboration or cross- or multi-media innovation by exploring the relationship between interactive designs and their effects in the 'lived in world'. This approach involves a socio-anthropological dimension of meaning and engages a general debate on the concept and use of 'toolkits' in interaction design. The aim is to establish a multi-viewpoint theoretical approach investigating the use of 'toolkits' within the lived-in world and its implications for the engineering of the technology based on interdisciplinary research replacing single viewpoint categorization, a concept also to be applied to the engineering of the toolkit itself.

This is coupled with the concept of 'thickening' as proposed by Clifford Geertz with its implication of interaction between multi-layers of meaning. The research seeks to define a 'liquid' form of understanding and analysis capable of approaching the complexity of artifacts that cross media and discourses.

A squeeze interaction toolkit is presented as an exemplary case study, chosen for its comparative relationship for the theory and practice of technology engineering for and construction of interactive objects.

This research is about the ways artists, designers, and scientists deal with and endure new meaning and comprehend and construct the world. Here the 'toolkit' is proposed as a method or strategy, a theory, model or map, providing a framework of understanding in conditions of hybridity and change.

References

[1] Arthur, W. B. 2009. *The nature of technology : what it is and how it evolves*. London: Penguin Books.

[2] Bauman, Z.; Bauman, L.; and Narodowy Instytut Audiowizualny (Poland). 2011. *Culture in a liquid modern world*. Cambridge: Polity Press.

[3] Bauman, Z. 2007. *Liquid times : living in an age of uncertainty*. Cambrid: Polity Press.

[4] Bolter, J. D., and Grusin, R. 1999. *Remediation : understanding new media*. Cambridge: MIT Press.

[5] Dery, M. 1996. *Escape velocity : cyberculture at the end of the century*. New York: Grove Press.

[6] Geertz, C. 1973. *The interpretation of cultures : selected essays*. New York: Basic Books.

[7] Gere, C. 2002. *Digital culture*. London: Reaktion Books.

[8] Gere, C. 2006. *Art, time, and technology*. London: Berg Publishers.

[9] Gere, C. 2008. *New Media Art and the Gallery in the Digital Age*. Berkeley: University of California Press. 13–25.

[10] Gitelman, L. 2006. *Always already new : media, history and the data of culture*. Cambridge: MIT Press.

[11] Gunning, T. 2003. Re-Newing Old Technologies: Astonishment, Second Nature, and the Uncanny in Technology from the Previous Turn-of-the-Century. In Thorburn, D.; Jenkins, H.; and Seawell, B., eds., *Rethinking Media Change*. Cambridge: MIT Press. 404.

[12] Hara, K.; , .; Tokyo Fiber-ten Jikko Iinkai.; Nihon Dezain Senta. Hara Dezain Kenkyujo.; Tokyo Fiber.; and . . 2009. *Tokyo Fiber'09 : Senseware*. Asahi Shinbun Shuppan.

[13] Johnson, S. 2010. *Where good ideas come from : the seven patterns of innovation*. London: Penguin Books.

[14] Kittler, F. 1999. *Gramophone, film, typewriter*. Stanford: Stanford University Press.

[15] Latour, B., and Porter, C. 1991. *We have never been modern*. Cambridge: Harvard University Press.

[16] Latour, B. 179. *Laboratory life : the construction of scientific facts*. Chichester: Princeton University Press.

[17] Liestøl, G.; Morrison, A.; and Rasmussen, T. 2003. *Digital media revisited : theoretical and conceptual innovation in digital domains*. Cambridge: MIT Press.

[18] Manovich, L. 2001. *The language of new media*. Cambridge: MIT Press.

[19] Manovich, L. 2002. Post-Media Aesthetics. In Asselberghs, H., and Devleminck, S., eds., *What's in a Name, Transmedia Text Series, vol. 1*. Brussels: Hogeschool Sint-Lukas. 12–20.

[20] Nakamaru, S.; Nakayama, R.; Niiyama, R.; and Kakehi, Y. 2017. FoamSense: Design of Three Dimensional Soft Sensors with Porous Materials. In *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology - UIST '17*, 437–447. New York, New York, USA: ACM Press.

[21] Paul, C. 2005. Intermedia in the Digital Age. In Breder, H., and Busse, K.-P., eds., *Intermedia: Enacting the Liminal, Dortmunder Schriften zur Kunst, Intermedia- Studien, vol 1*. Norderstedt: Books on Demand. 37–50.

[22] Paul, C. 2008. *New media in the white cube and beyond*. Berkeley: University of California Press.

[23] Stienstra, J., and Marti, P. 2012. Squeeze me. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction Making Sense Through Design - NordiCHI '12*, 746. New York, New York, USA: ACM Press.

[24] Sugiura, Y.; Kakehi, G.; Withana, A.; Lee, C.; Sakamoto, D.; Sugimoto, M.; Inami, M.; and Igarashi, T. 2011. Detecting shape deformation of soft objects using directional photoreflectivity measurement. In *Proceedings of the 24th annual ACM symposium on User interface software and technology - UIST '11*, 509. New York, New York, USA: ACM Press.

[25] Vandenberghe, B.; Gerling, K.; Geurts, L.; and Vanden Abeele, V. 2019. Skweezee for Processing. In *Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '19*, 375–381. New York, New York, USA: ACM Press.

[26] Vanderloock, K.; Vanden Abeele, V.; Suykens, J. A.; and Geurts, L. 2013. The skweezee system. In *Proceedings of the 26th annual ACM symposium on User interface software and technology - UIST '13*, 521–530. New York, New York, USA: ACM Press.

[27] Weinberg, G.; Orth, M.; and Russo, P. 2000. The embroidered musical ball. In *CHI '00 extended abstracts on Human factors in computing systems - CHI '00*, 283. New York, New York, USA: ACM Press.

[28] Wensveen, S. A. G.; Djajadiningrat, J. P.; and Overbeeke, C. J. 2004. Interaction frogger. In *Proceedings of the 2004 conference on Designing interactive systems processes, practices, methods, and techniques - DIS '04*, 177. New York, New York, USA: ACM Press.

[29] Wiberg, M. *The materiality of interaction : notes on the materials of interaction design*. MIT Press.

Authors Biographies

Steven Devleminck holds a Master degree in Engineering from the Vrije Universiteit Brussel and a PhD in Art and Philosophy from the University of the Arts, London. Previously, he was the Director of the Transmedia Research Programme in Arts, Media and Design of the Leuven University College of the Arts (LUCA), and visiting Professor at maHKU, Utrecht. Currently he is the Head of the Mediated Environments Research Group at LUCA School of Arts and Professor at the Department of Computer Sciences at KU Leuven. His publications include books and a series of internationally published articles and conference papers. His practice based work has been shown internationally. Research interests are mediated environments, interactive technology, cartography and mapping. He is the Scientific Coordinator of the Innoviris Anticipate Smart Urban Community Interface Blocks research project investigating the design of IoT toolkits for creating interactive urban interventions for both placemaking and civic purposes.

Kathrin Gerling is an Assistant Professor at KU Leuven, Belgium. Her main research areas are human-computer interaction and accessibility; her work examines interactive physical computing technologies in the context of games, play, and with a purpose besides entertainment. Kathrin is interested in how interfaces can be made accessible for diverse audiences, and how playful interactive technologies can be leveraged to support well-being.

Luc Geurts is professor at KU Leuven where he currently leads the e-Media Research Lab. His research focuses on technology for tangible and playful interactions. He holds a MSc degree in Electronic Engineering and did a PhD on signal processing for cochlear implants. He now explores new paradigms for physical computing, investigates novel technologies for human computer interaction, and tries to implement these in the design and the development of playful interactive applications. A few years ago, he started to collaborated with several artists, helping them to create projects with challenging and novel technological components.

Vero Vanden Abeele is a professor at the Faculty of Engineering Technology, KU Leuven, teaching and researching topics on human-computer interaction, user experience design, gamification, motivational design, social shaping and adoption of technology for health. Vero led the Belgian Chapter of the ACM Special Interest Group on Human-Computer Interaction (SIGCHI) from 2010 to 2013, was academic chair for ACM CHI subcommittee games and play, and has been involved in the official organisation of ACM CHIPLAY since its advent. Vero is equally member on several program committees and guest editor for several journals related to human and player computer interaction. Her recent work, inspired by governmentality, focuses on disorderly design, i.e., the design of health technologies to support disorderly conduct and accommodate behaviors that escape normalizing power.

Bert Vandenberghe is a PhD student at the Faculty of Engineering Technology, KU Leuven. He holds a Master's degree Electronics and ICT Engineering Technology and worked at the Faculty of Social Sciences, KU Leuven to study Human-Computer Interaction (HCI) from the perspectives of the social sciences and humanities. In his current PhD research, he studies squeeze interactions by implementing this novel interaction technique in health care settings. His research methods are strongly influenced by value-sensitive design, ethnographic research, visual methods, and research-through-design. He has a strong interest in the adoption & appropriation of technology; the ethics & politics of technology; and critical engineering.

Machinic Surrogates: Human-Machine Relationships in Computational Creativity

Ardavan Bidgoli[1], Eunsu Kang[2], Daniel Cardoso Llach[1]
[1] Computational Design Laboratory, [2] School of Computer Science
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA
{abidgoli, eunsuk, dcardoso} @andrew.cmu.edu

Abstract

Recent advancements in artificial intelligence (AI) and its sub-branch machine learning (ML) promise machines that go beyond the boundaries of automation and behave autonomously. Applications of these machines in creative practices such as art and design entail relationships between users and machines that have been described as a form of "collaboration" or "co-creation" between computational and human agents [1, 2]. This paper uses examples from art and design to argue that this frame is incomplete as it fails to acknowledge the socio-technical nature of AI systems, and the different human agencies involved in their design, implementation, and operation. Situating applications of AI-enabled tools in creative practices in a spectrum between automation and autonomy, this paper distinguishes different kinds of human engagement elicited by systems deemed "automated" or "autonomous." Reviewing models of artistic collaboration during the late 20th century, it suggests that collaboration is at the core of these artistic practices. We build upon the growing literature of machine learning and art to look for the human agencies inscribed in works of "computational creativity", and expand the "co-creation" frame to incorporate emerging forms of human-human collaboration mediated through technical artifacts such as algorithms and data.

Keywords

Artificial Intelligence, Machine Learning, Co-creation, Collaboration, Human-Machine Interaction, Computational Creativity, Art, Design, Machinic Surrogacy, AI-enabled Tools

Introduction

The application of AI-enabled tools in creative practices raises questions regarding the relationship between humans and their tools. Compared with traditional tools, i.e., a paintbrush, computer programs that leverage artificial intelligence models to accomplish a task, are not passive objects to facilitate artists' creative expression. These tools are designed and implemented to intervene in the course of actions and contribute to the creative process. This paper explores the relationship between human agents and AI-enabled tools and aims to outline the different roles that each one plays in a creative task.

Recent scholarship from the field of design and technology studies has shed light on how since the postwar, computers have enacted different roles in popular imaginaries of design —sometimes appearing as "perfect slaves" poised to liberate designers from labor, and sometimes as "collaborative partners" creatively contributing to the design process [3, p. 54]. Imagined as perfect slaves, machines are deprived of any creative agency. While the tool is an essential part of the process, and introduces new horizons to explore, creativity remains a distinctly human attribute. Imagined as collaborative partners, by contrast, computers are endowed with human attributes including creativity, judgment, and even sense of humor [3, p. 79]. Missing from these two frames is the recognition of these technologies' infrastructural scale and their nature as designed artifacts and thus as enactments of human intent [3, p. 149]. This recognition is crucial for an engaged critical as well as creative practice of computational art and design.

Examining artistic collaborations and cross-disciplinary case-studies in the realm of artificial intelligence and design, this paper emphasizes the human agencies involved in systems conventionally represented as autonomous. We propose the term "machinic surrogate" to highlight the intentional (even if at times unpredictable) nature of these systems. The final section discusses different forms of authorial engagement enabled by these "machinic surrogates."

Computational Creativity

Fueled by the recent advancements in the realm of AI and ML, "Computational Creativity" (CC) studies autonomous generative systems that can produce "creative products" [4, p. 197] in domains including art, music, literature, and mathematics. [5]

Computational Creativity can be traced back to the early AI proponents who were promising human-level intelligence "embedded" in computer programs and transferring human skills into the machines. The early literature of AI is permeated with the techno-optimistic and long-awaited promise of computers capable of duplicating human expertise as well as models to "elucidate" human skill and actions. [6, 7]

Despite the autonomy label, the human agency plays a critical role in the realm of CC. These tools are the outcomes of joint efforts by an assembly of human agents, constitutes

of researchers, developers, and designers who collectively crafted them. CC tools that leverage ML algorithms are heavily influenced by the process in which their training data sets have been designed and collected by human agents. Inevitably, CC tools serve as a proxy to reflect the skills, decisions, and biases of the human agents behind them. The agency of these "machinic surrogates" is derived from their "human inspirers" agency. [8]

Co-creation with Machines

In recent years, several artists repurposed tools that have been primarily developed by ML researches and adapted them to serve in their creative practices. The application of these tools in creative practices entails a relationship in which both the human agent and the machine contribute to the decision-making process. Both contributors can impose their decisions to initiate or change the course of actions and outcomes. This is a shift from the perspective that credits the human agent as the sole author and source of creativity.

To address this type of relationship, several scholars used co-creation model. It has drawn increasing interest in recent years among the human-computer interaction community. [1, 9, 10] As a broad term, co-creation refers to any act of collective creativity among human agents in different fields, including but not limited to design, public relation, business, and product development. [11]

In the realm of CC, co-creation refers to the joint effort of the human agents and machines to engage in a creative practice. The outcomes "cannot be ascribed either to the human or to the computer alone and surpasses both contributors' original intentions." [12, p. 137] Some scholars propose this relationship as analogous to the relationship between a "visionary" and a "doer", i.e., an art director and a graphic artist, or an orchestra conductor and the players. [13] In this capacity, machine demonstrates some level of autonomy that may be perceived as a form of agency. Thus, it might be possible to consider the relationship between human agents and CC tools as a form of collaboration between a human agent and a machinic agent.

As co-creation raises more interest among the scholars of human-computer interaction (HCI), it is illuminating to compare it with another form of companionship between multiple agents in creative practices, artistic collaboration.

Collaboration in Art

During the second half of the 20th century, many artists sought for new means of self-representation, breaking the traditional stereotype of the individual lonely artist waiting for inspiration to strike. Artists were questioning individual identity as an "index of the self" and started exploring new forms of identity and authorship. They found collaboration as an opportunity to manipulate the artist's identity to transform it from an individual one into a "composite subjectivity." Collaborative art attracted significant attention between the 1960s and 1970s and facilitated the transition of modern art to post-modern art in that era. [14]

Collaboration is described as "… a well-defined period of time during which two or more artists network their [mutual] interests, desire, and capacities on the basis of their shared interest in the common exploration of a topic or issue." [15, p. 94] It serves as a means to push the creative boundaries and inspiration for collaborators. From his point of view, the collaborators' complementary and unexpected contributions push the results beyond the capacities of each one. [4]

Collaboration forges a new identity beyond the sum of their individual identities and challenges their individual authorship. [16] It is not a mere "merger of two hands", but it is a more profound mutual effort that goes beyond each artist's signature style and creates a "third artistic identity superimposed over and exceeding the individual artists." [14, p. 179]

Diversity in backgrounds and identities is a critical ingredient that renders collaboration fruitful and necessary. In that sense, collaboration is a "cross-cultural dialogue". The initial diversity among the collaborators will eventually erode through the association between them and paves the ground for the creation of a new identity. [17]

This conception of collaboration can be associated with the ideas of French anthropologist, Claude Levi-Strauss. He emphasizes the importance of the "emerging identity" in collaboration. Levi-Strauss addresses the process in which a new identity emerges in collaboration: "… in the course of … collaboration, they gradually become aware of an identification in their relationships whose initial diversity was precisely what made their collaboration fruitful and necessary". [17, p. 533]

Some of the scholars who define their definition of collaboration based on Lévi-Strauss's thoughts suggest that relationships which are not aimed to form a new identity or fail to do so, are not collaboration. For example, the relationship between an artist and its craftsmen is usually not intended to form such an identity. [18] The short joint projects among artists can also be excluded from collaboration definition. These projects barely scratch the surface of individuals' "authorial signature style" and fail to shape a unique identity. [14, pp. xii-xiii]

Scholars in the history of art have observed and studied several collaboration efforts during the 1960s and 1980s that successfully formed their unique identities through long-term companionship. For example, Marina Abramovic and Ula formed a long-lasting collaboration by recreated themselves as a "third identity", or as they used to describe it the "two-headed body". [14, p. 180]

Human-machinic surrogate collaboration

Artistic collaboration, as we described above, is not directly applicable to the relationship between human agents and cc tools. Casting such a relationship as collaboration entails a basic assumption: associating identity with these tools. It is essential to determine the origin of this identity.

We argue that this identity is not derived from the machine, nor the algorithm that drives it. It is originated from the "human inspirers" and reflects the identity of the toolmakers who contributed to its development. However, it

is worth mentioning that the tool is not a perfect one-to-one mapping of human knowledge, skills, or creativity. It is a re-creation of these features, situated in the algorithm and its hardware with respect to all the limitations.

From this point of view, co-creation is a special case of collaboration where the tool acts as a "machinic surrogate" to represent the identity of its "toolmakers". In synergy with the artists' identity, this surrogacy flourishes in the form of an emergent identity.

Machinic Surrogacy in Practice

In this section, we first introduce three recent projects in which various AI-enabled tools surrogate authors' and/or users' agency. In each project, the bespoken AI-enabled tools that have been developed and/or modified by the artists serve as more than passive tools or automated systems. Combined with their hardware apparatus, they form a proxy that let the artists or audiences collaborate with the toolmakers through a machinic surrogate.

Each project accounts for a slightly different variation of machinic surrogacy by opting for a different interaction or user engagement model. This arrangement helps us to investigate different aspects of machinic surrogacy.

DeepCloud: The first author in collaboration with Pedro Veloso developed a data-driven modeling system that enables users to quickly generate new objects from a given class of objects, i.e., tables, chairs, cars. Users can interact with the graphical user interface to rapidly generate new objects that did not exist in the training dataset. (Figure 1) [19]

The machine learning back-end leverages an Autoencoder (AE) which was originally developed by Achlioptas et al. [20] The AE was trained on thousands of point cloud samples from different classes of the ShapeNets dataset. [21] The novel advantage of using this machine learning model crystalizes in the non-parametric representation of point cloud objects. During the learning process, this representation is being encoded in the AE by registering patterns and finding similarities in the data sets.

Serving as a generative model, the AE can generate new instances of each class based on the user's inputs. Users can move the sliders and rotate the knobs on a physical MIDI mixer to either manipulate different features of a given object or mix multiple ones to create a new object. [19]

In DeepCloud, machinic surrogacy is exhibited in the various parameters which were set by the original toolmakers and modified by the first author and Veloso, namely the AE architecture, the data set selection, and choice of hyperparameters. While the user is free to directly interact with the apparatus and make its own decisions to shape new objects, the range of outcomes and the design space is confined by these factors.

My artificial muse: Mario Klingemann, Albert Barqué-Duran, and Marc Marzenit took a different approach into the relationship between the artist, algorithms, and audiences. They chained different ML models to create a "pose-to-image tool". They started by training an ML model to extract body poses from still images. Then they trained their

Figure 1- *DeepCloud*, the physical interface (top), the interface (bottom). Images from [19]

Figure 2- *My Artificial Muse*, the generated image (left), the performance (right). Images from [22, 23]

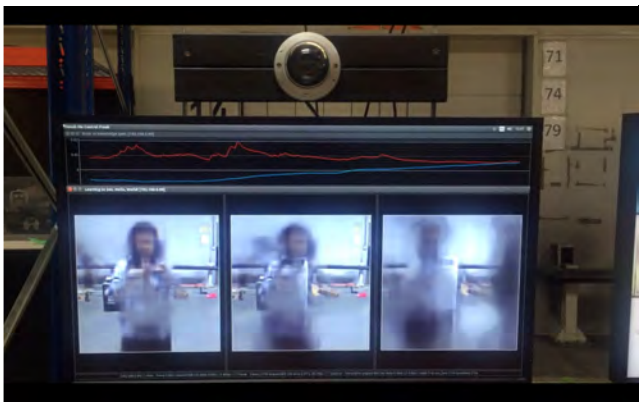


Figure 3- *Learning to see*: *Hello, World!* Image from [24]

Generative Adversarial Networks (GANs) to generate muses based on a given pose.

During a three-day performance, audiences could vote on their favorite pose to be used as the input for the generation of a digital image of an artificial muse. At last, Barqué-Duran painted the image on a 4 x 2.7m canvas. [22] (Figure 2)

Compared with *DeepCloud*, in this project, the toolmaker, performance artist, and the audiences all engage in a creative practice collectively. As Barqué-Duran states, they "collaborated" with this tool to generate the muse. [23]

While Klingemann and other toolmakers were not directly participated in the performance, their machinic surrogacy was directly impacting every aspect of it. The tool was informed by choices that they made in advance, i.e. selection of the ML models to chain, fine-tuning them, curating the training data sets, and several other factors. Although they

deliberately let the audiences chose the final pose, the process of generating the muse was heavily influenced by their surrogate agency.

Learning to See (Hello, World!): Memo Akten used various generative machine learning models, that have been primarily developed for ML research, to make a series of works titled *Learning to see*. [24] In *Hello, World!*, he used a Convolutional Variational Autoencoder, [25] and designed a specific model of interaction between the ML model and the audiences by providing them the opportunity to retrain the Convolutional Neural Network (CNN) in real-time. As an audience feeds the surveillance camera with visual inputs, the back-end CNN model is being trained in real-time to recognize patterns and shapes. However, the effect of each input signal gradually vanishes through the time as new audiences feed the model with new learning samples. (Figure 3) [26]

Compared with the other two projects, *Hello, World!* is best described as an interactive installation that calls for audiences' contribution as the source of training data. In the previous two projects, the AI-enabled tool was a surrogate for the absent human agents. In contrast, in *Hello, World!* the tool is pushed one step further to serve as a surrogate for the present audience. It faces the audience with its own decisions from a moment before. The toolmakers, artist, and audience are all contributing to the emergence of new characteristics that cannot be detached from their inputs.

Humans' Role in Collaboration with Machinic Surrogates

As discussed in the previous section, human agents can approach AI-enabled tools in various capacities and adopt different roles during each phase of a project's life cycle. For example, designing an ML model to empower a CST is a creative activity that requires a wide range of technical skills. It demands for experience, creativity, improvisation, and constant decision making. Developers who design and implement such tools inject their knowledge, skill, and agency to their craft. In this sense, developers act as toolmakers and authors. A classic example is the work of Ian Goodfellow et al. who invented GANs. [27] They designed and created a novel architecture for generative models in machine learning that has been extensively used for creative applications by various artists.

On the other hand, there are artists, or practitioners who use currently available ML models and repurpose them to serve their creative practices. Due to the open-source availability of a wide range of these ML models, artists and developers can modify and adjust them for their own specific goals. In such cases, these artists and practitioners are fading the borders between the user and the original author. They inject their own agency into the tool by modifying the architecture, moderating the training datasets, fine-tuning the hyperparameters, and proposing new forms of user interactions. They demonstrate a level of authorship and agency, but it is generally confined to the boundaries of the models that are available for them. The artists that have been introduced in the previous section, in the context of the discussed projects, fit in this range.

These two groups are occupying the apex of the tool making pyramid and creating machinic surrogates, either to enhance the creative practice of their own or facilitate the others'.

Some artists choose to be the users of the machinic surrogates. They generate creative contents by using AI-enabled tools "as they are" or use off-the-shelf ones. They treat these tools as black boxes with limited knowledge of their internal mechanics. Hence, they do not simply co-create with these tools, they interface the previous two groups, the toolmakers, through a machinic surrogate. An artist who uses DeepCloud to develop an early design sketch is an example of this group. The artist might not be aware of the behind-the-scene orchestra, but it enjoys the new possibilities that the tool brings to the table.

Human agents can also evaluate and judge the outcomes to determine which instances are qualified to be considered as artwork. In many cases, the artist itself serves this role. However, professional curators or even a group of audiences, through crowdsourcing, may make such decisions.

The other role that human agents can occupy is the role of the audiences. From those who enjoyed the early outcomes of "Deep Dream" [28] to the individuals who visited the "Gradient Descent" exhibition, [29] these individuals are the audiences who enjoyed AI-assisted artworks.

Various aspect of human agents' role can be best illustrated through a recent project by the *Obvious* team. This Paris-based trio of artists uses GANs to generate images that mimic classic portraits. They state that their role is limited to moderating the inputs and selecting the best ones among the pool of outputs. They signed the portraits with the famous GANs objective function to emphasize their argument that the piece is generated by an algorithm. But a closer look reveals a chain of machinic surrogacies and various hum in action to create this piece.

As the trio stated, their machine learning algorithm was inspired by *Art-DCGAN* which was modified, implemented, and trained by a young developer, Robbie Barrat. As Barrat describes in the projects' GitHub page, it is a "modified version of Soumith Chintala's torch implementation of *DCGAN* with a focus on generating artworks." [30] Together, this chain of researchers and developers can be credited as the original author and the toolmaker.

The Obvious team trained the algorithm on a dataset of classic portraits to generate a series of portraits, playing a hybrid role of toolmaker-artist. The resulted tool serves as a surrogate for ML experts, developers, and the Obvious team.

After generating a collection of outcomes, a team of curators and experts at Christie's evaluated them to pick one to be auctioned, acting as a moderator/curator. Eventually, the outcome titled "Portrait of Edmond Belamy" presented to art enthusiasts as the audiences and was sold in an auction in October 2018.

There are no solid boundaries between the aforementioned roles. Human agents may adopt different roles,

switch between them, or adopt multiple ones simultaneously. For example, in *Learning to see*, the audiences are also collaborators by feeding the ML model with new sets of training data and influencing the model's behavior. Another example of this dynamic role shifting is demonstrated in "Sketch RNN". The training dataset of this model was constantly collecting samples from the audience who were interactions through an online game titled "Quick, Draw!". The users were not only entertained by the outcomes, but they were constantly enriching the learning dataset by their inputs. Although due to the large number of co-creators, the contribution of each individual was subtle. [31]

Authorship and Ownership

When an artist uses an AI-enabled tool, it indirectly collaborates with a group of agents through a machinic surrogacy. Therefore, like any other form of artistic collaboration, the authorship could be associated with all the engaged agents.

There are various point of views to this topic, spanning from crediting the creativity solely to the agent who uses the tool, to acknowledging the ability of tools to create. In the early years of computer-aided design, Steven Coons believed that machines can be programmed to generate stylized content, i.e., music with the style of Vivaldi, but the "creative act" has been already performed. He argued that the machine is only extracting the "skeletal structure" that the created act was performed in it. [3] In recent years, artists like Klingemann assert that these tools are just a means in the hand of creative artists. He compares these tools with music instruments, emphasizing that the instrument is not an artist. [32] In contrast, specifically in popular media, machines have been credited as the agents which create art pieces.

The machinic surrogate perspective takes the middle ground between the two extreme ends of this spectrum. It distinguishes the AI-enabled tools from conventional tools of artistic expression, i.e., a musical instrument, due to their unique capacity to act as a surrogate for the human agent. Hence, because of the same reason, it does not solely credit the tool as the author either.

The ambiguity in ownership is another controversial source of discussion in this field. During the 1990s, the practice of relational art demonstrated that an artwork is not always an attainable asset and sometimes it cannot be confined in one's possession. [33] The same applies to the application of AI-enabled tools.

On one side, the generated artwork is the result of a probabilistic model. Thus, each edition of the work is generated unique and cannot be reproduced later. However, these unique editions can be cloned digitally in a countless number of copies. This defies the values associated with the rarity of an art piece. One approach is to treat these pieces in the same fashion as photography and printmaking, where the results are multipliable. In such cases, the rarity should be "manipulated" and "produced". [34] There are efforts to employ different technological solution, i.e., blockchain, to keep track of the authentic editions of digital art pieces and control unauthorized copies in the market.

Conclusion

Applications of AI and ML in creative practices can be seen as a form of collaboration between human agents mediated by technical artifacts such as algorithms and data, in which groups interface with others through what we have termed in this paper "machinic surrogates." Despite the claims on "autonomous creativity" of machines, it is the agency of the authors and toolmakers which is crystallized in the tool, creative process, and the outcomes in the examples we have studied. Human agents adopt various roles in the life cycle of a co-creation scenario, from being the original author of the algorithms, to enjoy the results as an audience.

The concept of machinic surrogacy might be also applicable to future AI advancements. Algorithms that can generate algorithms are among the challenging fields for machinic surrogacy since the human agent's contribution decays in each iteration. The fact that artistic forms such as shapes, color schemes, textural details of generated results are often not predictable by the human partner presents the possibility of minimal amount of surrogacy by the future development of machine learning.

We narrowed the scope of this paper to a subset of projects that have used ML algorithms during the past few years (2010-2018). A possible next step for this paper is to extend the discussion to other branches of AI as well as autonomous computer creativity tools. Not included in this paper but we notice current efforts of developing "creative" algorithms that may result in much amplified role of the machine. We are also looking forward to studying those examples in the future.

Acknowledgments

The authors would like to express their gratitude to CMU's Machine Learning department and the Dean's Office of School of Computer Science for its generous support. The authors would like to thank Memo Akten and also Obvious team for their feedbacks that helped us to accurately represent their projects.

References

[1] J. Zhu, A. Liapis, S. Risi, R. Bidarra and G. M. Youngblood, "Explainable AI for Designers: A Human-Centered Perspective on Mixed-Initiative Co-Creation," in *IEEE Conference on Computational Intelligence and Games, CIG*, 2018.

[2] G. N. Yannakakis, A. Liapis and C. Alexopoulos, "Mixed-initiative cocreativity," in *Proceedings of the 9th Conference on the Foundations of Digital Games*, 2014.

[3] D. Cardoso Llach, Builders of the vision, software and imagination of design, New York: Routledge, 2015.

[4] N. Davis, C.-P. Hsiao, K. Y. Singh, L. Li and B. Magerko, "Empirically studying participatory sense-making in abstract drawing with a co-creative cognitive agent," in *Proceedings of the 21st International Conference on Intelligent User Interfaces*, 2016.

[5] A. Liapis, G. N. Yannakakis and J. Tog, "Computational Game Creativity," in *Proceedings of the Fifth International Conference on Computational Creativity*, 2014.

[6] D. E. Forsythe, Studying Those Who Study Us: An Anthropologist in the World of Artificial Intelligence, Stanford: Stanford University Press, 2001.

[7] H. Asada and S. Liu, "Transfer of Human Skills to Neural Net Robot Controllers," in *Proceedings of the 1991 IEEE International Conference on Robotics and Automation*, Sacramento, 1991.

[8] D. Cardoso Llach, "Data as interface: The poetics of machine learning in design," in *Machine Learning – Medien, Infrastrukturen und Technologien der Künstlichen Intelligenz*, C. Engemann and A. Sudmann, Eds., Transcript-verlag, 2017.

[9] C. Oh, J. Song, J. Choi, S. Kim, S. Lee and B. Suh, "I Lead, You Help But Only with Enough Details: Understanding the User Experience of Co-Creation with Artificial Intelligence," in *CHI 2018*, Montreal, QC, Canada, 2018.

[10] A. Summerville, S. Snodgrass, M. Guzdial, C. Holmgård, A. K. Hoover, A. Isaksen, A. Nealen and J. Togelius, *IEEE Transactions on Games,* vol. 10, no. 3, pp. 257-270, 2018.

[11] E. B. Sanders and P. J. Stappers, "Co-creation and the new landscapes of design," *Co-Design,* vol. 4, no. 1, pp. 5-18, 2008.

[12] A. Liapis, G. N. Yannakakis, C. Alexopoulos and P. Lopes, "Can Computers Foster Human Users' Creativity? Theory and Praxis of Mixed-Initiative Co-Creativity," *Digital Culture & Education,* vol. 8, no. 2, pp. 136-153, 2016.

[13] M. Akten, "Steiner Lecture in Creative Inquiry," Pittsburgh, October 8, 2018, 2018.

[14] C. Green, The Third Hand: Collaboration in Art from Conceptualism to Postmodernism, UNSW Press, 2001.

[15] R. Laermans, "'Being in Common': Theorizing Artistic Collaboration," *Performance Research,* vol. 17, no. 6, pp. 94-102, 2012.

[16] J. Roberts and S. Wright, "Art and collaboration," *Third Text,* vol. 18, no. 6, p. 531–532, 2004.

[17] S. Wright, "The Delicate Essence of Artistic Collaboration," *Third Text,* vol. 18, no. 6, pp. 533-545, 2004.

[18] R. Penha and M. Carvalhais, "Will Machinic Art Lay Beyond Our Ability to Understand It?," in *Proceedings of the 24th International Symposium on Electronic Art*, Durban, South Africa, 2018.

[19] A. Bidgoli and P. Veloso, "DeepCloud," in *Recalibration: On imprecision and infidelity Paper proceedings book for the 2018 Association of Computer Aided Design in Architecture Conference*, Mexico, 2018.

[20] P. Achlioptas, O. Diamanti, I. Mitliagkas and L. Guibas, "Learning Representations and Generative Models for 3D Point Clouds," in *Proceedings of the 35th International Conference on Machine Learning, in PMLR*, 2018.

[21] Z. Wu, S. Song, A. Khosla, F. Yu, L. Zhang, X. Tang and J. Xiao, "3d shapenets: A deep representation for volumetric shapes," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 2015.

[22] A. Barqué-Duran, M. Klingemann and M. Marzenit, "My artificial muse," 2017. [Online]. Available: https://albertbarque.com/portfolio/myartificialmuseso nar/. [Accessed 10 12 2018].

[23] A. Barqué-Duran, "My Artificial Muse-World Tour," 2018. [Online]. Available: https://albertbarque.com/myartificialmuse/ . [Accessed 23 3 2019].

[24] M. Akten, "Learning to see (Hello, World!)," 2017. [Online]. Available: http://www.memo.tv/portfolio/learning-to-see-hello-world/. [Accessed 12 10 2018].

[25] D. P. Knigma and M. Welling, "Auto-Encoding Variational Bayes," *arXiv preprint,* vol. arXiv:1312.6114, 2013.

[26] M. Akten, "Learning to see: Hello World!," July 2018. [Online]. Available: https://vimeo.com/278351289. [Accessed 10 12 2018].

[27] I. Goodfellow, J. Pouget-Abadie, M. Mirza, B. Xu, D. Warde-Farley, S. Ozair, A. Courville and Y. Bengio, "Generative adversarial nets," *Advances in neural information processing systems,* pp. 2672-2680, 2014.

[28] A. Mordvintsev, "Inceptionism: Going Deeper into Neural Networks," Google AI, 17 6 2015. [Online]. Available: https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html. [Accessed 6 11 2018].

[29] "Gradient Descent," Nature Morte, 08 2018. [Online]. Available: http://naturemorte.com/exhibitions/gradientdescent/. [Accessed 30 12 2018].

[30] R. Barrat, "Art-DCGAN Github repository," 2017. [Online]. Available: https://github.com/robbiebarrat/art-DCGAN. [Accessed 23 3 2019].

[31] D. E. David Ha, "A Neural Representation of Sketch Drawings," *arXive preprint, arXive ID: 1704.03477v4,* 2017.

[32] A. Kazmin, "An AI genre in its infancy questions the nature of art | Financial Times," *Financial Times,* 27 August 2018.

[33] N. Bourriaud, S. Pleasance, F. Woods and M. Copeland., Relational Aesthetics, Dijon: Les presses du réel, 2002.

[34] R. Moulin and J. Yeoman, "The Genesis of the Rarity of Art," *Art in Translation,* vol. 3, no. 4, pp. 441-471, 2011.

[35] S. A. Coons, "An outline of the requirements for a computer-aided design system," in *Proceedings of the spring joint computer conference*, 1963.

[36] M. Treanor, A. Zook, M. P. Eladhari, J. Togelius, G. Smith, M. Cook, T. Thompson, B. Magerko, J. Levine and A. Smith, "AI-based game design patterns," *FDG,* 2015.

[37] P. Isola, J.-Y. Zhu, T. Zhou and A. A. Efros, "Image-to-image translation with conditional adversarial networks," *arXiv preprint arXiv:1611.07004,* 2016.

[38] Volatil, "Un recorrido por el MarketLab en Sónar+D," 28 6 2017. [Online]. Available: http://vjspain.com/blog/2017/06/28/nuestro-top3-del-marketlab-en-sonard/. [Accessed 10 12 2018].

Authors Biographies

Ardavan Bidgoli is a Ph.D. candidate in Computational Design at the School of Architecture, Carnegie Mellon University. His research is focused on machine learning generative models and human-machine co-creation in creative practices. He is the robotics fellow at the Computational Design lab (Code Lab) and routinely contributes to the architectural robotic research at the Design Fabrication lab (dFab) where he teaches Introduction to Architectural Robotics. His research has been published and presented in ACADIA, CAADRIA, RobArch, and NeurIPS. He had been collaborating with Bentley Systems as well as Autodesk's OCTO team at Pier 9 and BUILD space facilities. Ardavan has a Bachelor of Architecture and a Master of Architecture from the University of Tehran, Iran, and a Master of Architecture in Design Computing from The Pennsylvania State University.

Dr. Eunsu Kang is a Korean media artist who creates interactive audiovisual installations and AI artworks. Her current research is focused on creative AI and artistic expressions generated by Machine Learning algorithms. Creating interdisciplinary projects, her signature has been the seamless integration of art disciplines and innovative techniques. Her work has been invited to numerous places around the world including Korea, Japan, China, Switzerland, Sweden, France, Germany, and the US. All ten of her solo shows, consisting of individual or collaborative projects, were invited or awarded. She has won the Korean National Grant for Arts three times. Her researches have been presented at prestigious conferences including ACM, ICMC, ISEA, and NeurIPS. Kang earned her Ph.D. in Digital Arts and Experimental Media from DXARTS at the University of Washington. She received an MA in Media Arts and Technology from UCSB and an MFA from the Ewha Womans University. She had been a tenured art professor at the University of Akron for nine years and is currently a Visiting Professor of Art and Machine Learning at the School of Computer Science, Carnegie Mellon University.

Dr. Daniel Cardoso Llach is Associate Professor at Carnegie Mellon University, where he teaches architecture, directs the Master of Science in Computational Design, and co-directs the Code Lab, a multidisciplinary laboratory focusing on critically exploring design technologies. He is the author of *Builders of the Vision: Software and the Imagination of Design* (Routledge), which identifies and documents the theories of design emerging from postwar technology projects at MIT, and traces critically their architectural repercussions. He is a Graham Foundation grantee and the curator of a recent exhibition on the history and possible futures of computational design. His writings have been published in journals including *Design Issues*, *Architectural Research Quarterly* (ARQ), and *Thresholds*, among others, and in several edited collections, including *The Active Image: Architecture and Engineering in the Age of Modeling* (Springer 2017) and the forthcoming *DigitalSTS: A Handbook and a Fieldguide* (Princeton 2019). Daniel routinely lectures and teaches workshops around the world. He holds a Bachelor of Architecture from Universidad de los Andes, Bogotá, and a Ph.D. and MS (with honors) in Design and Computation from MIT. He has also been a research fellow at Leuphana (MECS), Germany, and a visiting scholar at the University of Cambridge, UK.

Blurring Borders Between the Real and Digital Worlds

Minso Kim
University of Colorado Boulder
Boulder, CO, U.S.A.
minso.kim@colorado.edu

Abstract

Borders between the real and digital worlds are blurred by a changed aura through a mediator: digital creative work. By introducing the history of the frame in art, this paper highlights a new perspective to unweave the relationship between the virtual image of an actor and its aura. Furthermore, the author expands the role of viewers who can gain independence and liberty while they participate in digital artwork. Based upon the reconfigured notion of aura in the digital environment from Walter Benjamin's seminal essay, "Work of Art in the Age of Mechanical Reproduction," this paper argues that digital creative works can use a 'screen-without-sound' as a stage in the real world with participating audiences. The digital creative work example of this paper focuses on a network-based screen interactive performance, *Telematic Dreaming* (1992) by Paul Sermon.

Keywords

virtual images, frame, aura, screen-without-sound, digital creative work, digital performance, Telematic Dreaming.

Introduction

Today, we live in a combined world, where reality and the digital environment are not independent from each other anymore. This combined world is not only observed in the gaming industry, such as Pokémon Go, but it is also evident through creative artworks. By introducing the history of the frame of art, this paper suggests a way to unweave the relationship between the virtual image of actors and aura. Based upon the reconfigured notion of aura in the digital environment from Walter Benjamin's seminal essay, this paper argues that digital creative works can create a screen-without-sound as a stage in the real world with participating audiences. The digital creative work example of this paper focuses on a network-based screen interactive artwork, *Telematic Dreaming* (1992) by Paul Sermon.

Telematic Dreaming (1992)

In 1992, Paul Sermon's installation and performance *Telematic Dreaming* was created with support from Telecom Finland. His artwork took part in an annual exhibition, which was curated by the Finnish Ministry of Culture in Kajanni. This installation exists in an ISDN digital telephone network, and two separate interfaces are located into distinct locations. Within the interfaces, the network forms a dynamic performance and installation while also functioning as a video conference system.

In the installation of *Telematic Dreaming,* two exhibition venues were required. At the exhibition venues, a bed is situated in two separate places. One is in a dark space for visitors (Figure 1) and another is in a space with a light for an artist (Figure 2). In each space, there are two cameras, one projector, and a couple of monitors. One camera is on the right above the bed-A and transmits its live video images, which are projected on a person who lies down on a bed-B in a dark space. Another camera, which is beside the projector in a bright space, presents a live video images of

Figure 1. Participant's exhibition venue. ©netzspannung

Figure 2. Artist's performance venue. ©University of Brighton

the bed-A and a person who lies down on it to the monitors that surround the bed-A. The same feedback loop appears at the bed-B space. Both projection spaces do not transmit any sound components.

According to Sermon's description, telepresence image conveys the representation of self and other. Immediate transition in the distanced space and the context of bed creates an ability to exist outside of the user's assigned space and time through a sense of touch in reality. The participant's cognition of the telepresent body is controlled by the voyeurism of self. By placing each participant's eyes and hands on the projection of the corresponding actor, *Telematic Dreaming* leads the two difference and distanced beings to exchange their tactile senses.

Through the artwork, Sermon argues a machine's celibacy leads to the celibacy of the telematic man (telematic human). As a user sits in front of a computer, he maintains his intelligence and a spectacle of his brain through his computer use. This 'telematic man' provides a spectacle of himself by using a processor, specifically the 'minitel rose,' a message service operated by Mintier in the 1980s to 1990s. Sermon sees that a relationship between one and others through the networked system provides a 'tortuous sensation', a virtual jouissance of himself. He states that his interactive performance installation, with the use of the 'telematic man', who performs in the installed space and in the virtual environment, and the other person, the sexual or cognitive interlocutor, is not aimed to evoke the sense of crossing the screen, but rather the sense of crossing the mirror. The screen itself is targeted as the point of interface. The interactive screen transforms the process of communication, such as the relationship from one to another, and the process of reversibility from the same to the same.

Emotion, Sense, and Body

Telematic Dreaming can be categorized as network-based performance art and an extender of performance art boundaries. Through the dynamic network system, theatrical improvisation, and in-depth philosophical approaches in *Telematic Dreaming,* various types of network discourses have been by exemplifying Sermon's artwork. Such discourses involve network-based emotional responses of participants, an assortment of sensory factors, which leads an audience to perceive a telepresence through interaction, and a perception of body.

Since the 16th century, performance artists have created physical illusionary spaces, and this tradition is realized in digital environments today. The 16th century's Neapolitan scientist and scholar Giammbattista della Porta defined an illusion as when an object appears and disappears in a space. In the 19th century, scientist and inventor John Henry Pepper actualized della Porta's description of illusion with better electric stage lighting through a technique known as Pepper's Ghost [1].

In this fashion, within the digital technological advancements since the 20th century, virtual imagery in online video conference technology is applied to performance art to reinforce thought about the participant and the actor's reaction, based on emotional connectedness. Through emotional connectedness, interactive videoconferencing technology in *Telematic Dreaming* lets its visitors have a feeling of telepresence and a feeling of being in a remote place across a virtual divide [2]. According to Susan Kozel, a performance artist who acted at the *Telematic Dreaming*, "Someone took out a knife. ... I felt the predictable shiver and it set off alarm bells in my mind. ... Someone elbowed me hard in the stomach and I doubled over, wondering why since I didn't actually feel it. ... I was shaken for a while; it was a betrayal of trust" [3]. The visitor responds and interacts with the illusion created at the projected video of the actor's performance, and the visitor develops a sense of attachment and trust through the interactions. Virtual image and the real person mimic the attachment between people in reality.

In terms of the feelings, such as an 'invisible pain' as Kozel describes, sensory elements in telepresence are also related to *Telematic Dreaming* with the sense of touch in the interaction with the digital environment. According to Sun Hee Jang and Kyung Won Lee [4], vividness is a way of offering environmental information to human sensory organs, which is the sensorial expression of the mediated environment. When a visual system is simultaneously and repetitively activated with a sense of hearing or touch, the combination of the two decreases the number of plausible situations, but reinforces one perception depending on the environment [4]. One of Sermon's goals in the project was to expand the spectrum of tactile sense via touching an intangible virtual bedmate in the live video feed. The immediate and reactive movement of the live moving image stimulates the experiencer's participation by both seeing the image and touching the empty space of the image on the bed.

In addition to the emotional and sensorial interpretations of *Telematic Dreaming*, according to Kozel's depiction, the perception of one's own body becomes two separate things while participating in the piece: corporeal body and virtual body. For instance, a man came back to the exhibition venue with a flower in his hand. This man tried to present it to the artist Kozel. However, since the man was in the real world while she existed as a virtual image, hovering on a bed, her action to grab the real flower makes the artist a metaphorical being. Kozel writes, "Distinction between materiality and immateriality in the technology is movement: as moving beings people take on an alternative materiality, while objects become immaterial in their inertia" [5]. Overall, her essay narrates the relationship between the physical body and emotional mind through

interactions between corporeal body and virtual body. Through the performance, which happens simultaneously in both real and digital space, participants can experience a two-part process. The participants recognize their two bodies, one in real and one in virtual, by seeing their movements through a monitor while moving in the real world. Then, they can re-recognize their corporeal body by seeing how their virtual body responds to other people. For instance, Kozel had an instinctive reaction when her virtual body was under attack.

The issue of media usage does not appear in previous discourses about *Telematic Dreaming*. In fact, in the video projection, the participants move with and react to the live moving images on this 'screen-without-sound'.

Aura, and Virtual Image and Frame

Telematic Dreaming has not only broadened the discourse about interaction in the network system, but it has also added a branch in the historical understanding of the virtual environment by supplementing the network-based 'screen-without-sound.' The screen-without-sound positions the film in a historical approach, because the media in *Telematic Dreaming* is tied to a film format, such as the silent film, *Battle of Chemulpo Bay* [6]. To Sermon, the media—the screen— is an agency that leads one to face another as in a mirror: facing a replicated image. Sermon believes that a sense of mirroring in *Telematic Dreaming* evokes a torturous feeling. However, at the moment when an authentic person and a replicated image of a remote person meet each other in the screen-without-sound, the participants' actions and reactions generate auras in the projection space. This projection space blurs a border between real and virtual environments. The screen-without-sound projection innately has a border as a frame around a painting does, yet the size and location of the screen in *Telematic Dreaming*'s venues emancipate the viewer's cognition of replicated images in reality with the transformed characteristics of aura. In other words, the frames' size and projection location help people have more liberty to think about images in reality. To this extent, the history of frames in art can be a beginning point to unweave the relationship between the participants' auras in the virtual and real environments.

1) Aura

An issue that distinguishes authenticity and replication has arisen during the development of technology. According to Walter Benjamin's celebrated essay, *The Work of Art in the Age of Mechanical Reproduction* (1936), the aura is embedded in the unique value of the 'authentic' work of art [7]. He claims the work of art is freed from ritual functions through mechanical reproduction and gains exhibition value. Benjamin believes since anyone can possess and access the countless number of replicas, the works of art in the age of mechanical reproduction can be exhibited broadly and the process slowly dilutes the aura.

Although digital reproduction cultivates far more replicas than its physical equivalent, such as photos and films, the meaning of replication has changed in the age of digital technology. In other words, replication might emancipate the aura from being used as a ritual tool, and yet the aura generates new forms of rituals and reactions. For instance, a digital online fan creative work, such as fan fiction, generates a new character of celebrity and strengthens the fan group's offline gathering [8]. Also, its influence grows as a digital reenactment video sharing mechanism through online platforms, such as YouTube [9]. The characteristics of the replication within the screen are changed from a static location with an assigned size of physical screens to a flexible location within an undefined sized screen. Additionally, participants' domain is expanded from online to offline, and the other way around. Thus, to this extent, within the digital environment, by experimenting with the liberal location and the size of the screens, *Telematic Dreaming* promotes active participation of an audience in the process of performative communication through the virtual moving image (projection) in the real world.

2) Virtual Image and Frame

The frame-oriented display, such as a painting within a frame on a wall, leads to its viewer's immobility similar to the screen's physical condition in early screen culture. Film and media scholar Jean-Louis Baudry proposes a notion of virtual images through the one-point perspective space, such as in the centered space of the Renaissance painting and unlike the multi-perspective space of the Greek's [10]. He claims Renaissance painting offers a "motionless and continuous whole", a virtual image which "provides a tangible representation of metaphysics" [10]. Such centered space suggests only one perspective and a singular point of view for the viewers. That is to say, the spectators can only have one fixed perspective; imagination and perspective within the given painting is limited.

It is hard to define the precise origins of framing, when the frame became a component of the painting, and the painting became independent from its wall. Early two dimensional pieces, such as the cave painting in Lascaux, France, and fresco painting, are positioned on the wall immobile and without a frame. In the 13th century, when panel painting appeared, one could carry the flat image to anywhere, from a religious place to the private household.

Although flat and two-dimensional paintings give the immobilization of the perspectives in both physical and imaginative spaces, the frames of the paintings attempt to obtain independence from the virtual image by their architectural settings. In the process of being detached from the

wall, the flat image created its own architectural functions by matching the frame with the image's message. The surrounding wall, door, windows, create an architectural harmony extended the space of the virtual image to reality [11].

If one wanted to see a piece of art, before the appearance of framing, the viewer had a limited perspective within the image and had to be in front of the wall on which the image was attached. With the appearance of the frame, along with panel painting, virtual images obtain the freedom of being positioned anywhere in the viewer's physical space, and of extending the imagination from the virtual image toward the surrounding reality. The advancement of screen technology leads us to consider juxtaposing the panel painting and projector and the frame and the screen-projection. In other words, as one can move the panel painting around, the projector can also be situated anywhere, not only on the wall, but also on the ceiling and the floor. The frame of the painting gives a chance for the virtual image to extend beyond its boundary to its surroundings. As such, when the screen projection achieves a variety of sizes and locations, the viewer's mobility is increased by adjusting their position to the projected image.

In tandem with these features, the viewer's mobility is strengthened by the performative socializing between individuals in both the real and the virtual worlds. Even though the frame of projection suggests a limited space, its scale and positionality turn the limited digital space into a physical space in which the spectator can act naturally. Thus, the generated virtual aura in the digital projection pleads with a participant to become an actor in another side of the real world.

Aura, and Virtual Image and Frame

The change of screen size and position in which participants immerse adds value to the discourses about the role of participants and interaction among the individuals. While one witnesses an art within physical and virtual spaces, the changed attributes of the screen encourages the person to be an active participant, not a passive screen-observer. Advanced digital technology shifts the status of spectators from a conventional watcher to a participatory involver who overcomes distance and time.

Even though a projected screen-without-sound necessarily needs at least a physical two-dimensional surface, once it possesses the independence of its positionality and size, a screen-without-sound creative work elicits more physical responses from its participants than any static screen-without-sound work.

At the same time, the changing perception of accepting others in the digital environment is evident through digital-based creative works. Building a relationship not only happens in the real world, but it is also possible in virtual space without knowing one another. In *Telematic Dream-ing,* audience and artist are a 'distance-being' and a 'virtual-being' to each other. During the interaction with each other's movements in the limited projection space, they build a connection when they respond to each other's actions. When participating audiences are represented within the virtual space (projection) in the real world, the projected virtual space turns into a stage. This means an audience is more than just an observer; they are capable of moving inside the digital projection to the 'screen-stage'.

Through digital-based screen art, viewers can experience creative works with independence and liberty. The connection between the digital and real worlds is blurred by a changed aura of actors through a mediator: digital creative work. In other words, the above phenomenon shows us evidence that digital creative work can extend its influences from virtual to real, and from real to virtual environments. Because creative work extends its role to mediator, an artwork not only provides a sensorial and aesthetic experience, but it also bridges the gap between reality and digital world: to a combined world.

References

[1] Wikipedia contributors, "Giambattista della Porta," Wikipedia, The Free Encyclopedia, accessed September 10, 2018, https://en.wikipedia.org/w/index.php?title=Giambattista_della_Porta&oldid=870835666.

[2] Geelhoed, Erik, Singh-Barmi, Kuldip, Biscoe, Ian, Cesar, Pablo, Jansen, Jack, Wang, Chen, and Kaiser, Rene. 2016. "Co-present and remote audience experiences: intensity and cohesion." *Multimedia Tools and Applica- tions* vol. 76, no.4 (February): p.5573-5606.

[3] Kozel, Susan. 2008. *Closer: Performance, Technologies, Phenomenology*, Malina, Roger F. Cambridge, MA: MIT Press.p.19-20.

[4] Jang, Sun Hee and Lee, Kyung Won. 2004. "The Principal Determinants of Telepresence focused on the Analysis of Telepresence Arts." *Journal of Korean Society of Design Science*, vol.17, no.2 (May): p. 413-424.

[5] Kozel, Susan. 2008. *Closer: Performance, Technologies, Phenomenology*, Malina, Roger F. Cambridge, MA: MIT Press. p.97.

[6] Edison Manufacturing Company. 1904. "Battle of Chemulpo Bay,", imdb website, accessed October 5, 2018, https:// www.imdb.com/title/tt0847550/

[7] Benjamin, Walter. 1968. ”The Work of Art in the Age of Mechanical Reproduction." in *Illuminations*, ed. Arendt, Hannah, p.217-251. New York: Schocken Books.

[8] Kim, M. 2017. “Does ritual disappear as Walter Benjamin describes in ‘The work of art in the age of mechanical reproduction’ in the age of digital technology?” (paper based on a talk presented at Universidad de de Caldas, Manizales, Colombia, June, 2017). *Proceedings of the 23rd International Symposium on Electronic Art*.

[9] ———-. 2018. “Newly generated rituals in the age of digital technology.” *Virtual Creativity* vol. 8, no.2 (December): p.177-186.

[10] Baudry, Jean-Louis, Williams, Alan. 1974. “Ideological Effects of the Basic Cinematographic Apparatus.” *Film Quarterly* vol.28, no. 2: p.39-47.

[11] Friedberg, Anne. 2006. *The virtual window: from Alberti to Microsoft*. Cambridge, MA: MIT Press. p.79.

[Figure1] Sermon, Paul. *Telematic Dreaming.* 1992. Performance. Interface and Experience Lessons Learned. From: Museum Exhibits, accessed on December 2, 2018, http:// netzspannung.org/cat/servlet/CatServlet?cmd=docu- ment&subCommand=show&forward=%2Fnetzkollek- tor%2Foutput %2Fproject.xml&entryId=148087§ion=content&lang=e n

[Figure 2] Sermon, Paul, *Telematic Dreaming*. 1992. Performance. University of Brighton, Brighton, UK. From: Art and Culture, accessed December 2, 2018, http://arts.brighton.ac.uk/__data/assets/image/0020/175115/ dream3.jpg

Bibliography

Dixon, Steve, Malina, Roger F., and Cubitt, Sean. 2007. “Virtual Body.” *Digital Performance : A History of New Media in Theater, Dance, Performance Art, and Installation,* p. 211-240. Cambridge: MIT Press.

Elsaesser, Thomas and Hoffmann, Kay, eds. 1998. “Towards an archaeology of the computer screen” *Cinema futures: cain, abel or cable?*. Amsterdam: Amsterdam University Press.

Fenemore, Anna. 2007. “Dialogical interaction and social participation in physical and virtual performance space.” *International Journal of Performance Arts and Digital Media* vol.3, no.1: p.37-58.

Gibson, James J. 1904-1979. *The senses considered as perceptual systems*. Boston: Houghton Mifflin.

Hayward, Susan. 2006. *Cinema Studies: The key concepts.* London; New York; (UK; NY;): Routledge.

Rheingold, Howard. 1991. *Virtual Reality*. New York, NY: Summit Books.

Sermon, Paul.“Telematic Dreaming - statement.” Official website accessed September 10, 2018, http://www.paulsermon.org/dream/

Shanken, Edward A. eds. 2009. *Art and electronic media*. London; New York: Phaidon Press.

Author(s) Biography(ies)

Minso Kim is an international artist, educator and researcher whose practice explores the relationship between analogue and digital worlds through human interaction. Together, her creative and academic works not only consider the sensorial experiences of art, but they meditate on human life infused with diverse categories, from the environment, to computational systems, to popular culture. Kim’s artwork and writing have been shown and published in various countries: Minnesota State University, Universidad de Caldas, Short Film Festival Budapest, (Buk-)Seoul Museum of Art, and more. She graduated from the School of the Art Institute of Chicago, with a Master’s Degree in Art and Technology Studies in 2013. Minso has taught contemporary art practices and theory at colleges from 2011 to 2017. Currently, the author conducts her research at University of Colorado at Boulder as a Ph.D in the Department of Critical Media Practices.

ART AND BIOTECHNOLOGY:
the curatorship in the light of the exercise between, technology, philosophy and politic

..... MUCELLI
Federal University of Minas Gerais – UFMG & Digital Art Festival - FAD
Belo Horizonte, Brazil
tadeus.mucelli@gmail.com

Abstract

This article approaches the linkages between technological art and biotechnology as places of conversation between philosophy of technology, politics and curatorship. Based on the literature reviews and experiences accumulated during the process of curating of the first digital art biennial of the digital art festival, held between 2017 and 2018 in Brazil, it was possible to produce reflections on the role of curatorship in technological art and its implications for decision-making amid an era of biotechnology where political, ethical and artistic processes are intensified under the sensitive eyes of artists and curators.

Keywords

Art, Technology, Philosophy, Biotechnology, Curatorship, Digital Art Biennial

Introduction

The Digital Art Biennial was conceived in 2015 with the objective of celebrating, in the year 2018, the 10 years of the FAD (Portuguese: *Festival de Arte Digital*), one of the pioneering festivals about art and technology in Brazil. In addition to the celebration, the Digital Art Biennial emerged as an international agenda project in Brazil, through the Oi Futuro Institute, seeking to verticalize the reflections concerning art in technological contexts and its derivations.

It is noteworthy that in the historicity of the arts in the midst of media, the country has previously had similar action, not named as biennial of digital art, but it carried within itself a reflection on positioning art as a highlight, in technological environment. I refer to the actions of the six editions of the exhibition called *Artificial* occurred in the Itaú Cultural Institute of São Paulo

Returning to the Digital Art Festival Biennial, which is partly the study of this article, the project included exhibitions of digital art, artistic presentations in audiovisual performances, workshops and international symposia, and took place during the months of February to April 2018 in the cities of Rio de Janeiro and Belo Horizonte.

The City of Rio de Janeiro, through the Oi Futuro cultural center, was chosen as the official venue and received, for the first time, between February and March 2018, the 1st Digital Art Biennial proposed by the festival with the curatorial theme *Hybrid Languages*.

The Biennial had important Brazilian and foreign names that started the cultural artistic activities through the International Symposium organized at the Oi Futuro Theater for two days.

There were Scientist-Artists and Artist-Scientists who, in their countries, participate of important research institutions, like Joe Davis, artist and pioneer scientist of bioart and MIT member, and Diana Domingues, notable Brazilian artist and researcher, who have ended the differences between art and science through themes related to hybridism. They were generous knowledge contributions. They discussed the contemporaneity in the society called Post-Digital based on the imbrications of Biomolecular Science, Education, Innovations in several areas, Hybrid Systems, Hybrids and the entire environment that involves the biotechnological society in the symbiosis between art and life.

In the first week, the activities of the audiovisual Performances occurred during 4 nights of Brazilian and foreign attractions that brought to the stage of the *Oi Futuro* theater and for the present audience, the hybridity as a process between body and machine, as seen in the performance *Corpus Nil*, by the Italian Marco Donnarumma.

The *Hybrid Languages* exhibition occupied all the spaces of the *Oi Futuro* cultural center, from the outside patio, library, galleries 1, 2 and 3 to the terrace. The works exhibited in addition to direct participation invitations were selected, after analysis of 675 proposals sent through international submissions call that began in 2017. It took four months of work for the curatorial team invited, formed by theoreticians, critics, artists, cultural producers, along with the direction of the Biennial, to achieve the selection of 15 works to be exhibited in the city of Rio de Janeiro.

Gallery 1, on the first floor, was devoted to works that focused on biotechnology. Gallery 2 approached hybridism from the perspective of digital art in the works. Gallery 3 conducted the theme of hybridism according to a Brazilian view toward the theme through audiovisual works derived from videoart, gambiology, among other. The external courtyard at the entrance of the cultural center and the terrace received works that engaged in the dialogue with the hybrid through the connection with the urban environmentcom ambiente externo e as leis físicas da natureza urbana.

For forty-three days, more than thirteen thousand people were present at the Digital Art Biennial in the city of Rio de Janeiro with a program with various activities.

The Biennial in circulation was taken to the city of Belo Horizonte between March and April, 2018, occupying the important architectural complex of the, Pampulha Modern Ensemble (Portuguese: *Conjunto Moderno da Pampulha*) in the Lake Pampulha (Portuguese: *Lagoa da Pampulha*, designed by Oscar Niemeyer and currently contemplated as Cultural Patrimony of Humanity by UNESCO.

The MAP - *Museu de Arte da Pampulha* received, for the first time, an exhibition of technological art. The main exhibition of the Digital Art Biennial was directed for the MAP. The Casa do Baile, center of reference in architecture and urbanism received part of the exhibition with an unprecedented work and performance, in site-specific model, related to the urban criticism and the building of cities and barrages in the perspective of recent environmental crimes in Brazil.

The Digital Art Biennial juxtaposing the notions of Patrimony and Digital Heritage, Memory and Digital Memory intended the choice of the *Conjunto Moderno da Pampulha.*

Two other spaces in the city of Belo Horizonte received activities and artistic works from the Digital Art Biennial: The *Casa Fiat de Cultura* located in the *Circuito Cultural Praça da Liberdade* and the *Atmosfera*, a place of innovation and technology. Both places also received for the first time, the works of digital art in their spaces.

The Biennial drew an imaginary line from north to south of the city, connecting three of the most important art and culture points, involving the main art exhibition spaces as well as regions where technology has developed by means of corporate and entity innovation with a focus on the creative economy.

In Belo Horizonte, the Biennial de Arte Digital exhibited 17 works. The themes around the proposed Hybridism prevailed as a central theme, but the concentration of participations remained in the surroundings of Post-Digital society and its implications in art and in social and political life. Biological Fabrics, Artificial Intelligence, Architecture and New Technologies, Biological Engineering were some of the themes most deeply reflected among critics, artists, scientists as Lucia Santaella, Giselle Beiguelman, Mark Klink, Ana Moravi, besides the present audience.

The Digital Art Biennial received more than thirty thousand people in Belo Horizonte.

Hybrid Languages

Next, I will bring the theme construction of the Hybrid Languages to this article, since it is fundamental to understand the reflections throughout this study.

In the construction of the curatorial text, it was understood and defined that "(…) the current configurations of Technological Art have been fused with contemporary life, in a viral process of incessant exchanges between the real and the simulated world." There are hybrid works in which the digital and the analog, the natural and the artificial, the real and the virtual are crossed. Technology has come to be seen as a constitutive factor of human life and with biotechnology, it is seen as life itself. Scientific research is reappropriated and transformed into artistic languages, using interactivity, virtuality, hybrid systems and immersion.

In addition to the digitization of information, we are witnessing an intense process of digitization of the physical world. At the same time, in the midst of this rapid and exorbitant flow of information in which we live, many artists, creators, professionals, researchers and intellectuals point to the need to produce other rhythms, other temporalities, other realities, other spaces and silences, so that transmutation and reconfiguration of new places become possible.

In this sense, what has been called a post-digital society, seems to mark the transition from an era characterized by technological enchantment to another, in which finding new ways of approaching, conceptualizing and rethinking the artistic and social universe in relation to these transformations, turns to be an urgent task.

The art, inserted in the post-digital, proposes an escape movement from the technological domain, but without discarding it completely. It invites the experimentation in a plan where the physical existence and the abstractions of the digital world meet. They are works that exploit - through alternative means to participation, interaction and collaboration between the public and the artist - haptic and synesthetic sensations of this constant updating of the human-machine relationship. More than that, they expose how the forces that constitute the condition of natural and technological existence, now more organic and symbiotic - even though they have not lost their characteristic in the operation of metadata and algorithms - are producing hybrid beings.

Wearable computing, the internet of things, artificial intelligence, BigData, geolocation, processes of robotics, automation, quantum computing and pervasive hybridism, have become expression material. It is necessary that these tools are increasingly open, so that the innovation they bring is decoded in the most diverse cultural and technological manifestations. It means that they must be constituted through changes and modifications available in their surroundings, allowing the improvement of larger technical groups. There can be no technological development and technical innovation without a certain margin of indetermination, an opening of the machines for new couplings" (Mucelli, Tadeus; Pinto, Luiz 2018).

This brief clipping is a part of the Biennial publication that elucidates the events and intentions achieved by

the project, giving shape and dimension to a Biennial that proposed a debate about the biotechnological era and the technological arts, which are points of reflection of our study from the curatorial process and the implications in which it occurs.

After facing a collective construction of writings, we have reached a consensus that the hybrid, as the intended focus, extrapolates the conception of the mixture of techniques. It is designed to blur the frontiers, no longer being possible the delimitation between science or art, but a proposition of transposing the technical processes of life. It would be a position of total occupation of life by art and science without antagonistic dualisms.

However, the course was only possible when we drew two contexts present in the mentioned fields of the arts and sciences; the perspective of a contemporary technology philosophy, and an approach to the biotechnology era in society

The philosophy of technology in contemporaneity

For the purposes of this article, we have cut for relevance, the progress of the Philosophy in the field of Technology since 1970's, when the studies in an especific field that was capable to draw an unique attention to the use of technology increased considerably, specially after war.

The path of the philosophic field that precedes this period is not taken into consideration, as Francis Bacon (1620) that refered to the natural philosophy observed in the development of human technical Works. Decartes (1637) which in the elaboration of the modern ideology post-renaissance, connected human state of being more and more closer from the nature control by understanding its functioning, its philosophy. Fundamentally, the second half of the XIX century when a closer expression of the "Philosophy of the Technology" was born as a "segmented" field of studies from social sequels of the Industrial Revolution through philosophical studies of the technique in the universe of the German world of Friederich Dessauer (1927).

Therefore, considering all these historic periods of the development of philosophy on the technical-technological interest, what is relevant for this study is to understand moments in which some ordinary thoughts were formed and replaced with the advance of its own field over the technologies in the society. Also, we must perceive where modernity made an effort to separate arts from other sciences and technologies.

In the arts field, the separation of the technique intended to science and not to arts anymore is annouced by Flusser (1982) who noticed the "purposed" and "subjective" use of the Greek concept of "techné". The purposed way is in charge of Science and its accuracy, a technical, technological and practical function. The subjective way is found in an isolated and random life point of view through pieces of art that have no context in life. It would be some sort of emptiness in the daily life, while technology (scientific) is a result of practical life and real, concrete knowledge.

The author is a philosopher which in the arts field questions not only the technical sense of technology but also puts in doubt that the division between arts and science, as well as the use of technique and technology as purposeful or subjective are separations with political aims, in which politics give life a sense. Therefore, understanding life policy takes us to apprehend that the process between arts and Science, philosophy and technology are part of the same field in our minds, reflection and action.

However, going back to the paths until the reflection of Flusser, the first notions about technology translate mostly a practical notion and a question of the necessity of the presence of "pure", "true", "scientifical" knowledge. For Philosophy, considered in a classical and general manner, there is also a mistaken average notion that the philosophical field is not about practical matters at all.

Some questions are drawn from these partial views of the fields of technology and philosophy, that according to the advent of techniques and uses of men in his social historicity before natural and technical processes, it cease to be separated and begins a conversion of knowledge that unite the technical interest of production, but also the reflection of its impact shortly after its action and its impact on the social, political and economic cycle. Another perspective of the partial views regarding the beginning of doubt about the role of the philosophy of technology are those that usually surrounded the field of doubt and disciplinary division. Usually they go around the field of doubt concerning the sense that the practice is always raised as something necessary. This also raises doubts about what is sufficiently technical rather than abstract. What would be the determining notions of what can be considered natural, as well as what should be raised to the idea of knowledge (Verkerk et al, 2018)

Flusser, once more deserves emphasis when recalls in his research that for a long time that the research laboratories and art galleries are both hermetically trapped (FLUSSER, 2011). Life seems meaningless in both places as they are empty of what the author calls "intersubjectivity", in other words, the ability of giving sense to technique, the practical, the objective and thoughts, and also to abstraction and reflection. It is important to think about the behavior of the philosophy of technology throughout time and also about the discovery of the technology as intersubjectivities.

In a certain level, with the development of highly practical-technical societies in many different social-technicals processes, we realize that doing things in an objective way is not apart from the reflexive thought of actions and its impacts. Even because the development practical-technical is possible only if reorganized on its own reflexes which need to be analyzed where the ab-

stractivity is not distant and it is part of the process of analysis.

Therefore, philosophy is not apart from the objectivistic experience, as it is normally described by laypeople, and the abstract is not about universes and things that do not exist. For an objective experience it is necessary some sort of reflection and abstraction on the studied analyzed things.

Most part of the experienced lived in the Industrial Revolution and its consequences was only capable of changes and developments from a set of analytical factors on itself which includes an increasingly tendency to a great participation of philosophy and sociology. On the contrary, we would not be in the contemporaneity in a model of data industry and knowledge-based.

It is then necessary to recall the role of philosophy, more necessarily its functions, as done in a study of a compilation of Dutch authors, about the philosophy of technology (Verker, Hoogland, Vries, 2018) on the philosophy of technology today, just as Carl Mitcham did for type analyzes in "Philosophy and Technology" (1983).

From an analytical point of view, the discussion is presented in the presence of the production of conceptual frameworks; a production of concepts beyond a "language game"; a dualism between saying and narrating reality, and realizing if the concepts produced say something about a perceived reality.

As for technology, the discussion of whether it is or is not an applied physical science, it can be considered as something surpassed, even if we can find resistance in some more conservative sectors. The preponderant factor for its understanding and that best translates its comprehension involves the applications of the term "technology" and the way we use it or insert it, in our objects of discussions according the same authors.

From the point of view of the critical role, philosophy is a look over a given reality and over what it produces, produced or will produce in it. There is a preponderant role of the critical discourse that is the centrality of the human being, his "well-being" and his freedoms. The analysis of the concepts for the production of a critical narrative can produce positive and negative effects, according to the authors.

What we apprehend from this perspective would be its somewhat "enlightening" or rather "hazy" character as it is seen by modern science, modern technology, and philosophy against technology. Finally, according to the authors Verker, Hoogland,Vries (2018) another feature of philosophy would be in its directional specialty ruled by an ethical agenda, which formulates guiding questions connected to the analytical and critical phase - a position of normative expression on technology from or even before modernism and its implications until the present time.

Having gathered the practical functions of philosophy as the critical and directional analytical phase, the authors who suggest a new look over technology of Philosophy it is possible to draw a historical summary of their contributions to technology. In 1877 Ernst Kapp defined the basic principles of a philosophy of technology, being a complement to the human body. Peter K. Engelmeier in 1911 dealt with the role of the human will in technology. Friederich Dessauer in 1908 and 1945 permeated the idea of technological culture in society under the watchful eye of the danger. Gilbert Simondon in 1958 characterized the nature of technical objects and their mode of existence. Lewis Mumford in 1934 and 1967 emphasized the impact of technologies relating primarily to technique and civilization. From 1950 on, the Frankfurt School related the idea of power to technology by minimally reinforcing the idea of Marx's superstructure. The political idea about technology gains dimensions of great influence by Michael Foucault (1975) mainly in the contemporaneity.

Therefore, we can notice that a reordering of technology in philosophical reflection has occurred for some decades, under a critical-political-cultural focus imbued with the positivist scientific force in a certain way. The idea of condition has been debated under a vision of victimhood or redemption to technologies and their adjacent powers. This reflection calls a social constructivist role: on the one hand technology reinforces fears and anxieties and, on the other, is created in social contexts to improve the future of all. It is a social construction.

According to the political philosopher Langdon Winner (1977) the empirical turn from the philosophy of traditional technology to the present one is the view that contradicts the thought that technology is something autonomous of human subjectivity (Heidegger). The observation turns to the political action of technology that becomes a prominent place in modern and contemporary thinking. In other words, it is the passage from the positivist Karl Popper (1959) and his deductivism to Thomas Kuhn (1962) in a profusion of historical social scientific studies around the observation of social phenomena. Technology like science is proven beyond the foundational rationalities and through social paradigms and factors, sometimes irrational.

For Carl Micham (1994), there are two perspectives of the construction of the technological philosophy. One of them was built by technologist engineers and the other by specialist humanists to whom the technical world is divided in optimistic and pessimistic views.

The vision of change in the perspective of the empirical-analytic turn is therefore given by the analysis of the technologies themselves, but of their technological and phenomenological contexts. A technological theory oriented to moral, social and ethical context gains relevance from authors as already mentioned, Gilbert Simodon, Jospeh Pitt for example.

We will notice the influence of these two perspectives in technological arts and views which since Flusser (2011) talk about indissociation between technology and

esthetic, art and science, practical and abstract, and the idea of them being complementary, appearing in a curatorship process as our case study in the Biennial of Digital Arts in Brazil where theses dualities occur between invited curators and transit among the thoughts always in contradiction , full of conceptual affirmations from the guests about the works that are being selected -some sort of temporal and conceptual mess between the classical idea of the technical philosophy and the contemporary technological philosophy, which suffer a tension because of the central theme of the event (*Hybrid Languages*) under the era and contexts of biotechnology.

Biotechnology and the human condition complicate the vision of one of the philosophy of technology

The biotechnology field has long experimented with living systems, through laboratory developments that directly influence events with impacts on society. Diverse scientific processes, and therefore biotechnology is an interdisciplinary science at its base, extend the boundaries in the search for technical-scientific applications of ways of living by means of the systems available in society. Therefore, in a scalable global growth of natural and biological challenges of which society belongs, interventions in these living systems are necessary, in order that they may continue to provide conditions of life, relocation, supplying and creating for a global society, which also longs for by global solutions of old and new problems; this extends to all human areas.

The human condition receives, from the biotechnologies, perspectives under the same axis of reflection. Some ways of thinking put them in a relation of opposition, but it is important to know that they are, in fact, elements of an inseparable technical, social, political, economic, philosophical, and scientific interrelation.

Biotechnology is found among the old and new scientific processes. In other words, it has been part of all scientific development until these days - from the discoveries, testing and uses of all chemical industry throughout the societies for the purpose of production and medicine improvement, food and industrial processes to the scientific bases in physics and computation responsible for the proliferation of current communication and information technologies that produce historical, social and cultural changes. Therefore we aim to starting from this notion of processes, complementary to each other to develop our reflection.

An example is the performance of biotechnological processes through the performance of drugs produced on a large scale at some level of social response success over hundreds of years in the health and medicine aspects. Here the idea of a historical culture, throughout time influenced and permeated by the structuring preconditions of a biotechnologically conceived society, based on their biological needs, which influence a biophysical character of society dependent on these factors. How much biotechnological processes in the health field have shaped psychic, behavioral perspectives of a broad social spectrum.

Thus, the conditions of the applications to the human, under the biotechnological ou purely the technology were not given otherwise than through the conquest of body and mind, by the control and functioning of both in order to conditioning our action in the world. Some examples are the improvements in the mode of production of food in scale, of diseases by means of chemical substances with neural actions and, finally, the sum of a set of subsidies in the surroundings and other implications of a life under increasingly complex social conditions (production, consuming, dependence and freedoms) are decisive for this double constituent between the biotechnology era and the human condition. And we can translate the same relation to technology and philosophy. Hence, there is the complex process of the philosophical view on the field of technologies, in the understanding that the biotechnological moment of the world directly implies technologies not only of the devices and interfaces, but of the involvement of bio in the human body and its other living systems of interaction.

Positive and opposing arguments are always present and refer to neurosciences, in the exemplifications of what we mentioned above, mainly the questioning of the ontological and anthropological "being" under a control of the body, through the neurotransmitters, the genesof DNA.

In the interface between biotechnologies and art, we have as an example the interdisciplinary but still restricted role of Bioart as pioneering artists such as Alexandre Fleeming (1929), bacterial germ paintings and Joe Davis (1996) with Mivrovenus, interstellar transmissions, among many others. We say restricted by the peculiarity of the activities in the need to use laboratories and considerable funding. Joe Davis, for example, participated in the Biennial of Digital Art in Brazil, being the source of this study of the article on the immanence of the philosophical and political exercise of the curatorial process of art and biotechnology projects.

If in the modernist advance there was a separation of concrete knowledge resulting exclusively from objectivist technology, in the Biotechnology era through Bioart, this scenario seems to revert from interdisciplinarity both of the technological processes in science as in the arts. In this sense, the indissociation between technology, art and science and the intended exercise of intersubjectivity between the rigorous analysis of technology and its aspects as a political-social phenomenon is confirmed.

Bioart as an interdisciplinary practice has long been driven by the bias critical to biotechnologies, a very oppositional character of the interferences in the living systems by the technologies and the science. Such behavior has repeatedly reinforced the constant disciplinary duality

between art and science, separated in modernity, making it difficult for a transposition in the philosophical field to account for an expanded look at technical processes beyond the field of criticism.

However, in another perspective, many artists have been ressearches and works focusing on the interdisciplinarity of the life sciences and art, deeply concerned with the intersubjective dimension that art could also be translated into scientific research to the point that collaborations have been widely recognized throughout the time.

Biotechnology, Bioarte and the humane condition, interchange the theme of life and its continuity or permanence. Subjects debated by the works exhibited at the Biennal of Digital Art in Brazil and by its curatorial council. By the look of biotechnologies the maintenance, recovery, amplification, adaptation and perhaps the creation of living systems are factors that reimposes a kind of immortality control of life, in the search to counterbalance a global system until then exhaustible of resources and possibilities. Bioart is led to deal with this theme by collaborating on the possibilities of intersubjective (political and social) views of these modified and created systems. And human condition is the central element, appropriated by these techno-scientific "philosophies", not being exclusive of the classical philosophical reflection.

An example for contemporary analysis is possible to be drawn from a very manageable perspective for the biotechnological and anthropological subjects, mainly in works of art, especially since *Documenta 10* (1997), which made the post-trans humanist agenda reverberates until the present time.

On the one hand a constant of the "death" complex that persists under the idea of humanity ("being" a human condition, the immortality),and along with this complex the path of the "soul", in its total and complex immateriality, under all forms of aesthetic or poetic signs were, in this sense, represented and discussed.

On the other hand, the biotechnology era produces at some point ideas of a condition for immortality on the planet, and a materiality for this permanence under the same transhumanist and post-digital agenda that is always present mainly through the cinema, in sci-fiction movies

It is at this point that the production of bioart, allusive or critical to biotechnological processes, and the role of the "new" philosophy of technology, or in a better words, the role of reflection of the human condition vis-a-vis the technical-scientific world, which may also occur critically or in favor of a new perception of a condition of life starting from the subjectivities and intersubjectivities inherent in the technical-scientific process.

The challenge of proposing the biotechnology era, replacing death and soul in a context of immateriality toward the immortality and materiality of things, is not simple, in an eternal permanence of the meaning of life.

The changes in charge of biotechnologies are large-scale. They span beyond the generational balance between new and old societies, from the physical to the cognitive perspectives of a new reality.

The “technified” body gains centrality in the post-digital and biotechnological society. It goes beyond the physical-bio-natural-cognitive from the cooperations between the human and biological sciences. This technological body reformulates the mortality, corporeality and rationality, central axis of a society in transformation.

The human condition so referred in the context of technological arts has a strongly anthropological perspective, which as a tool, adjusts conditions of existence, reconfigures and alters living under new ontological matrices, and transforms, making possible other forms of life and art. It is, in this sense, reconciliation between human, life and the natural - a "new" natural biotechnological that depends on the philosophical and political conceptions to exist.

Biothecnology goes from being a tool to being a conception of biotechnology as a way of life under a prior attention: the human condition. In this responsibility with one of the main actors of the living systems, it is necessary to reconcile the past separations between art and science, as well as to advance in the critical understanding of the role of the philosophy of technology. As well as perceiving a potential role of artistic works from Bioart in the contribution of these new ways of living and not only to an avid and gratuitous criticism, which insists on the construction of disciplinary barriers -complex process to the field of arts in many moments.

Considerations

Since Leonardo da Vinci, the boundaries between art and science have long been diluted not only by academia, but mainly by artists in the context of technological art in the last four decades - a reorganization of production at all levels, supported by nano and biotechnologies so immanent in our current society.

Again, it is important to highlight the role of Artists such as Alexandre Flemming, Edward Steichen, Joe Davis, George Gessert among others, in the production of works and research that together with the perceptions about the condition of life among the technologies, were not deterministic in assert the overlap between art and science. On the contrary, they took over intersubjective and conditional thinking among these disciplines, which is an extended thought of the philosophical aspects of technology.

In the same way, we recall that the Biennial of Digital Art has obtained in its exhibition works that go against an expanded thinking of Biotechnologies facing the theories and philosophies of technology as a political and social phenomena. Not based on a critical and impotent criticism of the technical-scientific processes, Joe Davis (Bombyx Chrysopoeia), Axel Cuevas Santamaria (Protoplasmic Routes), and Ivan Henriques (Caravel) produced

in the form of artistic works the perceptions of conflict still persistent in relation to the notions about technique and practice, objective and subjective, art and science, from the centrality in the human condition in association with the scientific-political-social system. However the works speak for themselves, which go beyond this constraint of persistent questioning of opposing criticism in the field of the arts. Each one was allowed to discuss what the living conditions are from a biotechnology era, all scenarios being possible and contributory.

These works were extensively discussed in another article (which complemented this work), which resorted to curatorial conflicts based on the analysis of works presented to the curatorial process but did not participate directly in the Biennial, in a constant activity of reflection between a philosophical and political thought in the curatorial decision, and making generating counterpoints, conflicts and contradictions.

The standardization and naturalization of many technologies in a post-digital word, post-biological is open to understanding new ways of life. To understand these new arrangements is to understand the world from these new forms in our social arrangement. In other words, it is about "living things," which move and transmute themselves by throwing light on our questions about explaining and living our present, with a way of minimally tracing our future.

Art is in this sense, an inseparable part of scientific processes, and simple criticism of technical processes become depleted in the contemporary world. To the curatorial council for the decision among the 675 works of which some would be selected for participation in the Biennial, it was necessary to constantly update concepts about the perspective of technologies as a factor and political act in societies. In other words the need was to perceive and analyze the technical-scientific accuracy as well as phenomenological and philosophical of the own technologies of some works focused on the central theme "Hybrid Languages" connected with the biotechnological question. The biotechnology era is translated into the conformation of the production of interconnections between life, science and society.

Philosophy and technology, deduced by a philosophical notion of technology, is a vast field of the themes that accompany our questions for so long. Technophobia, technophilia, under the eternal duality of artistic criticism, cannot be an end object of art. It is necessary to go beyond this place which maintains disciplines and political context separated in pro and anti-something, as well as autonomous forms, superorganisms, biohacking, the human condition and the digital humanities imagined in the context of the post-digital society, should progress in art beyond actions of disruption.

We have a need to update the production of art that unites itself rather than separating fields and techniques. In the same way it has been shown that there is no such clear phenomenological separation of technologies that does not fall on a global whole of its impacts on society. Just as contemporary philosophical thinking about technologies perceives a new vision towards life or anthropocene only. Far from the theoretical and conceptual statements, mediation to the general public had, as a principle, the post-digital and biotechnological condition given as present and not as future.

In the biennial of digital art held in Brazil in its first edition, a critical production was sought through technological appropriations in a non-fixation of post-humanism or anthropocene only as determinations of a world incapable of change either through art or techno-sciences, still seen in this classical way in separate. Far from the theoretical and conceptual statements, mediation to the general public had, as a principle, the post-digital and biotechnological condition given as present and not as future. This association allows the perception of common places between art and science already in the actuality, being impossible to distinguish separations in some works. Treatment as a gift demystifies thought and reflection.

Obviously, exposing and denouncing the "uses" of technology in a biopolitical society is also one of the key points in the work of curatorship; it was about perspectives concerning mainly the way the appropriations of everything around us occur. Inciting the objective and intersubjective senses, provoking and denouncing the "uses" and experiences in the contact with the selected works was, mainly, a philosophical and political exercise.

In the purpose of this short article, the desire was to understand how the influence of the separation between art and science still in the modernity, from the technological processes, is reversed through time, the technological engineering and by the philosophical exercise (political), and how they were not like separate entities, but rather united, bringing new conditions of art and science to rethink the processes of life in society in a symbiotic process of contributions.

If before in modernity they seemed hermetically isolated and willing to give meaning to life, they only really achieve such an objective if they are interconnected, which seems to happen noticeably in the biotechnology era, accompanied by new nondeterministic perceptions of the philosophy of technology in the contemporary world.

Regarding this, the process of a Technology-based Art Biennial has been between this critical and classic universe of the philosophy of technology, and another side of the same field based on new perspectives brought to philosophy by technologies and especially the Biotechnology era and some artists through Bioart.

The perceived factors are that acceptance by the field of the arts to the biotechnological processes are still expensive to their main actors, however trained and experienced they may be. This includes the artists and curators. This adjustment of accounts in the contemporaneity between art and sciences by the critical and philosophical

bias is still a challenge to be transposed. Not all curators and critics as well as artists understand that there is a distinct art performance in the actuality of what has been developed since walls were erected between some disciplinary fields (art and science). This same distinct performance reinforces the philosophical analysis of technology in the present day, not disregarding its connection with society and culture, but reinforcing an analytical bias inherent in an increasingly powerful technical-scientific and biotechnological world, where some artists and some political and critical perception have been acting for some time, even displaced from their traditions. In other words, there is a production of immanent art that does not fail to produce criticism, but constructs it in the form of results, in the pursuit of contributing empirically in this biotechnological world.

More information on the works and curatorship can be found in an article submitted to the 17th international meeting of art and technology in Brasilia.

Acknowledgements

This article is one of the research developed by Federal University of Minas Gerais (UFMG) in the postgraduate program doctoral degree from (ECI), Information Science School, The National Council for Scientific Technological Development (CAPES), an agency of the Ministry of Science, Technology, Innovation and Communications (CNPq). Thanks also to Aline Rodrigues by translate version. Results of this and other research are more advanced and can be accompanied by the Website (http://www.tadeusmucelli.net).

References

Bienal de Arte Digital (2018) – *Hybrid Languages* [Digital Art Exibition] – Rio de Janeiro, Oi Futuro & Belo Horizonte, Museu de Arte Contemporânea – January until March 2018. Organized by Tadeus Mucelli, Brasil.

Cupani, A. (2016). Filosofia da tecnologia: um convite. Editora da UFSC

Davis, J. (1996) Microvenus. Art J. 55, 70–74

Documenta X. (1997). Exibition of contemporary art. Kasel, 21 June – 28 September 1997. Organized by Documenta und Museum Fridericianum Veranstaltungs-GmbH, Germany.

Domingues, Diana. (2003). A Humanização das Tecnologias pela Arte". In Domingues, Diana (Org.). A Arte no Século XXI: a humanização das tecnologias. São Paulo: UNESP Editora

Domingues, Ivan. (2012). Biotechnologies and the Human Condition. 1. ed. Belo Horizonte: Editora UFMG/ IEAT, 290.

Fleming, A. (1929) On the antibacterial action of cultures of a Penicillium, with special reference to their use in the isolation of B. influenzae. Br. J. Exp. Pathol. 10, 226

Gessert, G. (1999) A history of art involving DNA. Ars Electronica 1999, 234

Giacoia Junior, Oswaldo. (2012). "Human Nature" In Domingues, Ivan. (Org.). Biotechnologies and the Human Condition. 1. ed. Belo Horizonte: Editora UFMG IEAT, 290.

Festival de Arte Digital. (2018). Mucelli, Tadeus (Org.) Catálogo edição 1ª Bienal de Arte Digital – Linguagens Híbridas. Belo Horizonte: Ed. Conteúdo Arte e Tecnologia.

Flusser, Vílem (1982). Criação científica e artística. In: Conferência Maison de la Culture, Chalon s/ Saone, s.p., 1982. Manuscrito disponível no Arquivo Flusser, Berlim.

Flusser, Vilém. (2002). Filosofia da caixa preta: ensaios para uma futura filosofia da fotografia (Vol. 1). Rio de Janeiro: Relume Dumará.

Flusser, Vílem. (2011). Pós-história: vinte instantâneos e um modo de usar. Livraria Duas Cidades.

Foucault, Michel. (1975). Discipline and punish. A. Sheridan, Tr., Paris, FR, Gallimard.

Heidegger, M. (1977). The question concerning Technology. In The question concerning Technology, and other essays. 3-35

Kuhn, Thomas S. (1997) A estrutura das revoluções científicas. 5. ed. São Paulo: Editora Perspectiva S.A

Mitcham, C., & Mackey, R. (Eds.). (1983). Philosophy and technology (Vol. 80). Simon and Schuster.

Mitcham, C. (1994). Thinking through technology: The path between engineering and philosophy. University of Chicago Press.

Mucelli, Tadeus. (2018). "Processos curatoriais da primeira Bienal de Arte Digital": percepções acerca da arte digital na era biotecnológica. In Encontro Interacional de Arte e tecnologia (#17.ART): a dimensão política da arte. Anais.Brasília: Goiás, MediaLab/UFG.

Mucelli, Tadeus; Pinto, Luiz (2018). "LinguagensHíbridas". In: 1ª Bienal de Arte Digital – Linguagens.Belo Horizonte, Ed. Conteúdo Arte e Tecnologia.

Popper, Karl R. (1959). _The Logic of Scientific Discovery_. Routledge.

Santaella, Lucia. (2018). Uma filosofia disruptiva para uma arte disruptiva. Revista ECO-Pós, v. 21, n. 2, p. 284-304.

Santaella, Lucia. (2018). Temas e dilemas do pós-digital: a voz da política. Pia Sociedade de São Paulo-Editora Paulus.

Verkerk, M., Hoogland, J., van der Stoep, J., & de Vries, M. J. (2018). Filosofia da technologia: uma introducao.

Yetisen, A. K., Davis, J., Coskun, A. F., Church, G. M., & Yun S. H. (2015). Bioart. Trends in biotechnology, 33(12), 724-734.

Winner, Linner. (1977). Autonomous Technology: Technolgy-out-of-Control as a Theme in Political Thought.

Author(s) Biography(ies)

Tadeus Mucelli, is an artist, curator, researcher and project manager in technological art and digital culture. Master in Arts by the stricto-sensu postgraduate program of the UEMG State University of Minas Gerais with thematic on memory, preservation and digital heritage.

He holds a PhD postgraduate program from Information Science School by Information Science School – Federal University of Minas Gerais. In the years 2013/2014/2015 he dedicated himself to research on "Instability of Digital" resulting in various actions and products, such as seminars, book and articles, as well as participation in national and international events.

He is the founder of the Digital Art Festival - FAD in Brazil - (since 2007) and the Digital Art Biennial (2018) in Rio de Janeiro/ Brazil. He has been working in the fields of Art and Technology since 1998, mainly in the field of electronic art, new media and technological enterprise. Self-taught musical and audiovisual producer, with works published in Brazil and abroad.

Organizer of the publications; Digital Art Festival catalog and essays (2011), Digital Art Festival retrospective with scientific essays (2012), Post-Digital Settings: Technological Art and Culture (2017 by Publisher State University of Minas Gerais), and the book of the 1st Biennial of the Digital Art in Brazil - Catalog and scientific essays (2018). He also works in the conception, artistic direction, consulting and management of cultural projects that involve new media and digital culture.

As a researcher, he is developing in his PhD through the Federal University of Minas Gerais the methodological relations in the field of information science with a view to the production of digital memory and digital heritage in the areas of digital humanities and information studies in technological arts.

In 2012 he was awarded the prize for the promotion of art by FUNARTE - Visual Arts. In 2014, it was awarded by the 1st Brazilian Creative Award, through the Ministry of Culture and the Secretariat of Creative Economy - Cultural Expressions/Digital Art for the project of the EAT - Creative School in Art and Technology.

VoicingHan: between Mortal and Immortal

1st Semi Ryu, 2nd Danielle Noreika, 3rd Malisa Dang, 4rd Egidio Del Fabbro

Affiliation (s) 1st Department of Kinetic Imaging, Department of Internal Medicine, VCU, Information and Knowledge Society, UOC
2nd, 3rd, 4nd Department of Internal Medicine, Division of Hematology, Oncology & Palliative Care, VCU
Location, Country 1st, 2nd, 3rd, 4nd Richmond, VA, USA. 1st Barcelona, Spain
Contact Emails 1st sryu2@vcu.edu, 2nd danielle.noreika@vcuhealth.org, 3rd malisa.dang@vcuhealth.org, 4nd egidio.delfabbro@vcuhealth.org

Abstract

The VoicingHan project is an avatar storytelling platform designed for patients with advanced cancer receiving palliative care at Virginia Commonwealth University's Massey Cancer Center. A Korean concept, "Han" reflects a paradoxical state of consciousness combining an extreme state of grief with a great hope for overcoming a seemingly impossible situation. We situate Han in a special and holistic cognition found among patients in the palliative care program who confront the critical issue of mortality, and the human dilemma in connecting our physical and spiritual domains. VoicingHan supports terminally ill patients by using oral storytelling as an artistic medium, facilitating patients' interactive performances while promoting autonomous creativity to support "patient activation" or "patient-centered care." In addition, the Avatar video, sound data of stories, and motion capture data will remain as an important patient and family legacy. This paper will discuss the VoicingHan project as an approach to dealing with mortality and potentially mitigating existential suffering for palliative care patients in the digital age.

Keywords

Avatar, Storytelling, Digital Immortality, Life-Review, Virtual Reality, Mixed Reality, Palliative Care, Thana technology, Embodiment, Korean Shamanism

Introduction

Patients with cancer face challenges that are multidimensional, extend beyond physical discomfort, and include psychological, spiritual, and existential distress. [1] Unaddressed domains of the patient's experience have a negative impact on their quality of life. [2]

The Palliative care (PC) teams often use a combination of pharmacological and non-pharmacological interventions to mitigate the high symptom burden and distress experienced by patients. [3][4][5] Our proposed study, VoicingHan, will use a dynamic, artistic medium, which facilitates patients' interactive, storytelling performance using avatars. The avatar platform will facilitate life review, an intervention originally developed for elderly patients, and also incorporated into conceptual psychosocial models for patients with cancer. [6] The VoicingHan Project is designed for use for patients with advanced cancer receiving palliative care at Virginia Commonwealth University's Massey Cancer Center. We have named our intervention "VoicingHan," since we believe the Korean mind/emotion model "Han" best reflects our goal of joining contradictory state of grief with a great hope for overcoming a seemingly impossible situation. [7] We situate Han in a special and holistic cognition found among patients and staff members in the palliative care program who have to confront the critical issue of mortality, and the human dilemma in connecting physical and spiritual domains. Carla Sofka coined the term "thana technology" to describe the intersection between death and technology. [8] VoicingHan explores thana technology in palliative care setting, inspired by Han and various structures of Korean shaman ritual "Kut", shaping a healthy attitude and culture in dealing with mortality in the digital age.

Currently, VoicingHan includes avatars at four developmental stages: child, teenager, adult, and elder. The user will be able to choose any stage in life and customize elements such as gender, ethnicity, and outfits.

Each avatar has a mirrored body movement via a wireless motion capture device, and lip-synchronization of live speech. Upon IRB approval, Avatar life-review sessions with cancer patients will begin June 2019, in the VCU palliative care outpatient clinic. Our goals are to explore the feasibility of delivering an avatar-life-review to support patients with active cancer, to archive the collected digital data, and to share the experience with family members.

VoicingHan: Avatar Life-review in Palliative care

Mortality is a recurrent topic in the hospital setting where the issue of life and death is faced by patients and their medical providers every day. A particularly cogent population to discuss "mortality" are patients receiving palliative care, where a fundamental inquiry of existential questions often occurs throughout their care. PC underscores the need to support patients in coping with the many facets of a life-limiting illness and intends to improve quality of life by relieving physical and emotional pain and by offering spiritual care and guidance. PC treats death as a life process and seeks to support patients through the difficult and uncertain process of transition [9]. Life reviews

have been used in PC to help individuals integrate memories into a meaningful whole, providing a balanced view of the past, present and future. Life review is also an evaluative process, enabling participants to examine how memories contribute to the meaning of their life. [10] Life review has demonstrated improvements in cancer survivors treated with curative intent, and in patients at the end of life. [11][12]

Funded by the VCU Massey Cancer Center, we are working on the VoicingHan project: an avatar life-review platform designed for use by patients with advanced cancer. Although the technology is not new, the incorporation of avatars into patient care is relatively recent, and to our knowledge no studies have included oncology or palliative care patients. VoicingHan is designed to promote creative expression, which may serve as a vehicle for patients with a life limiting illness in finding purpose and creating a sense of meaning. [13] By integrating art and technology into a storytelling, life review platform, and engaging physical, psychological and spiritual domains we anticipate our patients will be better supported in contemplating their own mortality.

VoicingHan supports terminally ill patients by using oral storytelling as an artistic medium, and facilitating patient's interactive performance while promoting autonomous creativity to encourage "patient activation" or "patient-centered care." After the project is completed, the Avatar video, sound data of stories, and motion capture data remain as an important patient and family legacy.

Avatar between Mortal and Immortal Body

The VoicingHan project creates an interactive avatar that simultaneously mirrors patients telling their stories as they are acted out in real time. The avatar mirrors the user's gestures using a wireless motion capture device and lip-syncs with the user's voice via microphone input. This feature gives an illusion that the avatar is the speaker, allowing users to observe their own stories as they are telling them, thereby providing a safe distance from the story and encouraging deeper reflection and memory retrieval. The users are able to create stories which may be difficult to express in daily interactions and conversation.

Patients will select avatars from different age groups, genders, and ethnicity during their sessions, allowing them to retrieve specific, positive memories of different lifetime periods and facilitating a more candid autobiographical memory. Each avatar has two design options: one with plain clothes (shirt and pants), and the other with delicate fashion and accessories. Each avatar has 4 ethnicity choices: African, Asian, Hispanic and Caucasian, and simple making variation of material colors. This allows 64 options of avatar choice the participants can make for their life story. Minimalistic aesthetic of avatar design stimulates the participants' imagination and playfulness to relate virtual body with significant ones in their life stories. In this playful engagement, users act out representations of themselves, significant others (family members, friends, etc.), or fictional characters, shaping and reflecting their life story in a personal and engaging way.

Based on each patient's preferences, VoicingHan provides some bucket list-environments such as beach, mountain, European attractions, and also everyday settings including a living room, and an empty space, to perform their chosen avatar.

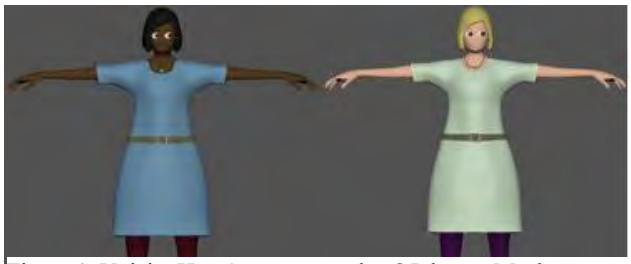


Figure 1. VoicingHan Avatar examples ©Johanna Meehan

In this drama of performing the avatar, the patients can experience their life stories as "thick" documentation, developing new perspectives and revealing deep memory and feeling. These unique histories will help patients better communicate with their family, caregivers and friends in a creative, engaging format that can be viewed both in live performance and as recordings.

The avatar as digital body is, in fact, free from illness. It is non-biological, computational, and in a way, "immortal." However, the participant's life story consistently makes the avatar "mortal", especially in the palliative care setting where the participants are facing the issue of life's end. Ironically, the avatar obtains mortality while it is being humanized through personal storytelling. The VoicingHan project lets patients, families and caregivers question what it means to be mortal, in the process of searching for humanity.

Han in the context of Mortality

As previously stated, the Korean concept of Han is a paradoxical state of consciousness that combines an extreme state of grief with a great hope and desire for overcoming a situation that seems almost impossible. Han is known as the most important character of Korean mind and emotion. [14] One of the most important implications of Han is its perspective on mourning and the process related to tragic experience. The ritual of disentangling and releasing Han can be seen as a new way of mourning, applied into its therapeutic process. [15] The process of releasing Han is a celebration of one's tragedy. Even in the face of tragedy, the Korean people show eternal optimism. This is the power and beauty of Han. The process of crying and laughing in recognition of Han is not a passive aspect of reaction but rather a powerful aspect of healing self. Han is a powerful

driving force to activate the process of releasing itself, shown in transformative consciousness "Han Transformation" happening, to the actual shamanic performance of "Kut". It is an optimistic sense of overcoming difficulties, in acknowledging pains.

What the king of the Cho-Sun dynasty of Korea feared most was to see people looking up to the sky with sighs or tears, since this is the sign of Han. [16] Han calls forth revolutions; it makes people look to the sky with fearsome desire for change. Han is connected with paradoxical attitude of being hopeful, even in the most frustrated situations. This distinguishes Han from anxiety, fear or depression. It is the critical state of reflection, where opposite states coexist with transformative power.

The VoicingHan project promotes the Han attitude, asking the participants to look up. The participants need to tell their story facing their avatar on the screen. They tell their story in an active mode of watching their digital reflection with active state of moving body, keeping the same eye level with positive sense about their story being told. When the patients talk about illness and other painful experiences, they have tendency to find their gaze point on the floor, which locks the storyteller's body posture in a down looking position, possibly increasing anxiety, demoralization and frustration. VoicingHan avatar helps the patient user tell their story of lived experiences, facing, witnessing, performing and accompanying their digital reflections.

In an ontological sense, Han can be understood as an infinite dream for finite being. [17] Han exits in an immortal dream of mortal human being, demonstrating a paradoxical context of the eternal dream of human existence. The way to deal with Han is a ritual of accepting, grieving, recognizing it, and sharing it with family members and community. Han is the state that cannot be resolved, but rather released and acknowledged. VoicingHan is contemporary ritual mediated by technology, in the mode of grieving, mourning, accepting, sharing and honoring our Han through storytelling.

Liminal zone between the Living and the Dead

In the Korean tradition, death means "return" to the place where the soul of living was originated, unlike western tradition where death is conceived as "passing away". [18] The life path from living to dead doesn't happen in newtonic timeline and is not linear nor hierarchical, as a Mobius strip.

The world of the living and the deceased in the Korean culture cross over frequently. There are constant shifts of boundaries that supports a unique way to deal with mortality. The dead person is considered to cross over the river, to travel to the zone of dead. However, it is possible to travel back to the zone of living, for example, in Pari-Gongju (princess) mythology. Pari princess was able to come back to the living zone, to save her father's life. In fact, the Pari princess became the first ancestor of Korean shaman, with a special ability to cross over boundaries. [19]

In Korea, it is living reality to exist with spirits of the deceased, ancestors, gods and goddesses in contemporary daily lives. [20] Shaman doesn't travel somewhere else, instead, spirits are visiting her in the urban setting. Korean shaman ritual Kut includes a belief that god and spirit are active in the world. [21] It demonstrates the way to deal with mortality, in a dramatic interaction with spirits of the deceased, with laughter and tears in catharsis to bring forth a harmonious unity.

Kut becomes necessary when soul of the dead has Han, as this soul cannot return to original place until Han is released. [22] Shaman performs Kut to call the spirit to her body. The spirit of the dead person can be identified based on shaman's gestures, behaviors, and way of speech. Shaman's speech and actions significantly resemble the dead person invited to the shaman's body. In turn, everyone believes the dead person has returned to reality and is with us again to make conversation possible. People acknowledge the spirit's presence with particular gestures of the hand and a bow. The shaman performs the spirit (of ancestors, gods, etc) with full emotional ability to talk, complain, dance, sing, cry or laugh. [23]

In VoicingHan, an avatar is activated by live speech and movement of the participant. The avatar body is performed by the participant with speech and behavior, sometimes via complete immersion, or dramatic acting, playing with diverse states of embodiment. A similar kind of engagement might happen to Shaman as well, sometimes possessed by spirit, sometimes acting and sometimes both. [24]

In VoicingHan, the avatar is constantly shifted into different identities by speech and behavior of different participants. The avatar body plays the same role as shaman's trans body in Kut, as it invites a person to act and tell a story. Although the avatar's appearance may not match the patient's, the speech, behavior, and stories determine the identity and spirit of the virtual body. VoicingHan records and archives all these data as "digital spirit."

Digital Spirit

In previous iteration of the VoicingElder project (avatar life-review for older adults) in 2016, we held an avatar video screening day in a public theater after the storytelling sessions with older adults. The participants enjoyed watching their own avatar performance as well as others'. Often, they were surprised by witnessing their own stories as avatar performances. The distanced setting brought a fresh perspective to stories told via avatar; some were surprised by their own words. Participants wanted DVD discs of their avatar video to watch again with friends and family members. [25]

In the VoicingHan project, all avatar storytelling performances will be screen-captured as movie files. The patients can record their stories using a diverse choice of avatars and their bucket list environments. The participants have the option to edit their video, with their choices of video motif, title, soundtrack, subtitles, etc. This editing process contributes to the patient's self-reflection and the final video may become an important and meaningful family legacy. The avatar video may become an important source of communication and relationship building, as well as a way to preserve elements of family legacy for patients in the palliative care setting. The continuing bonds with the deceased by recording and reviewing the avatar video may allow new meaning reconstruction. It supports continuation of the relationship between the bereaved and the deceased, helping the bereaved to move forward and restructure their lives. [26]

During VoicingElder project in 2016, the aspect of communal ritual was evident after each life-review session. Often, the audience surrounded the storyteller and dynamically expressed their impression, empathy, encouragements, and similar experiences, using warm body language such as hugs and hand-holding. [25] This occurred consistently and involved everyone, including observers, mediator, residents and staff members. Whereas VoicingElder was in a public theater setting, VoicingHan happens in private. However, the patient participant can share their Han, anxiety, fears, as well as life memories with family members, friends and staff, through the avatar video and live avatar storytelling. Patients in palliative care often do not want to record themselves in a video, as their appearance may have altered substantially due to the cancer or the intense therapy process. The avatar video provides some anonymity and is a perfect medium to express difficult life stories and share the meaning of their lived experience.

Figure 2. VoicingElder project in a public theater setting at senior center ©Brianna Ondris.

Using a wireless motion capture device, the participant's motion data will be captured as a digital spirit of each patient, as well as sound files of stories. The archived digital spirit can be reprocessed in real time simulation by using an avatar body, despite absence of the agency after the participant's death. The simulation of behaviors and speech

Figure 3. VoicingHan project in a private setting at family room, Inpatient Unit, Palliative Care ©Holly Ashton.

resembles the Shaman's performing the spirit in Kut, inviting the deceased to her body. Han from the spirits of the deceased who passed in untimely and unexpected ways, need to be released, requiring empathetic understandings of family members and the community all together.

Research Design

Currently VoicingHan avatar platform version 1 was completed with 64 options of avatars and 5 environments, with partial or full body connection with virtual body. The partial body connection (upper body only or arms) is still powerful for the seriously ill patients on wheelchair or bed, allowing them to still play with avatar, using his/her body. We are currently implementing a sentimental responsive algorithm (developed by Prof. Faralli, Univ of Rome Unitelma Sapienza, Italy), to promote emotional release and catharsis in the patient's life storytelling, and also to obtain the flow of sentimental data of the patient´s storytelling. The regular sessions of study will start from June 2019, upon IRB approval.

The objective of VoicingHan project is to explore the therapeutic benefits and determine the feasibility of delivering an avatar life review platform for patients with active cancer. During the Avatar life-review sessions, patients are prompted with structured life-review questions conducted by a facilitator (either Palliative care physician, artist or psychologist) to help engage in reflection and meaningful life stories. The Avatar is intended to promote creative expression, playful engagement, improve mood, and reduce anxiety. The Avatar provides a safe distance for users to freely explore their storytelling, which may otherwise be difficult to express. VoicingHan avatar platform provides an illusion that the Avatar is speaking, thus allowing users to observe their stories as they are telling them; this has the potential to encourage deeper reflection, playful engagement and memory retrieval.

This study will use a one-group observational design to establish feasibility and acceptability of Avatar therapy intervention in patients with advanced cancer. We will use both qualitative and quantitative research methods to further

evaluate this modality of patient care. It includes ethnographic methodology that includes semi-structured interviews and non-participant observation. The interviews will be guided and will take place directly after the VoicingHan session, to qualitatively review the patient's experiences.

Upon IRB and contract completion, we will recruit patients to participate in the Avatar life-review intervention. This feasibility study proposes to enroll 12-patients receiving outpatient palliative care. Eligible participants will undergo an unknown number of sessions depending on acceptability of the intervention to subjects and the capacity of the team to provide the intervention.

Feasibility and acceptability will be explored through semi-structured interviews and patient's satisfaction with the study using Likert scale. Following the Avatar session, a member of the research team will conduct a face-to-face interview that will consist of open-ended questions to elicit detailed responses. Questions will seek to understand participants' attitude about the intervention, perceived effectiveness or lack of it, barriers to engagement, and challenges faced throughout the session.

The outcome measures will include recruitment rate; number of subjects eligible; resources (e.g. cost), time scale; acceptability of the intervention; any barriers to data collection e.g. number of forms and questions patients are able to answer per session; response rates, adherence; the number of intervention sessions per patient and their perspective on recommending the study to others. Process issues including the potential for disruption of clinic flow, size of room constraints that may overwhelm patient or inhibit the patient narrative. The equipment acceptability and ease of use to patients (they will be attached to sensors) and sufficiently broad selection of avatars available for patients, based on age, ethnicity, etc. Patient demographic data will be recorded at the time of enrollment session.

Patient Selection

Inclusion Criteria

This study will enroll adults diagnosed with metastatic or locally recurrent cancer. Individuals will be recruited from Massey Cancer Center (MCC), a national cancer institute. MCC treats hundreds of patients a year providing an ample sample to enroll study subjects.

- Participants must be 18 years of age or older
- Patient participants must have metastatic or locally recurrent cancer
- Participants must be able to understand English
- Participants must be ambulatory
- Ability and willingness to sign a written informed consent document

Exclusion Criteria

- Participants who cannot understand written or spoken English
- Any prisoner and/or other vulnerable persons as defined by NIH (45 CFR 46, Subpart B, C and D).

Study Withdrawal Procedures

A patient may decide to withdraw from the study at any time. Participating is voluntary. However, a patient may be removed from the intervention for one of the following criteria: (1) unwillingness or inability of the patient to comply with the protocol requirements, (2) disease progression that prevents further administration of intervention, (3) general or specific changes in the patient's conditions that renders the patient unacceptable for further treatment in the judgment of the investigator.

Intervention Plan

After obtaining informed consent, VoicingHan will screen-capture patient's storytelling performances as video files. Immediately before the first intervention, patients will complete an array of self-reported questionnaires to assess physical, spiritual, and psychological well-being and elicit relevant demographic and medical information. The assessments include the ESAS, FACIT-Sp subscale, and EORTC PAL 15. Subsequent administration of these questionnaires spaced 2-4 weeks apart will occur before each avatar session (pre-intervention). This will determine if intensity of the patient's symptoms have changed over the course of the intervention. Following completion of the Avatar session, a member of the research team will conduct a semi-structured, open-ended interview to assess patients' perception of intervention components and identify possible factors influencing intervention feasibility and any technical barriers.

Each session is expected to last 20-60 minutes depending on the engagement level of each participant. During the intervention, a trained facilitator will ask open-ended questions to help engage patients in reflection and storytelling. Patients will follow-up with their scheduled appointment in 2-4 weeks for an unknown number of intervention sessions. Based on previous interventions of non-pharmacological therapy to improve spiritual and psychological well-being in patients with cancer, we anticipate sessions will be conducted every 2-4 weeks over a 2-month period. [27] A final administration of the questionnaires will be given approximately one month (± one week) after a patient's last Avatar-Therapy session to evaluate whether any sustained impact occurred. A time frame of one month was chosen to prevent hampering of recall and to accommodate conflicts patients may encounter when scheduling follow up appointments.

Interviews with the patient: Semi-structured interviews with the patient will be conducted to obtain a more in-depth examination of their experiences using VoicingHan. The

purpose of the semi-structured interview is to obtain data with rich explanations of the participant experience while using the virtual body and storytelling.

Interviews with family members: Semi-structured, in-depth interviews with family members of the participants will be conducted to obtain a more in-depth examination of their experiences watching their loved one share life stories using VoicingHan.

Non-Participant Observation: The purpose of the non-participant observation is to develop a holistic understanding of the process objectively and accurately as possible by documenting the emotions and behaviors of the participant while they are participating in VoicingHan life review. The observation will be conducted by a trained observer (i.e., researcher) and will use both structured (checklists) and unstructured (open observation) observations of verbal and nonverbal expression of feelings, frequency of behaviors and engagement in specific activities. In this context, non-participant observation will allow us to triangulate, or check definitions of terms that participants use in interviews.

Survey: Brief surveys will be given to all participants upon completion of their VoicingHan life review session in order to assess impact on quality of life, satisfaction with VoicingHan experience and recommendations for improvement to the experience. Quality of life will be assessed using the physical and mental health component scores of the EORTC PAL-15, and the FACIT-spiritual subscale.

Conclusion

Contemporary society facilitates online memorials in social media like facebook, and because society no longer has a taboo against the open discussion of death, mourning and grieving, may be mediated by technology, in private and public settings. However, it is important to take into account how the deceased will be memorialized and remembered in the digital age, and how this may impact patients with a life –limiting illness and their families. [28][29] It could reform our relationship with death, memory and mortality, and bring forth new discussion of humanity transcendence.

New technology in the digital age delivers a great opportunity for exploring possibilities of digital immortality as archived personal data, importantly, considering how to facilitate digital aids for personal and communal trespassing rituals. Kut could provide us with various structures supporting the VoicingHan avatar storytelling project, and can be a great model of VR, MR, AR and XR that supports multiple realities coexisting with harmonious unity. VoicingHan offers a cross reality setting where virtual/actual body, mortal/ immortal body coexist and cross-over, with creative tension of self-actualization. [30]

Acknowledgements

We would like to express our deep gratitude to Dean Shawn Brixey, Dr. John Nestler, and Dr. Sarah Cunningham, for making VoicingHan project possible between School of the Art and Medicine at VCU. VoicingHan project has been funded by VCU Massey Cancer Center, since June 2018.

References

[1] Coelho, Adriana, Vitor Parola, Daniela Cardoso, Miguel Escobar Bravo, and Joao Apostolo. 2017. "Use of Non-Pharmacological Interventions for Comforting Patients in Palliative Care: A Scoping Review." *JBI Database of Systematic Reviews and Implementation Reports* 15 (7): 1867–1904. https://doi.org/10.11124/JBISRIR-2016-003204.

[2] Zabora, James, Karlynn Brintzenhofeszoc, Barbara Curbow, Craig Hooker, and Steven Piantadosi. 2001. "The Prevalence of Psychological Distress by Cancer Site." *Psycho-Oncology* 10 (1): 19–28. https://doi.org/10.1002/1099-1611(200101/02)10:1<19::AID-PON501>3.0.CO;2-6.

[3] Lopez, Gabriel, M Kay Garcia, Wenli Liu, Michael Spano, Susan Underwood, Seyedeh S Dibaj, Yisheng Li, et al. "Journal of Cancer Outpatient Acupuncture Effects on Patient Self-Reported Symptoms in Oncology Care : A Retrospective Analysis" 9 (2018). https://doi.org/10.7150/jca.26527.

[4] Fabbro, Egidio Del, Shalini Dalal, and Eduardo Bruera. 2006. "Symptom Control in Palliative Care--Part III: Dyspnea and Delirium." Journal of Palliative Medicine 9 (2): 422–36. https://doi.org/10.1089/jpm.2006.9.422.

[5] Singer, Adam E, Joy R Goebel, Yan S Kim, Sydney M Dy, Sangeeta C Ahluwalia, Megan Clifford, Elizabeth Dzeng, et al. 2016. "Populations and Interventions for Palliative and End-of-Life Care: A Systematic Review." Journal of Palliative Medicine 19 (9): 995–1008. https://doi.org/10.1089/jpm.2015.0367.

[6] Holland, Jimmie, Shannon Poppito, Christian Nelson, Talia Weiss, Mindy Greenstein, Anne Martin, Phoutthasone Thirakul, and Andrew Roth. 2009. "Reappraisal in the Eighth Life Cycle Stage: A Theoretical Psychoeducational Intervention in Elderly Patients with Cancer." Palliative & Supportive Care 7 (3): 271–79. https://doi.org/10.1017/S1478951509990198.

[7] Ryu, Semi, Kinetic Imaging, Virginia Commonwealth, and Knowledge Society. 2017. "Avatar Life-Review : Virtual Bodies in a Dramatic Paradox" 7 (2): 5–8. https://doi.org/10.1386/vcr.7.2.121.

[8] Carla Sofka, Carla, "Social support 'Internetworks,' Caskets for sale, and more: Thanatology and the information superhighway." Death Studies 21 (1997): 553–74.

[9] Michael Brennan and Michael John Brennan, A-Z of Death and Dying : Social, Medical, and Cultural Aspects (ProQuest Ebook, 2014), 362-364. ABC-CLIO, LLC.

[10] Haber, David. 2006. "Life Review: Implementation, Theory, Research, and Therapy." International Journal of Aging & Human Development 63 (2): 153–71. https://doi.org/10.2190/DA9G-RHK5-N9JP-T6CC.

[11] Spek, N van der, J Vos, C F van Uden-Kraan, W Breitbart, P Cuijpers, K Holtmaat, B I Witte, R A E M Tollenaar, and I M Verdonck-de Leeuw. 2017. "Efficacy of Meaning-Centered

Group Psychotherapy for Cancer Survivors: A Randomized Controlled Trial." Psychological Medicine 47 (11): 1990–2001. https://doi.org/10.1017/S0033291717000447.
[12] Chochinov, Harvey Max, Linda J Kristjanson, William Breitbart, Susan McClement, Thomas F Hack, Tom Hassard, and Mike Harlos. 2011. "Effect of Dignity Therapy on Distress and End-of-Life Experience in Terminally Ill Patients: A Randomised Controlled Trial." The Lancet. Oncology 12 (8): 753–62. https://doi.org/10.1016/S1470-2045(11)70153-X.
[13] Stuckey, Heather L., and Jeremy Nobel. 2010. "The Connection between Art, Healing, and Public Health: A Review of Current Literature." American Journal of Public Health 100 (2): 254–63. https://doi.org/10.2105/AJPH.2008.156497.
[14] Min Han and Seong-Yeol Han, "Cultural Psychology of Shin-Myeong," Korean Journal of Psychology, vol. 26, no. 1 (2007), 85.
[15] Kui-Hee Song, Beyond Multiculturalism in Social Work Practice, University Press of America, 2004 -P.209
(Kim& Choi, 1995?).
[16] Sang-Yil Kim, Hanism (Seoul: Onuri Press, 1992), 228–230
[17] I-Doo Chun, The structure of Han, Literature& Intellect Publisher, Seoul, Korea, 1993) p.44, p. 72
[18] Salpuri-Chum, A Korean Dance for Expelling Evil Spirits: A Psychoanalytic Interpretation of its Artistic Characteristics, Eun-Joo Lee, Yong-Shin Kim, Rowman & Littlefield
[19] Daniel Kister, Korean Shamanist Ritual: Symbols and Dramas of Transformation (Jain Pub Co, 2006), 54.
[20] Daniel Kister, Korean Shamanist Ritual: Symbols and Dramas of Transformation (Jain Pub Co, 2006)
[21] Daniel Kister, Korean Shamanist Ritual: Symbols and Dramas of Transformation (Jain Pub Co, 2006), 115
[22] Salpuri-Chum, A Korean Dance for Expelling Evil Spirits: A Psychoanalytic Interpretation of its Artistic Characteristics, Eun-Joo Lee, Yong-Shin Kim, Rowman & Littlefield. P.28
[23] Daniel Kister, Korean Shamanist Ritual: Symbols and Dramas of Transformation (Jain Pub Co, 2006), 98
[24] Daniel Kister, Korean Shamanist Ritual: Symbols and Dramas of Transformation (Jain Pub Co, 2006), 105.
[25] Semi Ryu, "Avatar Life-Review: Seniors Reminiscing Through Virtual Bodies" 493 © Springer International Publishing AG 2017 C. Stephanidis (Ed.): HCII Posters 2017, Part I, CCIS 713, pp. 488–496, 2017. DOI: 10.1007/978-3-319-58750-9_68, 492-493
[26] Debra J. Bassett, Who Wants to Live Forever? Living, Dying and Grieving in Our Digital Society, Soc. Sci. 2015, 4, 1131; doi:10.3390/socsci4041127
[27] Breitbart W, Rosenfeld B, Gibson C, et al. Meaning-centered group psychotherapy for patients with advanced cancer: A pilot randomized controlled trial. Psychooncology. 2010;19:21–28.
[28] Elaine Kasket. "Continuing bonds in the age of social networking: Facebook as a modern-day medium." Bereavement Care 31 (2012): 62–69
[29] BBC, http://www.bbc.com/future/story/20150122-the-secret-to-immortality
[30] Semi Ryu "Avatar life-review: Virtual bodies in a dramatic paradox" Journal "Virtual Creativity" Volume 7 Number 2 doi 10.13869/vcr.7.2.121_1m, 122

Author Biography

Semi Ryu is a tenured associate professor in the Department of Kinetic Imaging, VCU Arts, and a joint appointed associate professor in the Department of Internal Medicine, VCU School of Medicine. Ryu earned a BFA from the Korean National University of Arts, MFA from Carnegie Mellon University and is finishing up her PhD in Doctoral program of Information and Knowledge Society, UOC, Barcelona.
Since 2002, Ryu has been working on virtual puppetry based on Korean ritual and oral storytelling. Her 3D animations, interactive artworks and papers have been presented at International venues of screenings, exhibitions, performances and publications in more than 20 countries, including Chelsea Art Museum (New York), Transmediale (Berlin), Videobrasil (Sao Paulo), Antonin Artaud space (London), ISEA, SIGGRAPH, the journal article "Ritualizing Interactive Media, from Motivation to Activation" (Technoetic Arts, Intellect Ltd), the book chapter "Sensing without Sensing"-The Point of Being (Cambridge Scholars), the journal article "Virtual Bodies in a Dramatic Paradox" (Virtual Creativity, Intellect Ltd), etc. Supported by VCU Presidential Research Quest Fund since 2014, Ryu has been working on Avatar projects for community engagement. Her transdiciplinary project "VoicingElder: Avatar Life-Review for Older Adults" has been presented in international venues of art, gerontology, drama therapy, and HCI. Ryu is the recipient of VCU Arts faculty award of distinguished achievement in Research, and had her TEDxRVA talk, "Virtual Reality for Han" at 2017. In 2018, She received "Massey cancer center" grant to support her current project VoicingHan: avatar life-review for palliative care, in collaboration with Dr. Del Fabbro and Dr. Noreika.

Dr. Danielle Noreika is the Medical Director of Palliative Services and an Associate Professor of Medicine in Virginia Commonwealth University's Division of Hematology, Oncology and Palliative Care. Dr. Noreika also serves as the Program Director for the Hospice and Palliative Medicine Fellowship. She received her medical degree from Drexel University College of Medicine and completed her Residency in Internal Medicine at the Naval Medical Center in Portsmouth, Virginia. After completing residency she remained active duty in the US Navy prior to honorable discharge after almost 10 years of service in order to pursue fellowship training in Hospice and Palliative Medicine at VCU in 2009. Dr. Noreika has published peer-reviewed articles as well as book chapters on palliative care, quality of life, and symptom management. Her areas of focus are applying technology to palliative care (telemedicine, Project ECHO, and the Avatar project) and education of the future palliative physician workforce.

Approaching Sustainability: Generative Art, Complexity, and Systems Thinking

Alexandra Dulic, Miles Thorogood,
University of British Columbia
Kelowna, British Columbia, Candada
aleksandra.dulic@ubc.ca, miles.thorogood@ubc.ca

Abstract

Generative art provides new opportunities for creating sustainable and resilient communities. We discuss three key elements important for the relationship between generative art and sustainability: Dynamic composition, Interdisciplinary development, and Community. Each of these elements is analyzed in relationship to exemplary artwork. We conclude with a discussion of the artwork *Journey of a Pod* that demonstrates how these three elements play a key role in the artwork development.

Keywords

Generative Art, Sustainability, Dynamic Composition, Resilient Communities

Introduction

Generative art and the fields of sustainability and resilient communities have the opportunity to become a reciprocal relationship of exchange, engagement and mutual benefit. Through collaboration and learning with communities about different ways of being that look at sustainability, generative art practitioners connect to new meaningful ideas that contribute to the algorithms and aesthetic details used in their work. Concurrently, communities and those individuals have access to the state of the art techniques and ways of understanding the world from generative art perspectives that bring value through the development of new media tools and new modes of public engagement.

Social change happens within a place we inhabit, incrementally, as things transform through practice. Social shifts evolve in the way we organize and relate to one another to build communities. Change processes that affect our collective and individual behaviours and worldviews have many influences. Some are explicit, and some are subtle. On a basic level, changes in our environmental conditions affect our behaviour. The question is how? How can we build resilient communities? The way that we see the world is shaped by our assumptions and metaphors we use to reconcile our experience. How does generative art add to themes of sustainable human living and reciprocity with nature to add to the transformative processes we need to engage in response to environmental crises we created?

As an artistic practice, generative art occupies a unique space in fine art. The reception of the artwork with fixed form and content shifts when contexts and audiences change. In a generative artwork, the form and content continuously change. This inherent change has the potential to directly respond to different audiences and contexts in which the work is received. This is an important element that renders generative artwork categorically different than its non-generative relatives. The flexibility of presentation and consequently reception enables the artwork to be encoded in such a way to embody the space-time and context of the communities in which the work functions to provide the reflective space for building resilient sustainability practices. Generative art often surprises and some artists go as far as saying that a generative artwork is not successful unless this is the case [12, 14] and reveals new ways of seeing the day to day reality drawing from complex threads that can be weaved together in a coherent whole. This element of surprise indicates dynamic composition. It represents a shift in the nature of artwork-artist - audience relationship and creates new types of interactions between these four elements.

If we consider generative artwork to be a distinct type of media, we can follow in asking what is their message? What themes, what ideas, are built into generative art because of its very nature? How does generative art produce spaces for reflection, re-imagination, and grasping of the complexity of our place and the world? Can it reveal new relationships between seemingly disparate entities? Does it allow participants to experience new avenues for the understanding of socio-environmental relationships? How can dynamics in form and content contribute to the process of making meaning? We aim to elucidate what it is specifically about generative art that adds to sustainability discourse.

The dynamics of form and content within generative art enables meaning making that reflects our world, in which we are experiencing rapid changes in climate, technology, politics, and social norms. In representing the non-static and rapidly shifting nature of our world, we see generative art as opening new avenues for exploring sustainable socio-environmental living practices, responsible and reciprocal cohabitation of this planet. This dynamics in form and content provides fruitful grounds for the weaving of multiple voices and perspectiveshuman and non-human. An encounter with multiplicity facilitates grasping and reflection on the complexity embedded in our current socio-environmental reality, opening new opportunities for integration of sensual experiences and ra-

tional thought. The analysis of media such as soundscape recordings, landscape documentation, and community voices as well as the design of algorithms within generative art systems can reveal relational characteristics within a given place and time. The algorithms that enable modelling of natural and community relations link media anthropology and big data with artistic expression that can make the knowledge embedded in these socio-environmental media accessible.

Doran et al. [4] propose a framework for generative art that focuses on form and mechanisms characteristics to be able to encompass its various complex forms. This framework, inclusive of the different type of media, time and physical manifestations, is structured within four primary elements: entities, processes, environmental interactions, and sensory outcomes each one focusing on fundamental aspects of the generative art form. Entities represent the smallest virtual or physical materials of the work, which are formed by various processes, digital, physical, or mechanical, into a work of art. Environmental interactions enable inputs and responses from the surroundings, while sensory outcomes refer to the experiential aspects of the artwork. The focus on formal structure within generative art allows Doran et al. to draw common features across a wide variety of generative systems including computational, physical, kinetic and virtual systems from the past, present, and future.

Conceptions of sustainability are primarily about change and involve imagining new ways that we can live and relate to each other and our environment. Kagan [10]writes about cultures of sustainability that reach across all areas of our being, knowing and doing. The change process entails identifying and developing cultural narratives of sustainability that are energizing and motivating [16] narratives that nurture human energy and promote activities that positively influence environmental and human health. Without new stories and visions of a relationship among people and the environment we risk failure in achieving sustainability[13]. Given the cultural roots of this crisis, its resolution requires new and renewed creative cultural approaches. In its role as catalyst, art and culture can significantly contribute to social transformation for a better quality of life [10].

From the perspective of sustainability practice, generative art offers tools for integrating various processes and media elements into a coherent whole. The dynamic processes that respond to the environment and each another in a correlated and co-dependent way, expressing equilibrium, is the most powerful narrative device that we aim to highlight in this discussion. The multiplicity of response and the possibility for exploration of a variety of relationships embedded in the dynamic art framework is a powerful instrument for exploring complexities embedded in the cultures of sustainability. However, given that the popularity of this term is rooted in the notions of techno-digital cultures its critique from the perspective of sustainable community practices lays in its preoccupation with pure form and coded abstractions removed from the body, place, stories, and community. What we aim to focus on locating the community context, space and time for generative art.

Generative work is in a constant process of self-reinvention, or what Maturana & Varela [11] call *autopoiesis*. The continual shift of the work enables reflection as it changes, and new ideas about the meaning emerge. The constant re-exploration of the media materials within the work resonate with a culture of sustainability, where the set of social practices contribute to the community regeneration. Sustainable living practices require attention to relationships that are in flux, events that need re-imagining, and conditions that demand multiple responses and weaving of different perspectives, that benefits from visualizing the contradictions, competing interests and common ideas. As we address some facets of sustainability, we reflect on our practices in light of diverse points of view. Through the experience of generative art, perhaps we can learn what it means to re-imagine our actions and relationships in a continuous, critical manner.

The re-evaluation brings us to another aspect of the relationship between generative art and sustainability: the importance of interdisciplinary work. Generative art is almost always an interdisciplinary endeavor. Within the compositional form, such art must carry on complexity, variety, nuance and holistic representations that directly speak to the sensual, while developing new codes and models adopted from science and technology as part of their process. On the content level it bridges the sensual experience with traditional and scientific knowledge critical for understanding our environment. Galanter [6] argues that "generative art is uniquely positioned to negotiate between science and the humanities." He defines generative art in terms of complexity theory, a branch of study that deals with "how relationships between parts give rise to the collective behaviors of a system, and how the system interacts and forms relationships with its environment." He argues that, while science traditionally holds a modernist viewpoint and the humanities have tended towards post-modernism and an organizing worldview, complexity or *complexism* as a worldview is the synthesis of modern and postmodern modes of thinking indicating critical need to develop new language, metaphors and worldviews that can support us in addressing the environmental challenges we created. Complexity challenges the orthodoxies of both modernism and postmodernism and, in doing so, opens up a third space for scientific modelling, humanities, media anthropology and fine art to engage with each other through the world that they represent and make accessible for community reflection.

Generative art encourages interdisciplinary engagement, not only by often bringing people from different disciplines together to work on a project. The art itself opens spaces for interdisciplinary dialogue because of its dynamic and uncertain nature. By drawing on many ways of knowing in the creative process, the result often opens up different entry points to the work itself, thus encouraging a disciplinarily-diverse audience to engage with it. These types of collaborations and dialogical spaces are essential resources for addressing sustainability. Just as generative art is complex practice, transformation toward sustainable, reciprocal and responsible relationships with the natural world that supports us is a complex problem. It has many interconnecting and often competing facets. The problem can and should be understood in many different ways. Understanding the problem in this multiplicity of ways means that it is critical to have interdisciplinary

perspectives when attempting to address sustainability and other complex problems. Generative art can represent the complexity and fluidity of the problem, open spaces for interdisciplinary dialogue and indicate synergies across diverse viewpoints.

Interdisciplinarity is recognizing that there are many simultaneous, complementary, and contradictory worldviews and that each of these lenses is both valuable and incomplete. These multiple viewpoints and disciplinary perspectives give rise to further diversity of values, beliefs, and needs. It informs how we understand our world in the context of the whole, to diverse communities of practice as well as how we interact with each other (and other species). Interdisciplinary art through creativity and sensual experiences provide a ground for meeting and grasping those diverse worldviews simultaneously, which can inform our place in the world and enable us to position our actions cognizant and compassionate for the diversity that surrounds us.

Interdisciplinarity is an essential aspect of approaching sustainability, but the term still implies a relationship between individuals with different backgrounds. However, the sustainability of individuals despite what "green" industries attempt to espouse makes little sense in isolation. Civilizations and species live and die as groups, and so the formation of "cultures of sustainability" [10] are essential in any formulation of sustainable futures. Giddens's [8] structuration theory posits that agents (individual people) and structures (communities and organizations) interact in a recursive (complex) manner, with each affecting the other and neither agents nor structures dominating the relationship. From that perspective, the change process needs to address agents and structures, which can be represented through generative art. The distributed nature of this form binds individual experience to a larger community of practice and begins to create a social context for approaching the complex question of sustainability.

Community, along with interdisciplinarity and dynamism are critical components of the generative art form. We propose that they are not only essential to the form but that they also contribute to the natural fit between the generative art and the topic of sustainability. The sustainability that we address moves beyond simple material actions such as recycling or being energy conscious though these are essential components of such sustainability and towards a mindset, lifestyles and relationships that are reciprocal and responsible. We see sustainability as a holistic idea that is itself constantly shifting to accommodate new understandings of the mutual impacts between our surroundings and ourselves. In the remainder of this work, we explore the notion of dynamics, interdisciplinarity, and community and as we do so, we will position them concerning the notions of sustainability.

Dynamics

"Cultures of sustainability may inspire hope, but their strength is also their vulnerability. As soon as they crystallize into fixed states, closing their boundaries and fixing their borders, they risk losing their elasticity and porosity, down the path of *autopoiesis*. Cultures of sustainability are a matter of dynamic self-critical exploration. They require a continuous re-actualization of reflexive competencies. For this reason, they demand an artful practice of life." - Kagan, 2010 [9], a dynamics of becoming. The process-driven generative art also emerges through the constant state of becoming. Often interactive, generative work can provide conceptual framework to engage with the dynamic socio-environmental inputs, which act a endless source for varied artwork representations. When artwork is interactive the work moves from a single creator and a single viewer to being to directly responding to its environment and enabling a multifaceted conversation within given environment.

Welsby's [17] work *Tree Studies*, a single channel weather driven video installation, explores ideas of collaborating with nature as a process for art-making enabled by generative art. The installation view shows an image of a tree against the stormy winter sky. Recalling the cubist image with multiple points of view, Welsby shoots the tree from three different angles 20 degrees apart centering on the tree using multiple single frame exposure. The sound included people in the distance, voices of starling and raven, wind sounds, footsteps from nearby gravel pathway and a computer-simulated harmonics of the Aeolian harp. Wind sensors positioned at the roof of the gallery space provide the dynamic input from the outside world to work inside the gallery. The system translates data captured from the wind sensor to compositional decisions that coordinated frame rate, picture and sound components of the work. The display of the weather sensor capture information is as another element of the work.

The changes in weather captured by the sensor provide core compositional element that weaves the recorded media, providing the multiple renderings of the work. This work visualizes the dynamics of interactions and co-dependencies among people, nature, and technology. It works highlights the social collaboration with the dynamic natural phenomenon as a critical component of our survival. Changing flickering winter light and sweeping clouds that paint the scenery animates the bare tree that dominates the installation. This composition alludes to melancholic and somber feelings that reflect transitory nature of life.

In this example, the dynamics within the generative art system acts as narrative devices for meaning-making. Artistic technique and system have a purpose of illuminating the dynamic co-dependence on with our natural environment. As such it provides a link for thoughts and feelings in a coherent experience that engages the viewers in the processes of reflection on dynamic co-existence and interrelationship between people, technology and nature that sustain us. This interrelationship is at the base of art and sustainability practices pointing to the significance of sensual understanding of the human effect on the global changes in the earth's climate.

Interdisciplinarity

Sustainability as complex problem benefits from an interdisciplinary approach, which can extend the individual point of view and facilitate new ways of approaching problems that consider a full range of goals and targets instead of focusing on a narrow set of objectives. Complex, generative artwork can be thought of as one possible forum for rendering such concepts in their near-infinite dimensionality. The

work is necessarily interdisciplinary, often exploring the liminal spaces between and around fields. As a gathering point for people with diverse backgrounds, the processes behind the creation of elaborate generative artwork can provide valuable proving grounds for models of working across and between disciplines. Successful artwork created in this mode often requires that the work consists of an ongoing dialogue between the parties involved in its creation. Some of the most compelling works in this have come from deep collaborations between the diverse people involved in a given project.

Installations by Brigny et al. [2] *Reefs on the Edge*, 2012 and *InterANTARCTICA*, 2010 are and interdisciplinary artworks that experiment with scientific data, photography, video, sound, and tangible user interfaces to provide educational space for reflection on climate change challenges. These two works are examples of the use of interactive and generative processes in education surrounding climate change. Both installations use tangible user interfaces and generative processes to shape interaction that invites viewers to engage with scientific measurements of climate change effects through embodied, visceral and aesthetic experience. These strategies allow the message of the effects of rising sea surface temperatures on young corals and melting ice in Antarctica to be translated seamlessly across multiple media platforms, creating a perceptible experience that integrates full body. In both of these works, de Brigny works with a team of interdisciplinary professionals to bring the science are art together into an integrated interactive experience that engages an audience on an embodied, emotional and intellectual levels in the exploration of the challenging topic of natural degradation that unfolds because of climate change. These examples point to the importance of an interdisciplinary team approach in addressing complex problems that face humanity today.

Community

Place and communities shape sustainability, providing a way of moving from individual experience to community to societal change and back again in his formulation of structuration theory. Structuration theory emerged as a response to objectivism and subjectivism, as a synthesis of the two perspectives that acknowledges that the relationships between agents and structures are fluid and cyclical. Structures affect agents, which affect structures and so forth. In the context of sustainability, this provides a pathway from individual learning and action to community development to the forms of profound structural change that are necessary to address questions of sustainability.

Generative artwork *Becoming World* by Aleksandra Dulic and Kenneth Newby [5] explores the idea of community by bridging two key ideas: that of cultural and ecological health both images of diversity. This exploration of the community expands the multicultural fabric with complementary ecological characteristics of complexity, biodiversity, and variety in balance. This dynamic artwork imbues the Canadian ethnocultural diversity with an ecological perspective. *Becoming World* engages in reconciling the culture-nature divide through a composition process that merges the images of beauty within natural environments with the overconsumption and environmental degradation. *Becoming World* is a work of generative art that produces transforming images of the human body embedded or extended by Nature. A generative collage system composes from an extensive database of images of people, our actions and Nature.

Meaning, both broad and focused, is drawn out of the work by including, in the compositing process, layers of human portraiture and acts drawn from the diverse community characteristic of Canada. The natural images function to reorganize and enhance the body becoming skins and spaces making of each a merging of the human and the world we inhabit. As an experience, the work situates itself around the boundary between knowledge, grief, hope, and memory. People, their faces and bodies emerge and are torn apart by images of sustainable and unsustainable human activities. The work reflects a state in which we at once carry an image of the world within us while, at the same time, are subject to the changes wrought on our selves by the external forces of an enveloping world. In this way *Becoming World* attempts to show an interpenetration of the human with the world an interpenetration that might hopefully enter into a discourse on a transpersonal state of being conducive to a rethinking of our place in the world as continuous, cohabitant, participatory and fundamentally resonant with the world.

The image of a community emerges through the dynamic representations of human and nature. The continues, slow transformation from one superimposed image to another, shift the viewers' attention to the multiplicity of relationship that we carry on and create as species. The works represent hybrid culture between nature, people and their technologies using hybrid media and generative art techniques to evoke an emotional engagement with a place. The dynamic juxtaposition among the human body, body of nature and our actions that exhibit the careless approach to nature human and more than human slowly shifts viewer's attention to multiple relationships and points of view we inhabit at once. The moving image transforms so slowly that is almost imperceivable to enable the audience's spaces in-between the states critical for reflections.

Bringing the Threads Together

How does generative art communicate sustainability?

In an attempt to answer this question, we will describe our recent work *Journey of a Pod* [7] that brings Dynamics, Interdisciplinarity, and Community together. Presented at the Kelowna Art Gallery and curated by Laura Jane Ritchie, the work is the union of objects from the creek, digital media, and encoded environment that connects the audience with an ecological cycle and highlights a reciprocal relationship with the earth. In this interactive and immersive installation, the artists invite visitors to engage with the wandering of a seed pod within Okanagan creek systems. Expressed through the interplay of image, sound, and object, the cycle of seasons guides the journey.

This communal experience of passage through waterways is rooted in these artists' love for nature and represents the fundamental relationship between humans and the ecosystem. The experience opens the ephemeral aperture between the

Figure 1: *Journey of a Pod* Installation view

Figure 2: *Journey of a Pod* Installation view

tangible and intangible, earth and sky while balancing the female and male present in Mother Earth and Father Sky, fused as the pod. The metaphor of the pod, seeding of a partnership with nature, animates a pattern that connects living things in the environment [1].

Dynamics

The Journey of the Pod system is made up of different software for the audio spatialization, video mapping, and motor controllers. A conductor program coordinates these discrete modules and manages the timing and media selection. We encoded the conductor with a cyclic pattern that internally represents the four seasons. A timing parameter tuned to the installation requirements sets the duration of the cycle.

Installation

The installation of *Journey of a Pod* includes a 21' by 8' platform shaped to reflect the curve of a stream that tapers to a point at either end. Roughly two metric tons of river

Figure 3: *Journey of a Pod* Installation view

stones and gravel cover and surround the platform. Stones, sourced from the Okanagan, measure 1' in diameter and descend in size around the perimeter of the platform to flow into the exhibition space. Along one side of this sculptural form is a path that has a fluid shape following the curvature of the platform. On the other side, an area covered in gravel and stepping stones encourage the playful experience of rock hopping. The surface of the elevated platform is the central

Figure 4: *Journey of a Pod* Installation view

visual media scene. This space embraces 12 video channels mapped to different objects and artifacts created by the artists. The main video channel is a 6' circular projection surrounded by 12 medium sized river stones. The remaining channels are mapped to project to the inside of ceramic chalices created by the artists. These chalices are filled with salt to form the projection surface. Another video channel projects onto an

importantly shaped stone sitting outside the centre circle. The final channel projects onto a simple flat stone carving of the great father. Contrasting the great father at the opposite end of the platform is an urn depicting the female form to indicate the great mother.

Nine video channels project to the chalices that display moments of experience encountered along the creek system during the year. Examples of the videos included water over stones, balsamroot flowers in the breeze, and ice flows. The video clips range in duration from 10 seconds to 1 minute and are periodically switched with other videos from the same season by the conductor to produce a stochastic cycle that changes not to repeat a particular motif of experiences. The conductor synchronizes video with a generative audio sequencing and spatialization module. The audio module, developed in Super Collider, outputs to an array of six speakers spaced equidistantly along the gallery wall. A motif of water represents each season with corresponding sounds such as birds and insects, and voices from the community to emphasize the importance of water to the landscape and people.

At the point of transition between seasons, the core audio-visual composition explores concepts of varied human relationships with Nature:

Spring to summer: "Light dark" is a piece that includes male and female voices, images and sounds and of water, earth and rocks, to highlight the relationship created between opposing concepts in nature - calling attention to the foundation of the space between things.

Summer to autumn: Focusing on the partnership with nature, "Thank you for sharing" includes male and female voices, and images and sounds of an insect that emphasizes how in nature the environment and its creatures come together and share experiences and relationships that form the tapestry of the soul in this world.

Autumn to winter: "War" is a piece that stresses escalating destruction and domination over the natural environment, moving between the development of forests, water pollution, oil industry, to landscape desolation.

Winter to spring: "Time to move on" reflects how the situation human-caused environmental damage is a space providing opportunities to reintegrate with more positive ways of coexisting nature.

Interdisciplinarity

Journey of a Pod is a part of a larger project funded by the Social Sciences and Humanities Research Council, entitled Water Ways - the Past, Present, and Future of Okanagan Waterscape. The Water Ways project is a four-year undertaking to research and create a community-based interactive media exhibition that explores the nature of human-water relationships in the Okanagan Valley, British Columbia. The artworks created in the exhibition employ creative and innovative uses of interactive media and artistic software design to present a platform for dialogue across diverse community-based, poetic, traditional and scientific water knowledge. These artworks synthesize diverse water knowledge of the past and present and use community-engaged research to envision multiple sustainable water futures of the Okanagan Valley. The exhibition will encapsulate the different meanings that water holds for many communities, cultures and interest groups in the valley, including Indigenous Okanagan (Syilx) communities, environmentalists, artists, agricultural, forest and tourist industries.

Water Ways is an interdisciplinary undertaking between UBC Okanagan researchers from Fine Arts (the autors), Traditional Ecological Knowledge (Dr. Jeannette Armstrong), Environmental Anthropology (Dr. John Wagner), Environmental Science (Dr. Lael Parrott) and Indigenous Scholarship (Dr. Marlowe Sam). We collaboratively research, design, implement and evaluate an artwork that draws from a rich history of participatory sustainability research and media for social change. This type of research-creation can lead to widely applicable approaches of engaging Canadians on local environmental sustainability in new and fruitful ways, fostering better citizenship and dialogical engagement on issues crucial to community resilience and well-being.

Community

Inspired by the artists' experiences within the environment and communities along the creek systems of the Okanagan, *Journey of a Pod* brings together a sculptural form, system design, and audio-visual media. We recorded audio and video media for 12 months exploring the seasonal episodes and shifts of death and rebirth. At a conceptual level, the work investigates the oppositions of domination versus partnership with the environment. The media representing the spring season includes recordings of the creek systems as they refresh the landscape with life-giving forces such as the incredible power of water overwhelming the creek banks. Events of drumming and children activities at the Salmon Release Ceremony at the Penticton Indian Band accompany the environmental pieces. Summer season features Okanagan sunflowers, bees, birds, sunlight refracting onto the underwater stones. The voices in this section were taken from Columbia River Treaty Workshop organized by John Wagner and the focus group led by Jeanette Armstrong at the Enowkin Centre

Themes about the culture and landscape as related to water and spoken by Indigenous and non-indigenous scholars and community members represent the diverse perspectives centered on waterways of the Okanagan. It is essential for us to recognize the depth of the words shared here by Syilx knowledge keeper Richard Armstrong. Canada Research Chair and UBC professor Dr. Jeannette Armstrong shared with us that the words spoken have been passed down in the traditional Syilx family from Uncle, and Mother, and teachings of family elders. It is a long line of teachings that are carried by this generation of knowledge keepers. The words are exact but are treated differently than direct quotation in the academic sense - for the Syilx knowledge keepers become owners of the exact wording and are to use it in the same way for the same purpose while acknowledging that they are words passed down from the relative that gave it

"Tell me about water is that even though it's soft to the touch, it's not hard it's something soft. Yet as soft as it is it can wear away the hardest material like solid rock wall, it will wear that away."

”Water is so sacred that where it comes from never empties and where is goes never fills up.”

Richard Armstrong

Dr. Marlowe Sam’s interviewed Richard Armstrong for the 2008 research entitled Okanagan Water Systems: An Historical Retrospect of Control, Domination, and Change [15]

The re-combinatory poetics in generative art brings together communal diversity with knowledge about the environment into the experience unified by the artistic whole. The artwork becomes the mechanism to achieve balance in diversity - negotiating across multiple perspectives, complexity, and ecological resilience - using experience design as a way to provide public access to complex ideas produced as a reciprocal relationship between the generative system and the artist/interactor forming an ecosystem with the expression of thoughts and feelings.

Discussion

The contribution of generative arts to sustainability discourse lays in its powers as a means of inquiry, as a way of knowing, understanding and representing the world we live. Generative arts practices provide awareness that reaches beyond the conceptual framework, building on the capacity to know the world, which exceeds the capacity to categorize the world. The epistemological dimensions of arts have the capacity to present realities as constructed, rather than fixed, in order to invite new cultural dialogues, construct new cultural narratives and develop new forms of creativity. In that regard, generative arts inherits a language of fine arts to create an embodied experience that enables reception of ideas in a fluid cycle across the sensual and conceptual, facilitating a space for ontological reflexivity [3]. We approach generative art as a source of ontological reflexivity and an agent of transformation and social change, where foundational knowledge of how humans connect with the more than the human world is brought into play through multi-sensory experience that activates lateral thinking and an intuitive grasp of concepts.

The digital characteristics of generative art enable the expressions that are dynamic, flexible and responsive to its environment. The dynamic feature embedded in generative art provides fruitful ground for engaging with complex problems. The artistic representation formed through an equilibrium across multiple elements within the system that act together in a co-dependent yet flexible way. This characteristic of generative art is a crucial narrative device that can enable an imaginative space of engagement and reflection on the multiple realities embedded in our place: geopolitical issues, histories, futures, resource availability, conflicts, demography, biodiversity, and beauty. The renderings of multiple relationships across its components within generative art provide a unique conversational space for a creative engagement with sustainability thinking and practices.

Generative art, and its unique language that spans across fine arts, technology, and scientific modelling, draws pathways for creative actions that can span across the world of politics, economics, and science while maintaining and leveraging transformational power of fine arts that can directly speak to our hearts. This interdisciplinary relationship between artistic and scientific inquiry can only be successful when the integrity of sensual processes within ontological reflexivity is in equilibrium with rational and technical. Fine arts and the power of persuasive aesthetic experience cannot be placed in service of representing the world through the lens of deductive, rational knowledge or financial gains. Instead, the artistic experience must be drawn from the way we perceive and engage with the world directly with our hearts and our minds. The integrity of artistic understanding as both process and outcome for enabling ontological reflexivity lay in its ability to affects the perception through creative engagement, for which the relationship between how we perceive, represent, know and change nature is firmly linked.

Sustainable futures have ethical implications regarding how to conduct life that is political, socially just and socially conciseness act, transcending our understanding through the process of perceiving positioned itself as an interactive performance of the agency. The artwork creates an experiential journey that transcends our personal and socio-cultural norms to reach beyond our normative structures to new creative territories through the sensual process of listening, looking, touching, tasting and smelling. This transcendence through a process of perception means co-evolving with social and personal structures as a result of improvisations within the experiences enabled by the artistic system. This form of communication enables the space for ontological reflexivity, compelling creative engagement from the participants to reach perceptual transcendence through the act of engagement with the artistic system. Artist, participants, digital media, and computer software all have equal status in the collaborative performance, and the improvisational interaction among them nurtures insights.

Conclusion

The discussion in this paper has been a team effort. The discussion of the dynamics that we see in complex systems was in many ways a reflection of dialogues we had over the years at the Centre for Culture and Technology at the University of British Columbia how does complex art reveal to us as the dynamic, fluctuating and co-dependent nature of our world? While one is often between disciplines oneself, an interdisciplinary practice usually involves working with groups comprised of people from different disciplinary backgrounds. As a team, we came together in our interest in the more profound understanding of intertwining art, science, technology, and nature. Building on the current work of the Waterways project we are integrating scientific modelling explaining species and land distribution and Indigenous knowledge for embedding generative artworks in the environment through locative media technology. This work aims to bring opportunities for imagining sustainable living solutions into the experiences of people situated in the environment.

References

[1] Bateson, G. 1979. *Mind and nature: A necessary unity*, volume 255. Bantam Books New York.

[2] de Bérigny, C.; Gough, P.; Faleh, M.; and Woolsey, E. 2014. Tangible user interface design for climate

change education in interactive installation art. *Leonardo* 47(5):451–456.

[3] Dieleman, H. 2008. Sustainability, art and reflexivity. *Sustainability: A new frontier for the arts and cultures* 108:146.

[4] Dorin, A.; McCabe, J.; McCormack, J.; Monro, G.; and Whitelaw, M. 2012. A framework for understanding generative art. *Digital Creativity* 23(3-4):239–259.

[5] Dulic, A., and Newby, K. 2016. 17 generative approaches for meaning making in art. *Intersecting Art and Technology in Practice: Techne/Technique/Technology* 207.

[6] Galanter, P. 2008. Complexism and the role of evolutionary art. In *The Art of Artificial Evolution*. Springer. 311–332.

[7] Gallery, K. A. 2018. Journey of a pod.

[8] Giddens, A. 1984. The constitution of society: Outline of the structuration theory. *Cambridge: Polity*.

[9] Kagan, S. 2010. Cultures of sustainability and the aesthetics of the pattern that connects. *Futures* 42(10):1094–1101.

[10] Kagan, S. 2014. *Art and sustainability: Connecting patterns for a culture of complexity*, volume 25. transcript Verlag.

[11] Maturana, H. R., and Varela, F. J. 1980. Problems in the neurophysiology of cognition. In *Autopoiesis and cognition*. Springer. 41–47.

[12] McCormack, J., and Dorin, A. 2001. Art, emergence and the computational sublime. In *Proceedings of Second Iteration: A Conference on Generative Systems in the Electronic Arts. Melbourne: CEMA*, 67–81.

[13] Robinson, J., and Cole, R. J. 2015. Theoretical underpinnings of regenerative sustainability. *Building Research & Information* 43(2):133–143.

[14] Rokeby, D. 1990. The harmonics of interaction. *Musicworks 46: Sound and Movement*.

[15] Sam, M. 2008. *Okanagan water systems: an historical retrospect of control, domination and change*. Ph.D. Dissertation, University of British Columbia.

[16] Talks, T. Sustainability: Are we the monsters?: John robinson at tedxstanleypark.

[17] Welsby, C. 2011. Technology, nature, software and networks: Materializing the post-romantic landscape. *Leonardo* 44(2):101–106.

The Rebirth of Shadow Arts: App Design for the Intangible Cultural Heritage of Chinese Traditional Shadow Art

Yingdao Jiang, Li Yang, Yingquan Wang
Department of Digital Media Arts, School of Art, Qingdao Huanghai College, Qingdao, Shandong Province, China
yingdao123@qq.com, 53327791@qq.com, 653934872@qq.com
Joonsung Yoon
Tianjin Normal University / Global School of Media, Soongsil University, Seoul, 07040, Korea
dryoon@maat.kr

Abstract

This study explores the digitization of Chinese traditional shadow arts, for making them into the form of mobile applications, in order to protect and conserve the intangible cultural heritage. The research has summarized the artistic characteristics for traditional shadow art from the perspective of semiotics. Then, combines it with modern life and design a modern shadow art database for users to participate in shadow art designing. Finally, according to the modern database, give three aspects of achievable mobile phone APP design scheme: character modeling, interactive control and animation. Furthermore, from the perspective of user experience, design an open, interactive and entertaining digital platform based on shadow art protection, which enables users to participate in the characteristics selection and action plot design of shadow art, let the shadow art evolve in the process of re-creation to achieve cultural preservation, inheritance and continuity.

Keywords

Chinese intangible cultural heritage, Mobile application platform design, Chinese traditional shadow art

Introduction

Shadow art is a great invention of the Chinese ancestors and also the model production of folk fine arts and artistic designing. As a Chinese intangible cultural heritage and traditional folk performing arts with a history of near one thousand years, shadow art enriches people's spiritual life, at the same time makes itself become one of splendid culture after all kinds of suffering. The value of shadow art is beyond doubt; however it's faced with multiple development plights nowadays. What we really need to discuss is how to inheritance and carry forward the traditional shadow art in the background of adapting to the development of modern society.

With the rapid development of new media technology, and its advantages in the preservation and dissemination, the transformation of intangible cultural heritage to digital cultural heritage has become an inevitable trend.

Nowadays digital mobile phone has already gradually becoming the necessities in everyone`s life, and it has certain characteristics of technology, popularity, openness, interaction and communication and it can also bring more profound emotional experience to the users. On the contrary for users, users are not only satisfied with the functions of the mobile software platform, but also pay more attention to the contents construction and user interface of the mobile software platform, which is beautiful, comfortable, simple and easy to use. Therefore, the content construction and user interface design of the mobile software platform are particularly important.

In the above background, the design of shadow art based on mobile applications platform is the exploration of the digitization of traditional shadow art, and it also opens up new ideas for the digital creation and dissemination of shadow art.

This paper is based on the digitization of intangible cultural heritage, taking shadow art as an example, design and research a mobile applications platform. The mobile applications platform content includes two parts: dissemination of traditional shadow art information resources and designing modern shadow art. The first aspect includes shadow art resources collection by digital technology methods, such as 2D scanning, photographing, video capture, text input and so on, mainly include excellent shadow sculpture works, history and culture of shadow art, shadow art performance skills, shadow art tools, singing of traditional shadow art opera, and the excellent shadow art film and animation. It is the development and evolution of shadow art and it is also folk culture performance of the literature collection. The second aspect includes increase the relevance between users and shadow art, improve users' participation. In this function module of the platform, users can participate in the shadow art characters design, landscapes and other scenario design to better understand the art of shadow art.

Overview of Chinese traditional Shadow art

Shadow art has a history of more than 2,000 years and there is a legend about the origin of shadow art. More than 2,000 years ago, a favorite imperial concubine of Wu

Emperor of the Han Dynasty died of illness; the Wu Emperor was absent-minded because he missed the imperial concubine. One day, minister Li Shaowang went out, happened to see children playing with dolls in their hands, where the shadows on the floor were vivid.[1] Inspired by this scene, he made a imperial concubine's image with cotton puppet and painted it, putted wooden poles on puppet's hands and feet. When night fell, he invited the Wu emperor to watch rear illuminated puppet show behind a curtain. The Wu emperor was very happy and took to it from then on[2]. This story recorded in the official history book which is believed to be the origin of shadow art. Shadow art was popular during the Tang dynasty (618 - 907) and Song dynasty (960 - 1279) in many areas of China. Shadow art was first made of paper carvings, and then from the leather of donkeys or cattle. That is why Chinese name is "皮 pi""影 ying"[3].

The stage for shadow art is a white gauze curtain and projecting the shadows of a flat puppet on the curtain. Chinese traditional shadow art looks similar to paper-cut puppets, but their joints are wired and can be operated freely and the scene is simple (Figure 1).

Figure1. Shadow art performance (©photograph by authors)

Shadow art performance is a two-dimensional form because of the puppets and scenery is flat. All of the shadow characters' faces are depicted in profile. In order to represent more expressive and can be better animated and manipulated. For traditional shadow art, modeling of characters emphasizesthe overall beauty of smooth lines, change of fluctuations and the proportion of each part of the puppet. Chest of shadow modeling is slightly forward, shows oblique side; from the waist, shows full side, leg and foot which are one front and one back, and show full side (Figure 2).

This kind of oblique side and full side combination modeling is conducive to adjustment of the action for puppet. Shadow characters generally consist of ten parts, including upper body, lower body, two legs, two upper arms, two lower arms and two hands. Usually, the upper body and arms are a bit long because easier to operate the shadow art performance.

Figure2. Character modeling (© photograph by authors)

Symbolic features of traditional shadow art

Semiotics, as a general theoretical subject for studying symbols, is widely used in various cultural researches. Semiotic mainly researches the essence of symbols, the law of Symbol development and change, the various meanings of symbols, the relationship between different symbols and human behavior. According to semiotic theory, symbols can be divided into "signifier" and "signified". "Signifier" means to expression of symbols and "signified" means to significance of symbols. In the symbols of shadow art, the contents reflected by the intuitive modeling, such as characters, articles for daily use, and nature. These are all belonged to "signifier" which is a modeling symbol transformed by objective things. According to these "signifier" inferences, people can associate the folk cultural meanings or concepts derived, which are the "signified" of shadow art symbols. The "signifier" feature of shadow modeling is mainly to use different patterns, lines and colors which have their own characteristics and conventionality symbolic to express people or things. For example: all of the puppets have a large head and small body; men have square face, broad forehead and tall strong body. Women have thin face, small mouth and slim body. Scholars wear long robes with an elegant demeanor; generals in martial attire bring to mind bravery and prowess.[4]

According to the traditional classification of shadow art modeling, it can be divided into character modeling symbols, articles for daily use modeling symbols and natural biological symbols (including plants, animals, etc.).

The face of puppets design follows traditional principles which are moral evaluation and aesthetics. The audience can know a character by seeing character's face. The positive characters have a small mouth, a straight bridge nose and long narrow eyes, while the negative characters

[1]Wei Liqun, *History of Shadow Art in China,* (Beijing: Cultural Relics Press, 2007), 16.

[2]Yuezhong Li, *Show Opera*, (Beijing: China Social Press, 2007), 158

[3]"皮 pi" means leather, "影 ying"means shadow

[4]https://www.travelchinaguide.com/intro/focus/shadowpuppetry.htm

have a sagging mouth, a protruding forehead and big eyes (Figure 3).

Figure3. Positive and negative characters of shadow art (© photograph by authors)

The performance of shadow art is a light and shadow art. The material of shadow puppet is transparent, which determines that the color of puppet can be displayed on the screen and get a good visual effect. The color used in the traditional shadow modeling which is a kind of visual symbols, and also has cultural significance. To a certain extent, it reflects the character and identity of the shadow role, such as the red face of Guan Yu, who symbolizes a justice man. The color culture also reflects the local social content such as folklore and history, as well as the aesthetic needs of the public. Shadow modeling is mainly used red, yellow, green, blue, black, white and other high-purity colors[5].

According to match with color depth, it reflects a good sense of level and commonly used complementary colors; such as matching red and green(because blue under the lamp is close to black, so it is replaced by green), the whole color tone is thick and calm, which makes the color contrast distinct and harmonious.

The scenery of stage for shadow art was simple layout instead of complex contents. The props in the scenery had various shapes, such as pavilions, pavilions, tables, chairs, benches, beds, stone, mountain, flowers, birds, insects, fish, etc. According to "cavalier perspective"[6], many buildings and furniture can be seen not only front but also can be seen half-side and top[7]. The flowers, woods, mountain and stone were carved rugged; Animals portrayals were concise and accurate, few knives can handle the animal's posture (Figure 4).

Figure 4.Shadow props modeling (© photograph by authors)

Setting up Source material databases for modern shadow art

According to the research and analysis for characteristics of traditional shadow art modeling, this part will design the modern shadow art database to support the platform design. In order to better convey the shadow art as a Chinese folk art, in the design of the database, the authors will adopt the color which is Chinese painting halo dyeing method and deal with it on the basis of real products color, combining with traditional shadow art colors(red, yellow, green, blue, black and white)

Setting up material databases for character modeling

In the traditional shadow art, different characters used different facial lines and colors. However, in order to satisfy the modern aesthetics, it is not necessary to be detailed classification for the characters in the modern shadow art material library. In the basic character symbol library, the authors divide the character design into four basic categories: men and women, old and young.

Figure 5 shows the head design for male and female characters, which is similar to the traditional shadow art male and female characters. Young women have oval face, full and round forehead, sharp nose, small mouth where is slightly under the nose, curve eyebrows, narrow and slanted eyes. Old women have a little different facial shape between with young women, such as manifesting in muscle relaxation and sagging in the zygomatic region, eye muscle relaxation and deeper nasolabial folds. Young men have square round face, full and round forehead, sharp nose, small mouth where is slightly under the nose, straight eyebrows, narrow eyes. Old men are similar to old women;

[5]Dongcai Zhang, *Performing Forms of Chinese Film shadow art,* (Zhengzhou: Elephant Press, 2008), 37

[6]A perspective method in Chinese painting

[7]Kai cheng Jin, *Chinese cultural knowledge reading: shadow art,* (Jilin: Jilin Literature And History Press, 2012), 70-84.

muscle relaxation and sagging in the zygomatic region, eye muscle relaxation and deeper nasolabial folds (Figure 5).

Figure5. Head design for characters in modern shadow art (© design by authors)

The costumes of traditional shadow art characters were derived from exaggeration and distortion of real costumes. Their outlines were formed by big straight lines or curves and the engraving pattern on costumes evolved from real costumes pattern and embroidery pattern. Artist deleted or chose the original costumes pattern and expressed them abstractly. In modern society, due to the aesthetics of modern clothing, the clothing pattern is not as complicated as ancient clothing. In modern fashion design, the outline was designed by using big straight lines and curves, which are derived from the exaggeration and distortion of real clothing. On clothing patterns, the big patterns were dyed and partially carved and the small patterns were carved.

Setting up basic props and scene database

In the traditional shadow art, props and scene modeling according to "cavalier perspective", they can be seen not only front but also can be seen half-side and top (Figure 6).

Figure6. Basic props database (© design by authors)

In order to achieve better visual effect, in the material database, the authors adopted a single perspective for a single prop design rather than cavalier perspective. The scene design for traditional shadow art mostly adopted the artistic technique that was planar formation with stereo sense, the layout was concise, but it extracted the main features from the real scene and expressed the region of the character activity.

The modern scene modeling designing in this paper, the authors used the traditional layout features to design the scene of modern life as a shadow style which provided basic database for platform design.

Setting up the basic action database

In the traditional shadow art, because of the blurred facial expression of shadow characters, people can only see the basic personality, such as good or bad, but could not express the deeper character's psychology and expression. Therefore, the shadow character's body language was rich and its movements were exaggerated. For example, if the shadow character talked when the mood was peace, its arms swung back and forth, and when the mood was excited, its arms swung up and down. These movements were exaggerated from the actions of real people.

The characters' basic action design in database, it was exaggeration for people's daily common movements, such as standing, sitting, turning around, walking, running, talking, crying and laughing, and was designed as a GIF forms to users used. The action below in the table is the basic action in the database; users can design freely and add GIF animation.

	Talk	Walk, Run	Others
Action	Stand-Peace stand-cry stand-laugh sit-Peace sit-cry sit-laugh etc.	Walk-Peace walk-sad walk-happy run-Peace run-sad run-happy etc.	Wave hand Take things bow down Turn around etc.

Table1. Basic action database (© by authors)

Function and structure analysis of APP

According to the user requirements analysis, this paper designs the platform structure scheme, which shows the core functions of the system platform. As shown in the figure (Figure 7), the platform functions include four aspects: shadow art design, the knowledge of traditional shadow art, video sharing and material shopping mall.

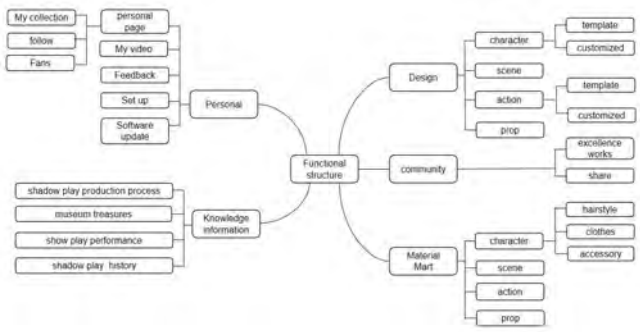


Figure7. Functional structure diagram (© draw by authors)

According to the system structure diagram, the platform mainly includes three systems; platform database system, resource sharing system and multimedia Communication application system.

Platform database system

This platform database system is the basic source of the whole platform. The other communication and application are based on this database to realize their system functions through some interactive means. This database system consists of four sub-databases.

Multimedia database for traditional shadow art

This database contains shadow art resources and collected by digital technology methods, such as 2D scanning, photographing, video capture, text input and so on, mainly

include excellent shadow sculpture works, shadow art history and culture, shadow art performance skills, shadow art tools, singing of traditional shadow art opera, and the excellent shadow art film and animation. It is the development and evolution of shadow art and it is also folk culture performance of the literature collection.

Material database for modern shadow art

As described above, shadow art protection is not only using digital technology to collect and save, but also fully expresses the characteristics of live inheritance. Therefore, this modern shadow art material database is mainly based on the analysis for traditional shadow art character, scene modeling and character movements and it had designed as modern character modeling, relevant scene modeling and character movements. It is the basis for users to innovate in shadow art design. Therefore, this database is used for information technology to assist the development of shadow art.

Modern shadow art innovation database

Shadow art innovation database is used to collect the excellent shadow art creations design which used the innovative design application system platform. Here, users can enjoy the different users' sharing, forming an art of shadow art and culture zone and users can upload their own creations, all users can vote to choose the most popular works.

Material mall

Material mall has more abundant material for character modeling and animation. It includes hair style, clothes, accessory and action. The resources in the material mall can be uploaded by users and screen out excellent works in the background, or supported by platform system design.

Resource sharing system

Sharing system relies on resource management and service technology. It is mainly divided into two modules, front desk service and background management. Background management is mainly responsible for two parts. The first part is the update and repair for the existing resources in the database, which is the daily maintenance for the database resources; the second part is the content audit for network resources, data entry and authority management, which is actually derived from the open protection principle. Open protection of cultural heritage can greatly improve the impact of cultural heritage and living space, consolidation and strengthening the user's inheritance sense and responsibility. These network resources are uploaded by registered users in the platform, filled in the corresponding data information, and submitted to the platform for audit and classification. Front desk service mainly responds to user access and provides resource sharing services.

Multimedia Communication Application System

Multimedia application system is based on 3D animation technology, speech recognition technology, multimedia interaction technology, knowledge visualization technology and other information technologies. Multimedia communication application system mainly includes three subsystems, mainly for different users.

Media display subsystem for shadow art

Media display subsystem for shadow art is through multimedia information technology to show the traditional shadow art multimedia database and resources of modern shadow art innovation sharing database. It combines with sound, image and text and expresses more intuitive and more systematic understanding the origin, development, innovation and other related information of shadow art (Figure 8).

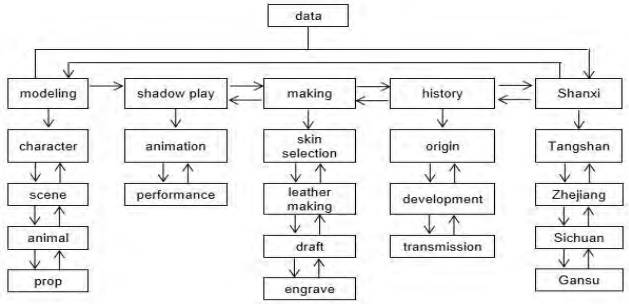


Figure8. Traditional shadow art information display flow chart (© draw by authors)

Innovative design experience subsystem of modeling material

It is to enable users to participate in the shadow characters, landscape and other scene modeling design to better understand the shadow art. The creation of traditional shadow art forms need skilled production skills, which could not be accomplished by ordinary users. However, it can design virtual shadow art by means of computer information technology.

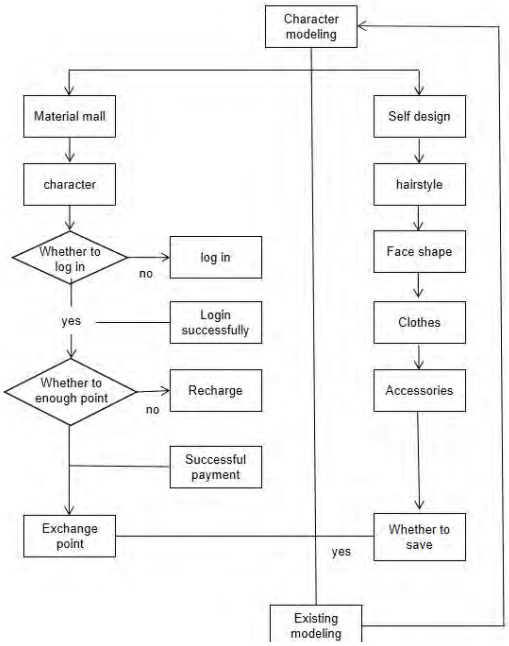


Figure9. Character modeling design flow chart (© draw by authors)

This paper refers to a large number of excellent shadow products and makes a detailed analysis for the element symbols, semantics expression and design techniques of shadow art, then summarizes the design characteristics of shadow art. Finally, generates a shadow art material database which based on modern characters and life scenes. Users can freely edit and modify the material resources in the digital vibration database to create shadow art works, so as to experience the art of shadow art and understand the art of shadow art more deeply. Finally, a shadow material database based on modern characters and life scenes are generated. Users can use the material resources in the database, edit and modify them freely as well as create shadow art works, so as to experience the art of shadow art creation, and further understand the art of shadow art (Figure 9).

Innovative design experience subsystem

The innovative design experience subsystem of shadow art is a system platform for users to participate in the creation experience of shadow art. The creation of traditional shadow art mainly control three sticks, one was fixed in the puppet's neck that controlled the movement of the body and head. The performance of this way needs a lot of time training, ordinary users can not skillfully complete. Therefore, through digital programming, interactive technology, voice recognition technology, users can freely choose the material in the modern shadow material database to design interesting animation effect. (Figure 9, 10) Finally, they can get their own shadow art by dubbing.

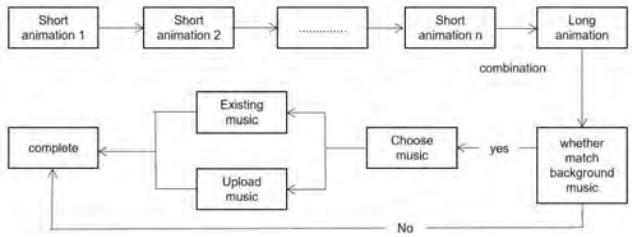


Figure10. Short Animation design flow chart (© draw by authors)

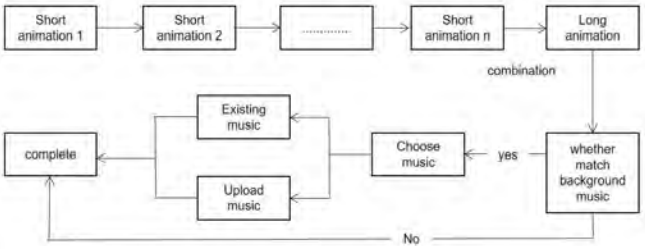


Figure11. Long Animation design flow chart (© draw by authors)

Material mall display subsystem

Material mall display subsystem is through multimedia information technology to show more image and GIF.

Mobile application interface design

The platform interface design is the user's first intuitive experience, as important as its functional structure. The complete interface visual style of APP will give users the initial impression. At present, the main style of mobile phone platform tends to be flat design. It gives up skeuomorphic visual effects which were the color gradient, shadow, texture and highlight and makes "information" itself prominent as the core, and emphasizes abstraction, simplicity and symbolization in design elements.

The authors will adopt the essence of flat design to design the mobile phone APP interface style, outstanding the artistic characteristics of shadow art, maximizing the satisfaction for users' needs, smooth interactive experience, visual aesthetics, and fully showing the functions and contents of the platform.

The interface layout directly affects the user's vision and operation, so this paper fully takes into account the user's eye movement pattern. Such as the user's visual orientation, the main pattern of eye is that the horizontal movement is faster than the vertical movement, the habit of moving from left to right and bottom to top, and for eyes the vertical movement is more fatigued than the horizontal movement (Figure 12).

Figure12. Interface layout (© design by authors)

There will be some basic scene materials on the scene design page. If user wants to have more choices, he/she can click on the "Mall" icon to enter the "Material Mall" page (Figure 13).

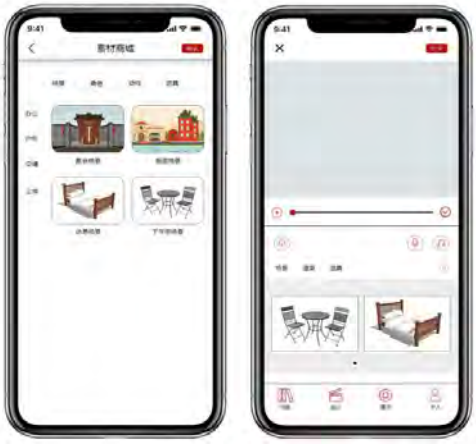


Figure13. Material mall and scene user interface (©design by authors)

In the character modeling design page, user chooses "modeling" and clicks "modeling design" to enter the self-designed characters modeling page. Through the selective combination with face, hairstyle, body proportion, clothing and accessories, user can design some new character modeling. If user could not find satisfactory materials, he/she can click the "mall" icon to enter the "material mall" page (Figure 14).

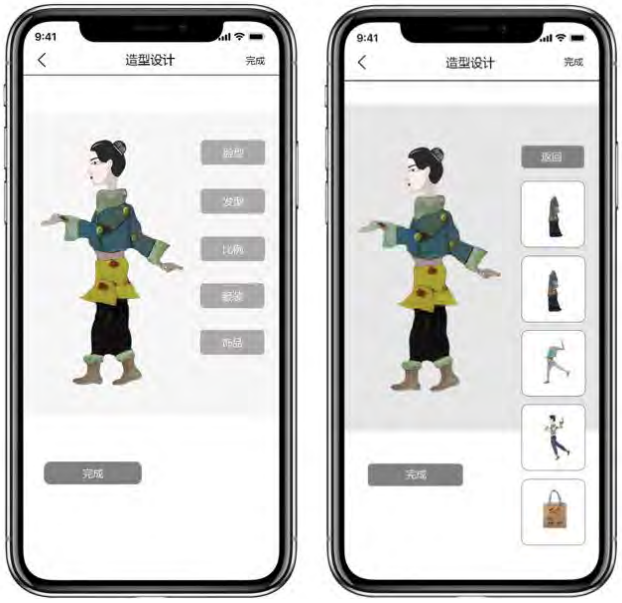


Figure14. Character modeling user interface (© design by authors)

Figure15. Character action modeling user interface (© design by authors)

In the character action modeling design page, when user places the character model in the video production area, he/she can do some function operation for character action modeling such as "delete" or "zoom", "give action" and previous step. If there are no suitable materials, user can design by himself/herself, and control the character pose by interactive gestures such as finger sliding. Click "Next" on the "Action Design" page to enter the GIF image generation page. User can control the playback speed and name the action (Figure 15).

Conclusion

With the rapid development of the information age, the collision of multicultural and the abundance of material life are what made modern people to pursue a fast-paced, strong stimulation and passionate life style. However, the traditional culture is declining, and there are few people who pay attention to and love shadow art as a folk art.

This paper is based on the protection of intangible cultural heritage in the context of modern digital era, takes shadow art as an example, using digital technology to build an open, interactive and entertaining digital platform which is according to modern people's living habits and aesthetic consciousness. Through the mobile application platform, user can view the information of traditional shadow art and also can directly participate in the design of shadow art. It will play a very important role in the dissemination and inheritance for shadow art. In modern shadow art design, the application of digital technology not only simplifies the process of shadow art design, but also promotes the spread and development of shadow art which adapts it to the aesthetic and cultural needs of the new era.

References

[1] Wei Liqun, *History of Shadow Art in China,* (Beijing: Cultural Relics Press, 2007), 16

[2]Yuezhong Li, *Show Opera*, (Beijing: China Social Press, 2007), 158

[3]Travel china guide, "Chinese Shadow Puppetry", Feb. 26, 2018, https://www.travelchinaguide.com/intro/focus/shadowpuppetry.htm

[4] Dongcai Zhang, *Performing Forms of Chinese Film shadow art,* (Zhengzhou: Elephant Press, 2008), 37

[5]Kai cheng Jin, *Chinese cultural knowledge reading: shadow art,*(Jilin: Jilin Literature and History Press, 2012), 70-84.

Scientific Research Projects: This paper is Phased Achievements for Doctoral Research Initiation Funds Project of Qingdao Huanghai University.
Project Number: 2017boshi03

Heterochronicity: Historicizing Drainage and Enlightenment in Mexican Ecological Art

Claudia Costa Pederson
Wichita State University
KS, USA
ccp9@cornell.edu

Abstract

This essay focuses on *Possessing Nature* as a project whose import pertains to heterochronic notions of historical development. Conceived as an environmental installation to represent Mexico at the Venice Biennale in 2015, the project's creation, as a collaboration between a curator and two artists, speaks to their shared focus, on highlighting the contemporary cultural particularities of Mexico through a historical framework based on multiple temporalities. This in turn entails a similar perspective on modernism and modernity. It relates Eduardo Galeano's manifestos against European colonization (*The Open Veins of Latin America,* 1971, and *Mirrors*, 2008), and Paula Findlen's historical account of thingified and commodified nature for European modernity (*Possessing Nature*, 1996), and expands on these works from a point-of-view akin to what Macarena Gomez-Barris's calls the "submerged perspectives", or decolonial epistemologies central to current ecologically-themed art by marginalized individuals and groups in Latin America. In this vein, *Possessing Nature* decenters Anthropocene chronologies, which as manifested in the form of the current water crisis in Mexico City, trace to European colonialization and enduring belief in modernity as temporal progress. As well, it shifts attention to the role of Venice not as perceived today, as an originary locus of the European Renaissance, but as an early model of European colonial expansionism. In contrast, it highlights overlooked modernisms, particularly the constructive legacies of the Latin American avant-gardes. This heterochronic perspective is ultimately central to *Possessing Nature*'s proposal concerning the limitations of progressivist narratives, and conversely, the significance of other notions of temporality, including those of non-Euro American arts and their insistence on heterochronous time, for sustainably changing our relationships with nature.

Keywords

Ecology, Art, Technology, Heterochronocity, Progressivism, Drainage, Enlightenment, Latin America, Colonization, Renaissance, Venice, Biennale, Mexico City.

Introduction

Reclaiming history is integral to postcolonial agency, as subaltern pasts and epistemes are either omitted from or intractable to dominant historical narratives. [1, 2] On this account, the writing of history is a theme integral to the media arts in the Global South. It is likewise currently a central concern in art history, as the discipline expands to include not previously accounted for artists and works in standard histories of modernism and contemporary art. This project requires decentering linear concepts of Western time and space, which privilege the idea that the West is the fulcrum of social and cultural progress. In the present moment, this involves most urgently re-thinking contemporaneity as a-historical, a form of time that bears no relation to the past, a heterochronocity. The notion of time as multiple is essential to understand and include non-Euro American arts on their own terms, as parallel formations embedded in particular geographies and histories, not as derivative or imitative of Western arts. This, as the Argentine art historian Keith Moxey recently proposed, rubs against interpretations of contemporaneity as a heterochronocity, which in the wake of modernism, heralds but the end of history [3]. This interpretation includes Frederic Jameson's notion of the "eternal present', Nicolas Bouriaud's "altermodern", and Marc Auge's and Terry Smith's notions of contemporaneity's multiple temporalities as signs of the impossibility of historical meaning, among others. As Moxey implies, these notions re-institute linear time post post-modernism's assault on master narratives, as they paint the end of progressivist modernist narratives as catastrophe. They carry "an apocalyptic tone", resonating in many forms today, be it in proclaiming the "end of art", "the destruction of the environment", "the destabilization of the nation-state", or "the collapse of secular democracy" [3]. As dominant notions of contemporaneity they also foreclose space for other notions of temporality that draw attention to the understanding of history and power as intrinsically linked, which is essential to both non-Western arts and art histories, and beyond, toward a more complex understandings about their relationships with dominant histories and spaces.

Created as an environmental installation and a collaborative project, *Possessing Nature* (2015) by Tania Candiani (b. 1974, Mexico City) and Luis Felipe Ortega (b. 1966, Mexico City), makes salient the significance of multiple temporalities as the basis for meaningful inclusion of marginalized art histories, whilst also addressing ecology, a more recent interest in Mexican art. The art historian and curator Karla Jasso oversaw the realization of the project as Mexico's submission to the 56th Venice Biennale (Fig. 1). [4] On the backdrop of this international event, and in acknowledgement of the current interest in ecology in Mexico, Jasso proposed a collaborative work regarding Venice's and Mexico City's lacustrine geographies, and their respective relationships with modernity, nature, and colonization. In response, Candiani and Ortega created *Possessing Nature* as an intervention into art and environmental histories in the form of an installation that consists of a map, a drainage system, and a video projection. With water as the common element tying the installation's components, the project addresses the histories and impact of its instrumentalization for the development of European and Latin American modernities. The focus is on exploring the shared aquatic origins of Venice and Mexico City, and their subsequent development as respectively a rich maritime environment and cultural center, and as a drought-stricken urbanity, respectively. As an artistic and art historical engagements with the histories of water, *Possessing Nature* is ultimately concerned with compelling understanding about the unevenness of the contemporary conditions of Venice and Mexico City. For this purpose, it rejects progressivist historical frameworks, which is not to say the abolition of history, as this would imply again the privileging of Western time and space as the standards of social and cultural progress, ideas brought to bear in European colonialist projects. Rather, it makes history central to contemporaneity. It relates the histories of modernity from the peripheries to the dominant one in pursuit of understanding how these various contemporaries form and express in relationship and differently, in this case with a particular focus on their shaping of aquatic urbanity.

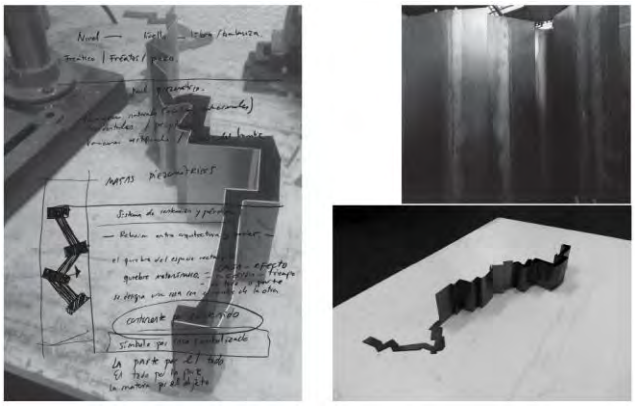


Figure 1. *Possessing Nature* (2015), installation sketches, Venice Biennale 2015. Courtesy of Tania Candiani.

As a reference to the unsustainable exploitation of the aquatic environments of Mexico City, spanning the arrival of the Spanish to today, the notion of drainage in *Possessing Nature* recalls the metaphor of bloodletting used by the Uruguayan journalist, author, and poet Eduardo Galeano as a metaphor for the historical dispossession of Latin America by successive colonial powers, a topic which he explored in *Open Veins of Latin America* (1971) and in later works, including *Mirrors: Stories of Almost Anyone* (2008). Partly written as geographical fiction, as a historical novel, and as a manifesto, Galeano focused in *Open Veins* on gold and silver, cacao and cotton, rubber and coffee, fruit, hides and wool, petroleum, iron, nickel, manganese, copper, aluminum ore, nitrates, and tin. These are the titular veins which he traced through the body of the continent, up to the Rio Grande and throughout the Caribbean, and all the way to the coffers of wealth that empty into the United States and Europe. Subsequently, in *Mirrors*, Galeano addresses briefly yet another such bloodletting, which is central to *Possessing Nature.* In his words: "The conquest of Mexico began as a war against water, and the vanquishing of water heralded the vanquishing of everything else". [5]

The other historical reference for *Possessing Nature*, and the inspiration for the project's title, is *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (1996) by the historian Paula Findlen. In this work, Findlen inverts Galeano's focus on dispossession to address possession as a notion integral to the cultural and scientific flourishing of Europe between the 14th and 17th centuries, i.e., the Renaissance and the period heralding the Enlightenment and modernity. [6] Findlen identifies this historical period with changes to notions about nature in European thought, as flora and fauna from the "new world" became a focus for collectors, researchers, and artists. Nature as such became objectified, a process that expressed in various forms, from coveted objects of consumption, and in representations of Europe's political, cultural, and scientific power–in short, of its world dominance. The merchant Republic of Venice, which emerged as Europe's earliest maritime power because of its monopoly on trade with the East, is one of the key players in Findlen's historical account of the central role of nature for the emergence of European modernity.

For *Possessing Nature*, Candiani and Ortega combine and expand on Galeano's and Findlen's work by way of relating histories about water, modernity, and colonization from overlooked perspectives of resistances and agencies in the Global South. In this sense, *Possessing Nature* follows on recent work by scholars interested in the histories of artistic and activist practices concerning ecology in the Global South. In this regard, the work of the queer theorist Macarena Gómez-Barris, entitled, *The Extractive Zone, Social Ecologies and Decolonial Perspectives*, is most relevant as a counter to Eurocentric narratives of the Anthropocene

from a Latin American perspective.[1] [7] Similarly acknowledging Galeano's contributions, Gómez-Barris emphasizes in contrast resistance to European colonialization in the forms of contemporary art and activist projects concerning ecology by communities of color in Latin America, including indigenous, black, and queer and trans people and organizations. These projects demonstrate what she calls the "submerged perspectives" in the "extractive zone" of Latin America, and are as such noted as an intervention into the a-historical nature of recent scholarship concerning the notion of the Anthropocene in Western academia. In this light, Gómez-Barris points out that these traditions have shown that environmental chaos is not an undifferentiated phenomenon caused or experimented evenly by a universal notion of humanity, but anchored in conquest and colonial epistemes. To this point, she argues that the recognition of such perspectives entails the rejection of approaches addressing ecological degradation that are unconcerned with its racial and colonial histories. Therefore solutions, redresses, and healing will not come from dominant entities and frameworks, be they settler states, multinational corporations, or neoliberal paradigms. The project of climate justice would as such ultimately mean the abolition and decolonization of dominant frameworks, in favor of as she puts it, "the possibility of renewed perception" as harbingered in the historical struggles and demands for indigenous sovereignty, queer and trans liberation, and an end to policing, militarism, and gendered violence today [7]. A homage to these histories and its contemporary representations in the various works that Gómez-Barris discusses, *The Extractive Zone* is also a call for the need to, by extension, unsettle colonial relationships to land and the forms of violence they reproduce.

Taking a similar perspective, *Possessing Nature* draws on the legacies of the Latin American avant-gardes (1920-1970), which have similarly not been considered in art historical accounts of modernity until recently in the Global North. [8] As portrayed by Mari Carmen Ramírez and Héctor Olea, this tradition worked to create "inverted utopias", or representations distinct from the European and North American avant-gardes. [9] Spanning a multitude of artists, sites, and media, this historical legacy converges on fusing European and indigenous traditions, and a shared belief in the constructive power of this fusion to compel imaginations about the possibility of recreating Latin America, and by extension its vision of the world, on its own terms. In *Possessing Nature*, Candiani and Ortega honor this artistic tradition accordingly, not only by bringing it into the limelight of a prestigious cultural space, the Venice Biennale, but also by extending its relevance for addressing a pressing shared condition at present, the Anthropocene from a historical perspective, thereby re-framing the current water crisis facing Mexico City as a symptom of the enduring grip of a progressivist notion of historical development. The project's deviation from singular to multiple temporalities, was similarly echoed in both its curatorial conception and material articulations.

Curating *Possessing Nature*

The curatorial concept of *Possessing Nature* undercuts Western notions of art. Rather than a focus on mastery (the artist genius) and a-historical notions of beauty, the work is based is based on collaboration and historical research. Jasso proposed tracing the divergent developments of Mexico City and Venice through their respective historical relationships with bodies of water. To elucidate, the exhibition catalogue includes selected curatorial research in the form of commissioned essays and archival and contemporary photographic documentation about this topic alongside documentation of the artistic component of the project developed in response to Jasso's proposal to relate the aquatic urbanities of Venice and Mexico City.

An essay by the science historian Roberto Ponce-López notes that maritime connection was a central factor for the divergent development of Venice and Mexico City, as one city had access to the sea and the other did not. This difference was accentuated by the Spanish colonization of Mexico, during which the unsustainable dredging of Tenochitlan's lagoons began. Ponce-López uses historical records by Spanish chroniclers to show that upon their arrival in 1519, they likened the Aztec capital (then called Tenochitlan, and dating to 1325), to Venice. Build on an island surrounded by lake Texcoco, Tenochitlan's transportation, trade, and agriculture were adapted to the lake, and, to this end, a sophisticated hydraulic system of interlocked bridges, dikes, and gates was collectively built and managed. For the Spanish, and for subsequent European colonizers, however, the lake was of no interest as it was disconnected to the sea route to Europe. They instead focused on draining to claim land from the lake, so as to recreate European models of land enclosure, or feudal haciendas. [10] [2]

Photographic documentation included in the exhibition catalogue evidences that drainage became entrenched as successive governors used it in a bid for historical recognition post-independence as Mexico became a nation-state. [11]. The commissioning and building of ever more monumental drainage systems became a shared project of every Mexican politician in power, regardless of his (they have been all men) political affiliation, and notwithstanding repeated failure of such projects to work as promised to stop periodic, regular floods. This legacy still has ecological consequences today. Parts of the valley are now deserts, and almost six centuries of overdrawing depleted the aquifer beneath the city. [12] This in turn causes parts of the city to

[1] The term Anthropocene is a combination of two Greek words, anthropo-, from the Greek Anthropos, meaning "human" and –*cene* from *Kainos* meaning "new" or recent. The term as been popularized in recent Western academic discourse about climate change and in particular in cultural and media literature where it is used as a shorthand for the claim that we have entered a new geological epoch characterized by significant human impact on the Earth's geology and ecosystems.

[2] Lake Texcoco was the largest of an interconnected chain of 5 major lakes in the valley of Mexico.

sink and buildings to crack as the soft lake sediment underlying the city liquefies during earthquakes, which are frequent in this volcanic landscape. Drainage is still upheld as the principal means of avoiding ecological and economic collapse in a city of twenty million inhabitants. However, the recent and wide-spread protests against the then-president, Enrique Peña Nieto (2012-2018) under whom the draining of the remnants of Lake Texcoco to build Mexico City's new airport began, show that civil society is beginning to mobilize around issues about ecological justice and in favor of restoring the city's aquatic environment, as part of broader demands for an end to state violence. *Possessing Nature* was conceived in light of these protests as construction of the airport began in 2015, right around the time of the Venice biennale.

In comparison, an essay by the art historian José Carlos Barrios situates the project in Venice, and specifically its biennale's location in the Arsenale, Venice's former shipyard and armories. Venice's origins trace to the 5th century, when a group of refugees from Padua settled in this area as they found in its lacustrine environment a natural defense against invaders. The city became a major financial, maritime, and cultural power in the Middle Ages, between the 10th and 15th centuries, and the Arsenale, as Barrios notes, was central to its monopoly of the Mediterranean trading routes connecting Europe to Asia. As he puts it, it then represented the "biggest industrial complex in Europe before the industrial revolution" and beyond, it was instrumental for the development of capitalist forms of production based on "work in series, freedom of contract, production of debt and desire, instrumental management of nature." [13] Additionally, the Arsenale was the gateway for Venice's status as a knowledge center during this time. Merchants collected classical works from the Middle-East on their journeys, which were translated, printed and distributed to the rest of Europe. The cultural legacy of the Arsenale includes literary and scientific works key to European modernity. These include Dante Alighieri's *Divina Commedia* (14th century), which references the Arsenale as a hellish workshop, and Galileo Galilei's theory about the mechanics of materials, concerning the relation between their strength and resistance, which he developed in the 16th century after visiting there.[3] Beyond Italy, Shakespeare showed how law should be the guarantor of free commerce in his *Merchant of Venice* (1598), and the French philosopher Jean-Jacques Rousseau held Venice's Republic as a model of enlightened governance in the 18th century heralding the era of the modern nation-state.

Long after Venice's mercantile era, as trade shifted to the dark sea (as the Atlantic was then known) in the 15th century, the Arsenale was eventually rehabilitated as one of the biennale's venues in the 19th century. It is as such today part of the city's creative model, a form of urbanity that in retrospective was foreshadowed by the biennale. Founded in 1895, the Venice biennale is today one of the most prestigious art events showcasing contemporary art from around the world. Its global and nationalist models trace to the universal exhibition, and by extension its utopian equation of the nation-state's social progress with its degree of industrial development. The 56th Venice Biennale, the first curated by an African-born curator, Okwui Enwezor, and entitled *All the World's Futures*, was dedicated to diagnosing the aftermath of this project. *Possessing Nature* reflected by and large the somber mood in the era of the Anthropocene, as did many of the projects, altogether pointing to a fragmented world mired in inequalities and other forms of violence. Yet it also addressed the need to move forward without losing an awareness of the past. The project was exceptional inasmuch its curatorial concept was not only historical, but also based on the collaboration of two artists, in a remarkable departure from the norm in this kind of international event, which tends to capitalize on the value of individual works.

Possessing Nature's Material Heterogeneity

Jasso approached Candiani and Ortega as their work was familiar to her from previous collaborations in Mexico, and as such knew about their shared interests in site-specific installation projects. In response to Jasso's proposal to consider multiple temporalities and spaces, Candiani and Ortega created *Possessing Nature* similarly, as an installation that draws on a multiplicity of materials and media forms for its meaning, letting go of the object and purity of medium as favored in Western art, to focus on relationships and heterogeneity. It consisted of a tripartite assemblage including a route, a hydraulic sculpture, and a video projection. The route marked two parallel white lines traced in a zigzag shape on the pavement. These lines mapped the buildings housing the Mexican Pavilion at the Venice Biennale since 2007. The traces began at the Palazzo Soranzo Van Axel, where Rafael Lozano-Hemmer's interactive light and sound installation entitled *Some things happen more often than all of the time* inaugurated Mexico's participation in the Biennale. From there, the route led to the Palazzo Rota Evancich and to the former Church of San Lorenzo, respectively the Mexican pavilions in 2009 and 2011, and in 2013. The Arsenale's Sale d'Armi (1460), where the sculptural and visual components of *Possessing Nature* were installed as the final stop in the route.[4]

Inside, a monumental structure measuring 21 x 11 x 5 meters was arranged to echo the zigzagging traces leading to it (fig. 2). Made of tall steel plates, the structure concealed hydraulic pumps submerged in the lagoon underneath. The water moved in a closed cycle as it was pushed between the

[3] The reference is in the twenty-first canto of the *Inferno*.

[4] This location also marks the end of Mexico's perambulatory presence at the Biennale, as the country's government committed to rent the space for the next twenty years.

plates and returned to the lagoon.[5] The cycled water produced a roaring sound and vibrations evocative of an earthquake.

Placed against the structure, a rectangular pool filled with lagoon water provided contrast to the steel verticality and opaqueness, as well as functioned as a screen for the video piece created by Ortega. The projection was best watched from a viewing platform above the pool (Fig. 3). The video consisted of a split-screen collage of historical and contemporary images of Venice's and Mexico City's aquatic landscapes and infrastructures. Images of both cities are shown alongside each other. For example, a postcard image of Venice and its characteristic gondolas is juxtaposed with its counterpart, an image of the trajineras of Xochimilco, today the touristic remnant of the city's pre-hispanic canals (Fig. 4). Next, an image of a charming bridge in contemporary Venice appears next to the tequixquiac tunnel in Mexico, as is today, a waste dump (Fig. 5).[6] The pool's glistering surface lent an enticing luminosity. Otherwise, the somber mood inside the hall—as condensation dripped incessantly down the hall's walls and a strong swampy odor permeated the air—echoed Dante's quote from the twenty-first canto of the *Inferno*, in which he compared the spectacle of the industrial activity of Arsenale to the darkness of hell's depths. It is now etched on the Arsenale's main entrance:

> As in the Arsenal of the Venetians
> Boils in the winter the tenacious pitch
> To smear their unsound vessels ov'er again,
> For sail they cannot; and instead thereof
> One makes his vessel new, and one recaulks
> The ribs of that which many a voyage made.
> One hammers at the prow, one at the stern
> This one makes oars and that one cordage twists
> Another mends the mainsail and the mizzen.

Taken together, *Possessing Nature*'s components—a cartographic trace, a hydraulic sculpture, and a video—materialize the project's curatorial proposal, to collaborate toward decentering Western time and space; that is temporal progression, as well as linear space and its bequests of instrumental perspectives of and relationships with nature that still dominate today. *Possessing Nature* pays homage and builds upon the parallel modernity developed by the Latin American modernist avant-gardes, a legacy that because of its focus on multiplicity and hybridity, opposed to the purism of Western modernist art, was until recently largely overlooked in historical accounts about modernity. *Possessing Nature* addresses as much the origins of Mexico City's current ecological impasse; that is its unsustainable relationship with water as a result of unthinking imitation of European models, as does the envisioning of this relationship anew, this time from the lens of a fresh appraisal of indigenous modernity.

In this light, *Possessing Nature* takes as its entry point mapping in reference to the critical geography bequeathed by the Latin American avant-garde. Critical geography refers to cartographic practices that challenge the dominant culture's representation of a territory, with *Inverted America* (1943) by the Uruguayan artist Joaquín Torres-García representing one of the poignant examples. Torres-García's drawing of an inverted map of the American continent (the South is on top), has been interpreted as a rejection of the notion of Latin American avant-gardism as a derivative of its European and North-American counterparts, and conversely, as a call for cultural autonomy. [14] The map encapsulates the artist's project, named the School of the South, and conceived both as an avant-garde manifesto and workshop based on the integration of indigenous, i.e., pre-Columbian, and European, i.e., abstraction, representations, an art which he deemed, Constructivist Universalism. It is at its most basic, a rejection of linear space, seen as the ideal in Western art, however instrumental in European colonialist projects.

Similarly, *Possessing Nature* counter-maps by connecting Venice's constellation of architecture and power built out of the city's monopoly of maritime routes, and relating these connections to the present conditions in Mexico, as locked in enduring colonialist culture and inherent unequal power relations. Built for a nobleman, the Palazzo Soranzo Van Axel (1473-79), represents the feudal component of the Republic. The Palazzo Rota Invacich, built in the sixteenth-century for a wealthy Venetian merchant family stands for its capitalist economy. The Church of San Lorenzo, built for the mendicant orders (the Benedictes) in the ninth-century, represents its Christian doctrine. Bringing all the branches of the Republic together, the Arsenale's Sale d'Armi symbolizes military control over the waters of the Mediterranean Sea. According to Jasso, this counter-cartography traces likewise the historical origins of the biennale, and the conditions of its current moment described by Enwezor as a "global landscape" that recalls once again "the evanescent debris of previous catastrophes." [15] Jasso notes similarly the "overwhelming coincidence" of Mexico's choice of the Arsenale as its permanent venue at the biennale, as "the country is living under the most violent circumstances, a clear case of state terrorism that threatens not only nature and security but life itself." [16] *Possessing Nature* inverts the nationalist model of the Venice Biennial, and by extension forecloses Mexico's participation as such (as a sign of nationalist pride), instead placing focus on nationalism and colonialism as expressions of linear spatiality. The adoption of this model as the ideal in art spaces as prestigious as the Venice biennial is again evidence of the persistent belief in

[5] Overtime, the pumps were reclaimed by the lagoon's waters, as salty deposits and animal and plant life corroded them in two months.

[6] The project's origins trace to a proposal by the German explorer Alexander von Humbolt to stop flooding in Mexico City. The French emperor Maximiliam, then ruling Mexico began its construction, which completed under the dictator Porfirio Diaz in 1900. The city flooded 4 years later.

the idea that Western cultural, political and economic standards are the markers of intellectual and spiritual progress.

Figure 2. *Possessing Nature* (2015), *Arsenale*, Venice Biennale 2015. Courtesy of Tania Candiani.

Figure 3. *Possesssing Nature* (2015), pool with video projection. Courtesy of Tania Candiani

Figure 4. *Possesssing Nature* (2015), video projection. Courtesy of Tania Candiani.

Figure 5. *Possesssing Nature* (2015), video projection. Courtesy of Tania Candiani.

The hydraulic sculpture inside the Arsenale stands likewise in reference to this notion, as well as its materialization as drainage systems brought to Mexico City from Europe during conquest. In extension to counter-mapping, this drainage system evokes the notion of counter-monumentality in the sense of this concept's application by Rafael Lozano-Hemmer, who, as previously mentioned, was the first artist to represent Mexico at the biennale. Lozano-Hemmer's notion of counter-monumentality, which he developed as "relational architecture", draws on the Brazilian avant-garde, specifically the artists Lygia Clark and Hélio Oiticica who in the 1960s and 1970s created the concept of relational objects.[7] Unlike static sculpture, relational objects were meant to be manipulated by the public such that new configurations and relationships would emerge. Similarly, relational architecture involves public participation into reconfiguring the memory of a space, in this case, by emphasizing the interconnection of bodies, technology, and memory. It is counter-monumentality because by addressing trauma, it rejects the "necrophiliac" underpinning of monumental power, as the artist puts it. The point is to compel "new memories and relationships, including connections to contemporary massacres that are taking place today."[8] [17] It is a monumentality that again lets go of the linearity of Western time and space.

While the hydraulic sculpture in *Possessing Nature* is not participatory per se, its concept is similarly counter to the logic of monumental power and its pursuit of centralized control. In this case it concerns water and the environmental destruction wrought on by hydraulic engineering in Mexico, as exemplified by today's deteriorated state of the tequixquiac tunnel. (This project, which consisted of a 9 km tunnel designed to stop flooding in Mexico City, was meant to represent the crown jewel of the Porfiriato's technocratic rule; however, only to prove its inadequacy to the task four years after its completion in 1900, as the city flooded once again). From this perspective, Jasso notes that the hydraulic sculpture references a "failed modernity" based on "a scale of possession" that matches "the arrogance to create ever bigger constructions, always with the aim of giving shape to anything, as long it was 'the biggest construction in the world'." [16] Similarly, Candiani alludes to this history, stating that "it [the hydraulic sculpture] is just as impressive, as is useless", and "a wound roaring in pain."[9]

Inasmuch as the first two components of *Possessing Nature* evoke the underlying links between linear representations of time and space, and show how they manifest as ideals in art and science (cartography and hydraulic engineering), the piece concludes with a proposal for relating with water (nature) and memory (history) in reference to multiplicity. Conceived as such, the video projection created by Ortega involves the interplay of water, light and shadow, as elements central in modern Mexican architecture, as exemplified by the works of Luis Barragán (1902-1988), one of Mexico's most celebrated architects and the winner of the Pritzker Prize 1980. At a time when European architecture celebrated "a machine for living", Barragán emphasized natural elements, such as water, as well as the interplay between color, and light and shadow, as central components of his vision of modernist Mexican architecture, created as a synthesis of the vernacular hacienda, Mediterranean, and modern architectures. Barragán worked against the prominence against the prominence accorded to the "uninhabitable glasshouses," to reinstate the "shadows" as a basic human need. [18] From this multi-layered perspective, the architect saw the house (which is also the root word of ecology, from the Greek word, *oikos*) as an environment emerging out of the different tones of shadows, and as such, as a space enriching because of its allowance of the resonances of memory and tranquility. In sum, Barragán's vision privileged shadows as metaphors of history and slow time, opposed to European modernist architects' focus on light as synonymous of speed and historical development.

Similar notions underpin Ortega's manipulation of the cinematic image and choice of the pool as a screen. The video recalls travel documentary, a cinematic genre associated with anthropological expeditions and tourism, only to undercut this tradition's connotations with mobility and speed. For segments of the video, Ortega filmed in motion, shooting while walking, and from boats and gondolas, but used a high-speed camera to slow down the images. As a result, the images projected on the pool attract not because of their movement, but because of their glistering quality akin to that of a shadow play, the predecessor of modern cinema. A longstanding focus for Ortega, this aesthetic is underpinned by his interest in questioning the Western equation of light with truth and knowledge, and conversely, of the shadow with guilt and suffering, as exemplified by Dante's quote at the entrance of the Arsenale. In highlighting Barragán's notion of the role of shadows and darkness in contemplative reprise, Ortega's watery screen denotes similarly an alternative understanding of enlightenment, as embracing multiple histories and aesthetics. Furthermore, the evocation of Barragán in this context is not coincidental, but implicates a subtle address to the project of reclaiming historical legacies, in this case, very concretely, Barragán's professional archive. As it happens, following the architect's death, the archive was bought by the

[7] The term relational, as the artist indicates, is additionally inspired by its use by the Chilean biologists and cyberneticians Humberto Maturana and Francisco Varela in the 1970s. They proposed that the minimal definition of life may be based on one property, which they called autopoeisis. As they theorized, autopoeisis is a relational property, as it depends not on the nature (i.e., type, intrinsic properties) of the components of those entities which have the property, but on the relations between the components.

[8] Obliquely alluding to de-familiarization as a goal of relational architecture, Lozano-Hemmer notes that such processes are set in motion by introducing what calls, "alien memory", or "something that is familiar but does not belong," into a given space.

[9] Personal communication with the artist, September 10, 2018.

Italian architecture historian, Federica Zanco, who was born in Venice. Since then, Zanco's control over and restriction of access to the archive, which is stored at the headquarters of Vitra, a Swiss furniture company, has been compared in a 1998 article in *La Journada* to "the conquistadors' pillaging of Mexican soil for gold and silver," and was center stage in recent artistic projects aimed at restoring public access to its contents.[10] A discussion of the significance of Barragán's work for contemporary urban planners and architects in Mexico is beyond the scope of this paper, but suffice to say that many of them cite Barragán as their inspiration for the restoration of the aquatic environments of the city.

Concluding with a shadow play on the murk of the Venice's lagoon, *Possessing Nature* proposes likewise that the restoration of nature and history are interrelated projects. Hence, its concerns about re-envisioning water and memory beyond the progressivism of modernism and the a-historicism of the Anthropocene—that is, the re-building of sustainable relationships with nature and culture—are based on the inclusion of the multiplicity of "submerged perspectives." [7] As Moxey sums up: "Only when the histories from the peripheries can be related to the dominant one, then the particular nature of both histories becomes evident". [3]

Acknowledgements

My gratitude to Tania Candiani for kindly sharing documentation and thoughts about the project.

References

[1] María Férnandez, "Postcolonial Media Theory", in *Art Journal* Vol. 58, No.3 (Autumn, 1999), pp. 58-73.

[2] José Carlos Mariátegui, "How Media Art Becomes Social: A New Technological Culture in Latin America", in *Latin American Modernisms and Technology*, edited by María Férnandez (New Jersey: Africa World Press, 2018), 357-378.

[3] Keith Moxey, "Multiple Modernities, Is Modernity Multiple?", available at, http://www.columbia.edu/cu/arthistory/courses/Multiple-Modernities/moxey-essay.html.

[4] Tania Candiani and Luis Felipe Ortega, *Possessing Nature* (Madrid: Artes Graficas Palermo, 2015).

[5] Eduardo Galeano, "La Primera Guerra del Agua", in *Espejos: Una Historia Casi Universal* (México: Siglo XXI, 2008), 123. Translation by the author.

[6] Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley, CA: University of California Press, 1996).

[7] Macarena Gomez-Barris, *The Extractive Zone, Social Ecologies and Decolonial Perspectives* (Durham and London: Duke University Press, 2017), 1.

[8] Rubén Gallo, *Mexican Modernity: The Avant-Garde and the Technological Revolution* (Massachusetts, MA: MIT Press, 2005).

[9] Mari Carmen Ramírez and Héctor Olea, *Inverted Utopias, Avant-garde Art in Latin America* (New Haven and London: Yale University Press, and the Museum of Fine Arts, Houston, 2004).

[10] Roberto Ponce-López, "What the lagoon left us, Changes of urban space in Mexico and Venice", in *Possessing Nature*, 80-89.

[11] Karla Jasso, Ana Sol González, Roselin Rodriguez, and Ximena Juárez, "Hydrous Bodies and Deep Time", in *Possessing Nature*, 115-198.

[12] Michel Kimmelman, "Mexico City, Parched and Sinking, Faces a Water Crisis", *New York Times*, February 17, 2017, available at, https://www.nytimes.com/interactive/2017/02/17/world/americas/mexico-city-sinking.html.

[13] José Carlos Barrios, "Art, biennials and spaces, brief essay about a recent history", in *Possessing Nature*, 50.

[14] Mari Carmen Ramírez, "Inversions, The School of the South", *in Inverted Utopias, Avant-Garde Art in Latin America*, 73-83.

[15] Okwui Enwezor, "All the World's Futures", 2015, available at, https://universes.art/en/venice-biennale/2015/tour/all-the-worlds-futures/curatorial-statement/.

[16] Karla Jasso, "Possessing Nature", in *Possessing Nature,* 58-59.

[17] Marie-Pier Boucher and Patrick Harrop, "Alien Media: Interview with Rafael Lozano-Hemmer", in *Latin American Modernisms and Technology*, 318.

[18] Alice Gregory, "The Architect Who Became A Diamond," in *The New Yorker*, August 1, 2016, available at, https://www.newyorker.com/magazine/2016/08/01/how-luis-barragan-became-a-diamond.

Bibliography

Candiani, Tania and Luis Felipe Ortega. *Possessing Nature.* Madrid: Artes Graficas Palermo, 2015.

[10] The American conceptual artist Jill Magid has an ongoing project entitled, "The Barragán's Archives" (2013-ongoing), consisting of installations and performance, and including a film with the director Laura Poitras, entitled *The Proposal* (2018), concerning this topic.

Enwezor, Okwui. “All the World’s Futures”, 2015. Available at, https://universes.art/en/venice-biennale/2015/tour/all-the-worlds-futures/curatorial-statement/.

Fernández, María. “Postcolonial Media Theory.” *Art Journal* Vol. 58, No.3 (Autumn, 1999): pp. 58-73.

Fernández, María, editor. *Latin American Modernisms and Technology.* New Jersey: Africa World Press, 2018.

Findlen, Paula. *Possessing Nature Museums, Collecting, and Scientific Culture in Early Modern Italy.* Berkeley, CA: University of California Press, 1996.

Gallo, Rubén. *Mexican Modernity: The Avant-Garde and the Technological Revolution.* Massachusetts, MA: MIT Press, 2005.

Gomez-Barris, Macarena. *The Extractive Zone, Social Ecologies and Decolonial Perspectives.* Durham and London: Duke University Press, 2017.

Galeano, Eduardo. *Espejos: Una Historia Casi Universal.* México: Siglo XXI, 2008.

Gregory, Alice. “The Architect Who Became A Diamond.” *The New Yorker*, August 1, 2016. Available at, https://www.newyorker.com/magazine/2016/08/01/how-luis-barragan-became-a-diamond

Kimmelman, Michel. “Mexico City, Parched and Sinking, Faces a Water Crisis.”*New York Times*, February 17, 2017. Available at, https://www.nytimes.com/interactive/2017/02/17/world/americas/mexico-city-sinking.html.

Moxey, Keith. “Multiple Modernities, Is Modernity Multiple?”. Available at, http://www.columbia.edu/cu/arthistory/courses/Multiple-Modernities/moxey-essay.html.

Ramírez, Mari Carmen and Héctor Olea. *Inverted Utopias, Avant-Garde Art in Latin America.* New haven and London: Yale University Press and The Museum of Fine Arts, Houston, 2004.

Author Biography

Claudia Costa Pederson holds a Ph.D in Art History and Visual Studies from Cornell University. Her research focuses on contemporary art and digital culture. Her essays appear in *Editorial Centro de Cultura Digital*, *Review: Literature and Art of the Americas*, *Journal of Peer Production*, *Media-N*, *Afterimage*, *InterActive*, *Intelligent Agent*, *Eludamos*, and ISEA, DAC, and CHI conference proceedings. Book chapters are included in *The Philosophy of Documentary Film*, *Indie Reframed: Women Filmmakers and Contemporary American Cinema*, *Cinema em Redes: Tecnologia*, *Estetica e Politica na Era Digital*, and *Latin American Modernisms and Technology*. Her book, *Gaming Utopia: Ludic Visions in Art, Design, and Media* is forthcoming from Indiana University Press. Pederson is currently an Assistant Professor of Art and Technology at Wichita State University, and the Finger Lakes Environmental Film Festival Curator of New Media.

One Step: The Impact of Interactive Public Installations on Promoting Public Awareness of Poverty Issues

Jinsil Hwaryoung Seo, Eman Al-Zubeidi
Courtney Michalsky, Stephanie Sykora, Lauren Toler
Soft Interaction Lab, Texas A&M University
College Station, United States of America
hwaryoung@tamu.edu, eman.alzubeidi@tamu.edu

Abstract

Those living in poverty are often misjudged as being the reason they are in their situation. Because of this misconception, most people do not know how extensive and how many people are affected by poverty. The problem is commonly ignored mainly on the college campuses. We developed bodily interactive displays entitled *One Step* to address this issue and promote public awareness. *One Step* aims to create an emotional response and understanding in its viewers and nurture a relationship between individuals affected by poverty and students. To investigate effectiveness of the interactive displays, we compared a non-interactive version (print posters) serving as a baseline, with an interactive version where participants' body movements are translated into the system playing the interactive contents. The study presents that interactive displays are more engaging than non-interactive displays and more effective to support promoting public awareness around poverty issues.

Keywords

Interactive art, public art, public awareness, poverty, community

Introduction

It generally defines poverty as "a state of one who lacks a usual or socially acceptable amount of money or material possessions" [1]. According to the United Nations (UN), 1.4 billion people live in extreme poverty conditions, about 1/5th of the global population. In the United States, 46.7 million people live in poverty, despite a growing economy and declining unemployment rate [2]. A recent study by the Bush School of Government and Public Services found "... more than 28 percent of the population in the Brazos County lives at or below the federal poverty line. This includes 26.3 percent of those less than the age of 18, 10.6 percent of those more than age 65, and 15.9 percent of total families [3]. There have been many governmental and nongovernmental efforts to reduce poverty. These range from neighborhood efforts to campaigns with a national focus. However, many people remain unaware of or misunderstand this issue. One of the misconceptions about the poor in America is that people are poor because they are lazy. This is not true. There are many factors that affect the poor including economic instability, cultural discrimination, physical or mental disability, or familial problems. Poverty is not just life below the poverty line, it's living under financial stress, where it is difficult to maintain the quality of life [4]. After searching for organizations on campus that tackle this issue, we were surprised to find that only 4 existed, most of which were only just recently created and not very active. This finding further strengthened our desire to bring to light the issue of poverty in our city to our campus.

We focused on creating a campus awareness project using interactive public installations. Due to recent innovations in display and projection technologies, and sensing methods which enable a greater variety of interactions, public interactive installations are growing in popularity across public urban spaces. Such spaces include museums, libraries, plazas, and architectural facades, where these projects can present information and enhance experiences with highly visual interactivity. Over the years, a significant body of research has formed around interactive public displays, including media facades, museum displays, community displays, and interactive displays embedded in urban settings. Even though public interactive installations have proven to be effective in engaging multiple people at a time, most installations feature only one application, geared toward one particular issue [5]. Not many works present social issues to increase the awareness on relevant topics [6, 7]. After researching poverty in our community, we decided to share what we learned with the public through interactive art installations. The aim was to open eyes and spark involvement in issues surrounding poverty. We decided to create public installations in the form of interactive poster displays, because a poster is a common format to share ideas and information on campus.

We created *One Step*, a public interactive installation designed to engage people with the realities of poverty in our community, to encourage them to take steps to get involved, to help solve this issue, and to see those living in poverty as people who are not so different from ourselves. With *One Step*, we studied how people interact with interactive displays installations, and how these interactions are evolving for raising awareness of poverty issues via qualitative and quantitative research methods. In this paper, we

start with a background review on creative efforts for raising awareness of poverty, focusing on efforts from Interactive Art Installations for public engagement and the Human Computer Interaction (HCI) community. Next, we present the design process of *One Step*. Then, the study setup and the procedure are presented together with the results.

Background

Public Engagement via Interactive Art Installations

Interactive arts often actively grasp the attention of audiences, in contrast to the conventional ways of experiencing art. They invite viewers to become an active part of the artwork in order to create new meanings by responding to the technology around the artwork. Based on the Edmonds's research [8], Wang, Hu, and Rauterberg defined three types of art and technology works according to the carrying technology and interactivity [9]. Hu, J., et al. added one more type to make a total of four: static form, dynamic form, interactive form, and participatory form [10]. A Static form means that there is no interaction between the art artifact and the viewer. Dynamic forms refer to an art project that has its own system to evolve its forms, depending on its surrounding conditions. Examples of these conditional changes include temperature, sound or light. In interactive forms, the viewer has an active role in influencing the dynamics of the artwork. The input from the viewer can be a gesture, motion, or sound, as well as any other human activity that can be captured by the sensing system of the artwork. Participatory forms allow social interactivity to contribute to the physical and digital parts of the artifact. Artists create these the public arts as platforms for other artists and the public to contribute to the artifact and to develop relationships amongst all parties. Since interactive arts are always emerging with new interactions and new narratives based on how users participate, interactive art forms are being utilized for increasing participants' engagement in a public environment. Examples of this include art installations visualizing real-time data [11], interactive floors [12, 13], interactive objects in museums [14], and an information wall [15].

Many of these systems include some kind of sensing technology, in order to recognize people and allow the system's interaction. There are three interactive techniques commonly used with public displays: direct, bodily, and mobile-based [16]. Direct interaction assumes that the user is close to the display, and that the interaction takes place using the user's hand. While studies show that this technique is fast and natural, it requires direct physical effort from the user [16, 17]. Bodily interaction happens via gestures, postures, or proximity. Although studies show that this type of interaction is quick and intuitive, it sometimes is difficult for the user to understand the interaction, and therefore brings a cognitive load to the user [18]. This type of interaction also increases concerns of performing gestures in public spaces [16]. Furthermore, researchers have evaluated gestural techniques for locations where users merely pass-by and rarely stop to interact with the work [17]. Body gestures were found to be not well suited to passing-by interaction, while hand Gestures can be performed while walking, and have an acceptable mental, physical and temporal workload [17]. Lastly, mobile-based interaction has become one of the most common techniques. It allows the user to interact from any distance, without any physical effort. However, users often find this technique too technical and disconnected [16].

One of the biggest challenges for the design of interactive public displays is figuring out how to communicate interactivity with people. People may or may not notice the installations. Once interactivity has been noticed, the next challenge is to motivate users to interact with the screens in public settings. In addition, the interaction should be meaningful, and effective, so that participants do take actions toward the intended goal of a project. Various strategies for engaging audiences have been developed. Researchers suggest that playfulness might be considered one of the most critical elements to provoke more meaningful experiences as an individual, or as a group [19, 20].

Creative Efforts for Awareness of Poverty

Artists have been investigating the interface of these media arts, in an attempt to reveal forms which engage audiences. "In My World" is a story-based website that discusses the challenges that people with mental illnesses, of countries in crisis, face every day [21]. The whole approach is very personal, full of photographs and testimonies, both written and recorded. This approach makes it easy for the user to relate to the storyteller and understand the reality of these issues. These are the sort of relatable interactions we hope to exhibit in our website. We also found it intriguing that they had a call to action for users to share their own personal stories about the issue so that these users' perspective could also be shared with others. We thought this could be another way to encourage interactivity and community in our own project. Although campaigns like "In My World" are successful in drawing attention to a subject, they lack in forming a community. Our campaign is centered around making relationships throughout a community, which ultimately will have a more meaningful and lasting impact.

The Compassion Experience [22] is an interactive work that we took inspiration from. In the Compassion Experience, participants wear headphones and listen to a story of a child who lived in poverty, while walking through reconstructed rooms of the child's life when growing up. When we visited the Compassion Experience, we were impressed with how the use of sound, along with the visuals, affected us. We felt that sound placed the user in the scene, and made it more impactful. As a result, we wanted to incorporate sound into one of our interactive posters.

Vilaza et al. created "StreetHeart", a project that provides a channel for homeless artists to share their artworks with other people. These artworks can be viewed via public displays and can be purchased through an online store [23].

"StreetHeart" has the potential to empower the homeless artists, and bring them closer to society.

Efforts in Interactive Art/Design Research for Poverty Issues

In Interactive Art/Design Research, there is a growing community to explore different poverty issues in various populations. One of the popular issues is "homelessness". Several researchers investigate HCI challenges in homelessness and the relationship between the homeless and everyday technology. The challenges involved include access to technology and information, reaching the community, and empowering homeless people to create new knowledge in education and health [24]. Le Dantec and Edwards studied how homeless people relate to technology, the urban environment, and their social networks. They suggested that when designing innovations for homeless people, an inclusive awareness of the social context of technology is critical [25]. Jill Woelfer et at. have explored issues around technology with youth homeless, who suffer mentally and physically from the long-term effects of childhood trauma. They studied how homeless young people experience information systems and personal digital technologies [26]. They created "InfoBike", industrial-sized tricycle equipped with information and an Internet access point. It has been used as a site for investigating mobile phones and place-based safety [27]. There are also creative designs that empower homeless people through different activities. "Elevate" is a mobile system that allows homeless people, and their supporters to update and receive notifications about locations serving free hot meals in a given area [28]. "Enroll Me" is an information transfer device to expedite the enrollment of homeless children in schools. Homeless children change schools often, seriously disrupting their educational experience. Their design uses existing, familiar technology to unobtrusively facilitate the enrollment process for both the school staff and the homeless parents [29]. "Homeless HealthShare" is a web-based system that supports the improvement of the health of homeless people. This system supports healthcare professionals in terms of identifying, locating, and contacting homeless patients, in order to initiate and continue effective healthcare. [30].

One Step: Design Process

The general research objective of our project was to explore how interactive display installations can increase public awareness of social issues. To better inform our design goals, we conducted several design activities, including field study and design prototyping.

Poverty Study

In Voices of the Poor [31], a study done by World Bank, over 60,000 participants living in poverty were interviewed. The majority of the findings pointed to people's lack and need for well-being, over the need for material items. Furthermore in "A Framework for Understanding Poverty", the author argues that out of the 8 resources of well-being, emotional resources are the most important [32]. Looking at the depravity of the working poor, and the desperate need for a support system, we decided to focus our project on the importance of community within poverty, and how through authentic community we can overcome all aspects of poverty together. We started to research local shelters and resource centers that make personal connections with people in poverty in the community. After learning about their commitment to building lasting communities, we chose to collaborate with Habitat for Humanity in Bryan/College Station [33]. Habitat for Humanity lives out this community ideal by providing a one-year program to future homeowners. They've found that the personal relationships formed through this program are just as beneficial as the home itself. Looking forward, we will begin to establish our own relationships with the families that go through the Habitat one-year program. Through these relationships, we hope to gather testimonies, memories, and stories that not only will bring a real perspective of poverty to life but also will give the injustice of poverty a voice.

To examine the current awareness level from the community, we began by researching student organizations at Texas A&M University, in order to see how the Brazos Valley community is involved. What we found was shocking. Out of over a thousand student organizations, only 5 of them are contributing to fight against the poverty that surrounds us, most of which were just recently created. Moreover, we created a survey to see what the current awareness of poverty was within the student body. Over 71 percent of students who participated in the survey did not know that 30% of our community lived in poverty. In addition, almost 70 percent said they would be more likely to get involved if they knew more about the poverty in our area. Inspired by these results, we started a campaign on campus to inform people about poverty with interactive projects.

Concept Prototyping

As an early prototype (Figure 1), we focused on conceptualizing the interaction type for "taking a step closer to social issues" as an interactive installation. This seemed like a great way to evoke an immersive and embodied experience. We started with three issues, (human trafficking, the refugee crisis, and homelessness) and projected black and white photographs onto a screen on the wall. The common thread between the photographs was that the people present in each one are desperately in need and that this is where our help is important. As the viewer takes a step closer to the photograph, a motion graphic is triggered, and a drawing begins to form over the image of the presented issue. Slowly, the shelter around the people in the photographs is transformed, reiterating the note that it only takes one step to make a difference. After the motion graphic stops, the viewer is invited to take another step, to positively alter the surroundings of another person.

Our illustrations are animated on top of the black and white photographs, to transform the subjects' environment

Figure 1. One Step early prototype (A, B, C), Motion graphic animation (D, E), Technical Setup (F)

into healthier and safer settings. Here, we take this mom and her kids out of a refugee camp and place them in a fun and lively carnival setting (Figure 1D & IE). Our design reflects the contrast between our bold, serious topics, and a hopeful future for each cause. Black and white photographs clash with colors to demonstrate the harsh realities, but yellow is used to symbolize positivity and hope. In addition, the illustrations have a fluid, hand-drawn style to give off a natural & genuine feel. After all three of the social issues have been visited, the user is invited to take the next step in real-life, by visiting websites listed on a flyer for more information on the presented issues.

The installation consists of: a semi-curved screen for an immersive viewing experience (to draw the viewer in), a projector to project our videos onto the screen, 3 lasers with corresponding light sensors (that act as motion sensors on the ground to detect the user's footsteps), an Arduino board, and a closed hallway setting (to allow the user to go through a personal and private journey) (Figure 1F). In the prototype, an Arduino board sends signals to the software Processing, according to which laser was blocked.

Figure 2. Individual and group interaction

Processing then sends video signals to the software MadMapper via the Syphon protocol, and MadMapper utilizes projection images to fit the projection onto the semi-curved screen. We tried to ensure that the user experience was as intuitive and natural as possible.

Our main goal in creating *One Step*, was to convey to people that it's easy to make a difference. It only takes a step to make a difference in someone's life. We not only wanted to spread awareness of these social issues to others but also to encourage them to help make a change. It can be overwhelming, trying to make a change to the big social issues presented in the project. It can make you feel like you are just one person, and too small to have any impact on the situation. But that is not true. Showing the simplicity of making a change, helps to take away this overwhelming feeling. From what we saw and read from our participants, we think it is safe to say that we met our main goal. Although not everyone left with a flyer with additional information on the presented issues, everyone did leave affected, with more knowledge on the issues, and with the sense that even a single person can make a great difference in another's life. For the next study, we wanted to create a holistic campaign experience, to evoke a similar, strong emotional impact. This would involve working on the interactive display installations, print materials, and the social media activities.

Exploration of Individual vs. Group Interactions

As discussed earlier, poverty is not only an individual problem but also a problem that the community has to take actions against as a collective effort. Therefore, we decided to create two interactive displays, that could be experienced as either an individual or a group. The concept for the individual interaction was to put the user "into the shoes" of someone living in poverty (Figure 2A).

We achieved this through a motion graphic, accompanied with a sound design, displayed on a screen with a webcam. The webcam showed the user's face within a silhouette and allowed the user to see his or her face, as the face of the person in the motion graphic. This made the experience more personal and showed the user that poverty can affect anyone, even you and I. Whenever a user stood in front of the screen, and fit his or her face into the frame, the webcam would use face recognition to trigger an animation. This was done through the use of Touch Designer. The experience begins by showing the user in a secure home. But then, items around them slowly start to fade away to represent the beginning effects of poverty. Suddenly, the environment changes to a loud and busy street corner, to show how fast someone can lose their home and fall into extreme poverty.

Working together as a community is the only way to truly overcome poverty. Therefore, we experimented with a group interaction method. On the left side of a large computer monitor, we displayed general stereotypes of poverty. When a user moved in front of the screen, words appeared on the right side of the monitor and altered the original phrase on the left. The new phrase was now more positive and showed how we need to help our neighbors in poverty, instead of erroneously judging them (Figure 2B). The more that users move, the longer that the positive messages stayed on the screen. If the users stopped moving, the positive messages would disappear. These interactions worked together to show that not paying attention to poverty doesn't make it go away, we have to work to end it. This all was done using a motion tracking function and using pixel differences.

Final Installations

We believe that an interactive installation is a great way to evoke an immersive and embodied experience about a certain story. After multiple iterations, prototypes, and user studies, we created two final interactive displays that used different interactive elements to raise awareness at Texas A&M University about poverty. Both final displays functioned using an X-Box Kinect and a program called Touch Designer. These allowed us to capture users' body movement and facial recognition to trigger motion graphics within each display.

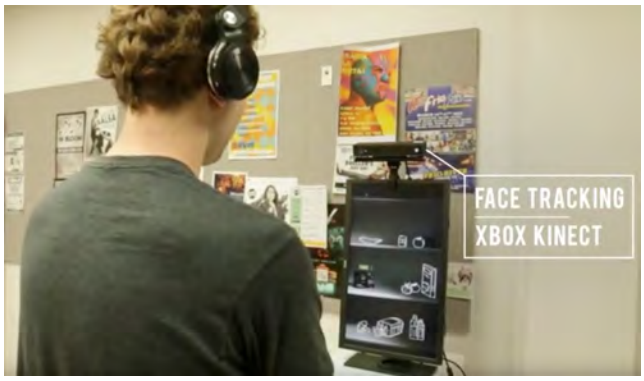


Figure 4. One Step final version

The first interactive display (Figure 4) focused on the hunger aspect of poverty, and how this issue affects 1 in 5 families in Brazos Valley every day. We brought to light an element of poverty that goes unseen in the development stage. In this situation, families are forced to choose between food and electricity, medical care, or heat. - This reality was portrayed through a narrative, which was told through a motion graphic and audio recording. Each user was placed in the shoes of a mother struggling to provide basic needs for her and her family. At the end of the video, we informed students of an organization called Campus Kitchen's Project. If started at our school, this organization could benefit over 73 local pantries. At the end of the experience, the users could choose whether or not to participate in our social media campaign, by sharing their screen capture to Twitter.

The second interactive display (Figure 5) was created to emphasize the original concept of community. This began with a photo of a substandard house in our community. As users moved in front of the house, a motion graphic would appear, drawing a new house on top of the original image. If the user stopped moving, the new house would fade away. This interactive installation emphasized the notion that although action is difficult, requires commitment, and is uncomfortable at times, it is necessary in order to help our neighbors living in poverty.

Figure 5. One Step final version

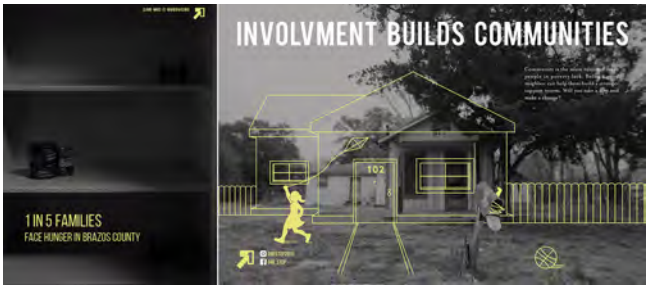


Figure 6. Print poster designs

Participant Study

To investigate the quality of participants' engagements with interactive displays, and how their interactions are meaningful for raising awareness among college students around local poverty issues, we conducted user studies in a public environment setting.

Study Materials

For the purpose of the study, we created two sets of displays (two print posters and two interactive displays) that illustrate poverty issues in the community (table). The print posters were created to correspond with the interactive posters. The first poster brought to life the reality of the hunger problem in Brazos County, within the development stage of poverty. The second taught the importance of community within poverty and why it is needed. The final interactive display installations were chosen for the study. We tried to make the setup compact and clean so that participants didn't feel that the displays were not too technical and complicated to use. The interactive displays don't require complex gestures to experience them, and they do detect any movements or faces in front of each display that uses the X-box Kinect.

Participants and Study Procedure

Twenty-five participants (15 males and 10 females), aged 19 to 25-years-old, participated in the study. Participants were recruited through a university mailing list. Participants scheduled a thirty-minute time slot to experience the interactive posters, and the print posters in the public space. As soon as a student agreed to participate in the study, and began scheduling a meeting time with us, they were assigned a subject ID number and then referred to as that number on all personal and research data documents. The only information during the recruitment process that would have had their name on it, would be the initial email reply from them.

Upon entering the interview room, the researcher introduced herself to the participant while briefly explaining the study procedure. The study consisted of four stages: 1) Pre-study questionnaire, 2) print poster experience, 3) interactive display experience, and 4) post-study questionnaire & interview. After the consent to participate was acquired, the participant was asked to complete the pre-study questionnaire which asked about the user's age, gender, major, and general understanding of the poverty issue. The second

and third stages were counterbalanced with half of the participants beginning with the print posters, prior to interactive displays, and the other half engaging with the print posters after interactive displays. All experience sessions were video-recorded for analysis. After experiencing the interactive displays and the print posters, the participant was asked to finish with a post-study questionnaire, which asked about what they learned from their experience. A short interview was conducted to ask about the user's experience in a greater detail. This concluded the study.

We collected qualitative and quantitative data. The qualitative data was obtained from observations and post interviews. For quantitative data, we relied on the interaction logs and images captured by the Kinect camera, as well as the survey data. For this purpose, we applied state-of-the-art computer vision algorithms to detect and generate the passer-by count. The logs were also used to contrast and corroborate the annotations by the researchers, regarding their observations.

Data Analysis and Findings

From the pre-study surveys, we learned that only 30% of the participants read print posters "every day", 55% of them read print posters "somewhat often" and 15% of participants read posters "not very often". When asked which print posters they remember seeing recently, most of the participants mentioned posters that somehow related to their major. Three participants commented that people tend to only pay attention to posters from organizations they are already familiar with and that they would be less likely to take the time to stop and read something new. 70% of the participants mentioned that they learn about social issues via social media, 20% said that they learn from word of mouth, and 10% said they learn about social issues via the news sources on either television or the internet. Most of the students (85%) didn't know about the poverty issues in our county.

Overall, participants preferred interacting with interactive displays to viewing print posters. 75% of the participants answered that the interactive displays were more effective and pleasant than the prints. 90% of participants said that they would pay more attention to the interactive displays on a normal day. Participants spent more time with the interactive displays. The user who preferred the print posters noted that print was what he was used to, and it was a quicker and easier way to get the information. The average time for each interactive display was 1 min 25 seconds while the average time for each poster was 22 seconds.

The experience with the print posters was generally positive, but participants complained about the lack of information that each poster provides. Many participants mentioned that they would not be likely to pay attention to the posters, because the colors did not stand out, and they normally would not stop and take that much time to look at one poster. Only 25% of participants answered that they would share what they learned from their experience with the print posters.

Participants' experiences with the interactive displays were mostly very positive. They felt that interacting with the interactive posters was intuitive and playful. Reasons that participants thought the interactive displays were more effective include: the fact that they provided more information using multimedia data, they evoked more of an emotional response, they required active involvement, they created a more focused experience, and they were more memorable because of their engagement. 95% of participants said that they would share their experience with the interactive displays with their friends. 96% of participants felt that they were more aware of the poverty issue in our county, after playing with interactive displays. 75% of participants said that they were more likely to get involved with the social issue, after interacting with the interactive displays. 85% of participants allowed the interactive system to take a photo of the participant's face at the end of the experience and 95% of participants took an information brochure when they were leaving. A few participants reported that they wouldn't perform gestures in a public space by themselves but they wouldn't mind performing with their friends.

Conclusion

Interactive techniques for public display have been applied to support HCI related research and activities. We created interactive display installations (*One Step*) focusing on providing information about local poverty issues to college students to promote public awareness on campus. We utilized bodily interactions, multimedia contents, social media channels. To invite passer-by to the project, we incorporated motion tracking technology, so that people realized the interactive display immediately. Once the system triggered a viewer, he or she experiences story-based multimedia contents through various visual signals including color, animation, and infographics. To support the viewer's engagement, we created the interactive contents to be evolved only when the viewer is actively involved in front of the display. Through experiencing interactive display installations, viewers learn about the issue of poverty and how it is up to us to do something to solve it. Through our social media channels, users can share their own thoughts on the issue, and together we can spread the word and begin to make a difference. Displaying a captured video of the participant was effective in attracting people to the project and in keeping them engaged with the project.

To investigate effeteness of the interactive display installations, we compared a non-interactive version (print posters) serving as a baseline, with a Kinect-based interactive version where participants' body movements are translated into the system playing the interactive contents. We focused on investigating how interactive displays impact on follow-up actions, such as taking a picture, performing more than once, inviting friends, sharing information with friends, signing up to volunteering systems. We learned that bodily interaction with a public display supports participants' social and emotional engagement for social is-

sues. We hope to expand this interactive campaign so many people can learn about social issues, take a step, and make a change.

References

[1] *Merriam-Webster Dictionary*. Available from: https://www.merriam-webster.com/dictionary/poverty.
[2] *United Nations: Millennium Development Goals. Goal 4: Reduce Child Mortality*. Available from: http://www.un.org/millenniumgoals/childhealth.shtml.
[3] Dell, B., *Understanding Poverty in Brazos County*. 2016, The Bush School of Government and Public Service: College Station.
[4] *10 Common Misconceptions About the Poor*. Available from: https://www.socialworkdegreecenter.com/10-common-misconceptions-poor/.
[5] Hinrichs, U., et al., *Interactive Public Displays.* IEEE Computer Graphics and Applications, 2013.
[6] Ananny, M. and C. Strohecker, *TexTales: Creating Interactive Forums with Urban Publics.*, in *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City*, M. Foth, Editor. 2009, IGI Global: Hershey, PA,.
[7] Schroeter, R., M. Foth, and C. Satchell. *People, Content, Location: Sweet Spotting Urban Screens for Situated Engagement*. in *DIS*. 2012.
[8] Edmonds, E., G. Turner, and L. Candy. *Approaches to interactive art systems*. in *International Conference on Computer Graphics and Interactive Techniques in Australasia and South East Asia*. 2004. Singapore: ACM.
[9] Wang, F., J. Hu, and M. Rauterberg, *New Carriers, Media and Forms of Public Digital Arts.* Culture and Computing 2012, 2012: p. 83-93.
[10] 'Hu, J., et al.'. *Participatory Public Media Arts for Social Creativity*. in *International Conference on Culture and Computing (Culture Computing)*. 2013. IEEE.
[11] Holmes, T.G. *Eco-visualization: combining art and technology to reduce energy consumption*. in *Creativity & Cognition*. 2007. ACM.
[12] Krogh, P.e.a., *"Help Me Pull That Cursor" A Collaborative Interactive Floor Enhancing Community Interaction.* Australasian Journal of Inf. Systems, 2004. **11**(2).
[13] Morris, M.R. *Web on the wall: insights from a multimodal interaction elicitation study.* in *ITS'12*. 2012.
[14] Perry, M.e.a. *WaveWindow: public, performative gestural interaction*. in *ITS'10*. 2010. ACM.
[15] Mäkelä, V.e.a. *Information wall: evaluation of a gesture-controlled public display*. in *Mobiquitous'14*. 2014.
[16] Kurdyukova, E., M. Obaid, and E. André. *Direct, bodily or mobile interaction?: comparing interaction techniques for personalized public displays*. in *MUM/12*. 2012. ACM.
[17] Ning, T., et al., *No Need To Stop: Menu Techniques for Passing by Public Displays*, in *CHI'11 Workshop on Large Displays in Urban Life*. 2011.
[18] Walter, R., G. Bailly, and J. Müller. *StrikeAPose: revealing mid-air gestures on public displays*. in *CHI'2013*. 2013. ACM.
[19] Polaine, A. *The flow principle in interactivity*. in *The second Australasian conference on Interactive entertainment*. 2005.
[20] Moggridge, B., *Designing Interactions*. 2007: MIT Press.
[21] *In My World*. [cited 2017 September 10]; Available from: http://www.onedayinmyworld.com/.
[22] *The Compassion Experience*. Available from: https://cts.compassion.com/.
[23] Vilaza, G.N., et al., *StreetHeart: Empowering Homeless Through Art and Technology*, in *CHI'17 Extended Abstract*. 2017, ACM: Denver, CO, USA.
[24] Chagas, D.A., et al. *Prospecting HCI Challenges for Extreme Poverty Communities: Redefining and Optimizing User Experiences with Technology*. in *International Conference on Human-Computer Interaction 2015*. 2015.
[25] Dantec, C.A.L. and W.K. Edwards. *Designs on Dignity: Perceptions of Technology Among the Homeless*. in *CHI'08*. 2008. Florence, Italy: ACM.
[26] Woelfer, J.P. and D.G. Hendry, *Homeless Young People and Technology: Ordinary Interactions, Extraordinary Circumstances*, in *Interactions*. 2011, ACM.
[27] Woelfer, J.P., et al. *Improving the safety of homeless young people with mobile phones: Values, form and function*. in *SIGCHI Conference on Human Factors in Computing Systems*. 2011. Vancouver, BC: ACM.
[28] Mohan, N. and A. Sarma, *Elevate: Ensuring Access to Food for Homeless Populations*, in *CHI'17 Extended Abstract*. 2017, ACM: Denver, CO, USA.
[29] Chang, E., et al., *Enroll Me! A Portable Device to Facilitate Homeless Student Enrollment*, in *CHI'08 Extended Abstract*. 2008, ACM: Florence, Italy.
[30] Engelhardt, A.E., J.J. Pierce, and J.Y. Yim, *Homeless HealthShare: Connecting Health Professionals and the Homeless*, in *CHI'08 Extended Abstract*. 2008, ACM: Florence, Italy.
[31] Narayan, D., et al., *Voices of the Poor: Crying Out for Change*. 2000, New York: Oxford University Press for the World Bank.
[32] Payne, R.K., *A Framework for Understanding and Working with Students and Adults from Poverty*. 1995, Baytown: RFT Publishing.
[33] *Bryan/College Station Habitat for Humanity*. Available from: www.habitatbcs.org.

Authors Biographies

Jinsil Hwaryoung Seo is an interactive artist/researcher focusing on aesthetics of interactive experience. Currently she is an associate professor in the Department of Visualization at the College of Architecture and a faculty fellow in the Institute for Applied Creativity and the Center for Health Systems & Design at Texas A&M University. Seo has been fascinated by the aesthetic qualities of human experience, the relationships that emerge through interactions within artworks, the underlying beauty and pattern inherent in the nature. Her current research concentrates on designing for tangible and kinetic aesthetics in the contexts of education and health.

Eman Al-Zubeidi is an interaction designer with a background in multimedia design. She explores the concept of breaking down barriers relating to social issues and human rights. Her main goal is to integrate digital media and influential topics to make lasting impressions and deeply connect with an audience.

A Method to Being: The Time Space Scanner

Maria Lantin, Alexandra Hass, Simon Lysander Overstall
Emily Carr University of Art + Design
Vancouver, BC CANADA
mlantin@ecuad.ca, alex@alexhass.ca, simonlysander@gmail.com

Abstract

We describe the Time Space Scanner, a method of capturing living and dying organic matter that prioritizes neither time nor space but rather weaves them together into continuous co-existence, delving into the instability of memory, the insistence of being, and the constancy of change. The Time Space Scanner uses a 2D scanner programmed to scan spatially random small samples at regular intervals, collecting 25,000 to 50,000 images over a period of 3–5 days. These micro captures are then reassembled and animated in a real-time flow of constantly changing mixtures of growth, decay, time and space. Any frame of the animation contains pixels drawn from multiple times and locations of the scanner bed.

Keywords

living, dying, organic matter, time, space, sampling, scanner, procedural video, procedural sound, ambient

Introduction

In any particular moment, we are composed of multiplicities of time re-enacted by memory. The present contains the past and the seeds of the future. We contain traces of places we have visited and our movements reflect habits of inhabited space. There is a shifting fluidity to being even as we look for permanence and solid reference points. The Time Space Scanner attempts to capture the experience of the present as a churning mixture of time and space (Figure 1), referencing qualitative multiplicity, described by Bergson as an experience where "several conscious states are organized into a whole, permeate one another, [and] gradually gain a richer content [2]." Just as memory infuses the present, influenced by immediate and past experience of flux, rhythm, colour, our reconstituted scans are minutely detailed and nuanced, never experienced in exactly the same way twice and yet reflecting multiple presents of our scanned subjects, each one as true as the other.

The Time Space Scanner had its inception seven years ago, as a Master degree project [10] during which flowers were scanned with a deliberate intent to stress out a 2D flatbed scanner[1] which introduced digital artifacts and created a kind of "technological expressionism." The flatbed scanner was positioned in such a way as to receive direct sunlight and was directed to scan at maximum resolution, thus creating very large scans that spanned many hours. During the scanning time, the flowers change, losing moisture and waning from exposure to the scanners and suns heat. Because the scanner captures the red, green, and blue channels of the image in sequence, any movement or change (including lighting) between capture of the different channels induces a kind of rainbow effect in the final scan (Figure 2). The resulting images, printed at a large scale, exhibit striking juxtapositions of organic and digital form – the apparent eye of a machine trained on delicate matter.

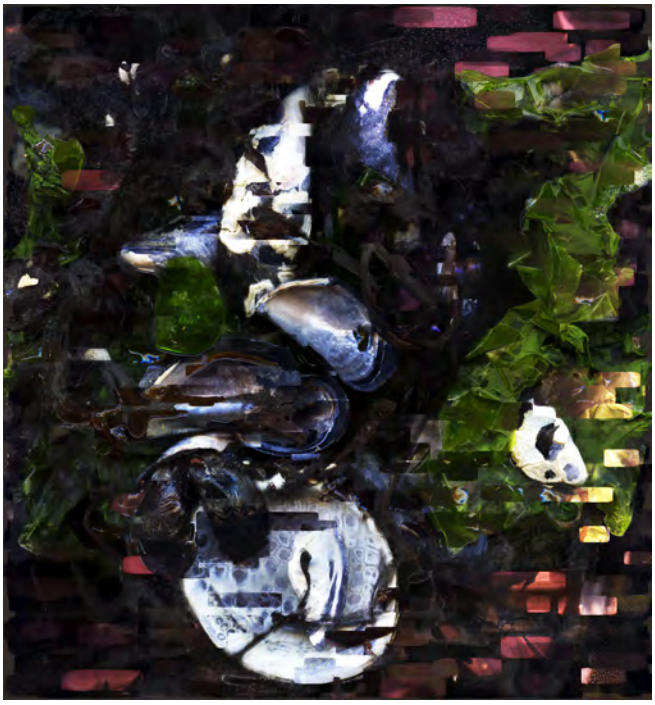


Figure 1: *Tides.* Kitsilano Beach, Vancouver BC, Canada. August 8–10, 2017. 11,786 scans of multiple types of seaweed, shells, sand, amoeba, and seawater, reconstituted and animated in layered time and space using a TouchDesigner script. ©authors

[1] Several scanners were used including an Epson Perfection V750 and an Esko 1970s flatbed scanner.

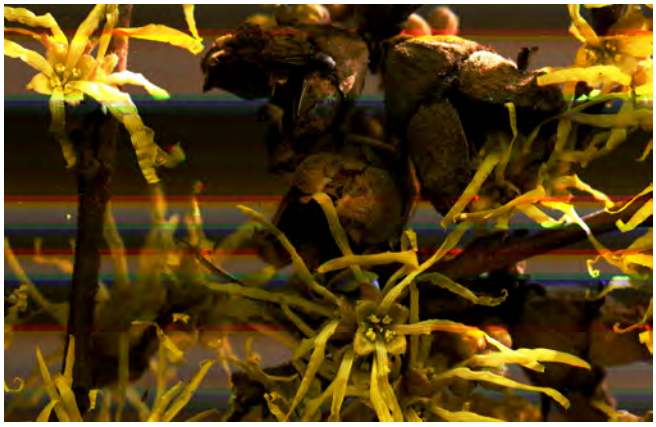


Figure 2: *Winter.* Armory District, Vancouver BC, Canada. October 26, 2008. Witch Hazel scanned on open scanner, in the sun, at very high resolution, for over an hour. ©Alex Hass

Near the end of this initial project, we envisioned stretching the scanning time even further to highlight the decay of the flowers by assembling a disjointed collage of scan lines taken at random times. Using the sane open source drivers [15], we programmed the scanner to capture a complete scan as a set number of horizontal regions with a set delay between each region. Each region was scanned only once in random order, creating a striped time-based image.

However, because of life circumstances, this idea was paused for seven years.

When the idea resurfaced, it was expanded to include random overlapping non-linear scans of different sizes. This meant that at the end of the scan time, we did not have a single image but rather 25,000–50,000 partial images that needed to be reconstituted. This new dynamic collage of individual scans presents new technologically expressionistic marks created from the disjointed layering within the compound image.

The Method

Gathering

Each scan begins with the gathering of materials from a specific location, close to home and attentive to space and time. We have gathered materials from the beach (seaweed, shells, sand), the forest (moss, lichen, deadwood, berries), landscaped parks (trees, bushes, plants), and our kitchen (fruits, vegetables, seeds, sprouts).

Composing and Scanning

The materials for the scan are positioned on the scanner with a combination of compositional chance and conceptual intention. An overall scan area is chosen and a range of partial rectangular scan sizes is specified based on the scale of interest and aesthetic considerations. The resolution is chosen so as to generate an overall scan size of 6–8 MPs.

Scanning conditions are set up to reflect the original gathering context, for example by inducing movement and change using fans, water, glass covers, etc. The open scanner is placed by a window in the studio and left to scan for several days (3–5), gathering thousands of numbered images which are tagged with relative location and size information. The scanner has a very shallow depth of field and sees things in sharp detail only within about 5mm of the glass surface. But it does see far, and if the matter is sparsely composed on the glass, there are clear visual distinctions between day and night, blue sky and dusk. We have also used additional glass panels to separate layers of material, thereby creating contextual backgrounds and shadows on the lower layers.

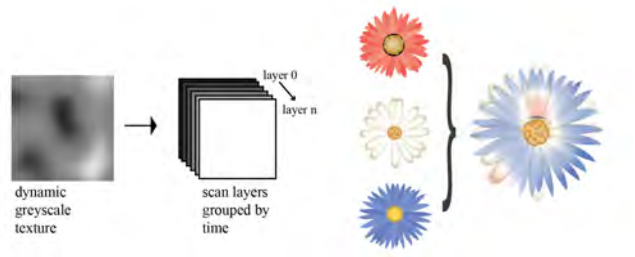


Figure 3: At each frame, a dynamic greyscale texture is used to blend between layers of scans. Each layer represents 500–1000 scans. ©author

Assemblage

The partial scans are reconstituted dynamically in real-time using a TouchDesigner [8] script that loads the scans into textures and remixes these at each frame. First, the partial scans are grouped in sequences of 500–1000 scans to create a series of sparse semi-transparent textures. Typically, there are 35–60 of these textures, depending on the capability of the graphics card being used. These textures form layers in a 3D texture that can be accessed using generated 3D coordinates within a 1 unit cube. The x and y coordinates access the location within the image, and the z coordinate chooses the layer from which the x and y coordinate is sampled (or a blend of layers if the z coordinate falls between layers). To form a full image frame for the animation, each pixel is fetched using a different x, y, z coordinate. Essentially, a 3D greyscale image is used to generate each frame. Continuity between frames is achieved by using a procedural animated texture that is continuous in three dimensions (Figure 3).

Animation and Post-Processing

The dynamic 3D texture used for fetching frames of the animation is highly customizable in speed and pattern. We have used procedural noise textures in most cases, and have also generated other textures using dynamic wave patterns and cumulative greyscale shape stacking. At the animation stage, we spend time with the images and the resulting animation reflects the materials gathered, the feeling of place, and the artists' current context. The process is a fluid collaboration between the material, the tools, the artists, and chance. As well as generating an appropriate dynamic coordinate texture, we also work with post-processing effects to change the final orientation, colour, and size of the animation. These effects are sometimes also varied in time.

A good example of this process is can be seen with the Japanese Maple/Smoke Bush scan which was done during a week in the summer of 2017 when the California forest fires were burning quite intensely. The resulting animation is reminiscent of smoke, haze, and auroras (Figure 4).

> "How do we pass from this inner time to the time of things? We perceive the physical world and the perceptions appear, rightly or wrongly, to be inside or outside us at one and the same time." — Henri Bergson [3]

Figure 4: *Hazy Week.* Armory District, Vancouver BC, Canada. October 6–10, 2017. Hazy windy week while fires burned in California and Mitchell Island. 30,000 scans of Japanese Maple and Smoke Bush, sunlight, wind (fan), scanned over 5 days on an open scanner by a window, reconstituted and animated in layered time and space using a TouchDesigner script. The frames are post-processed (colour inverted and levels modified). The dark/light bands are the result of night/day shifts of light. ©authors

Interactive Possibilities

Because the animation is generated in real-time, it is possible to use external inputs to influence any of the steps towards the final animation. For example, the 3D coordinate texture can be generated from touch, a voice signal, ambient sounds, or a midi keyboard.

In an exhibition setting, if a scan is in progress in the space, it is even possible to have viewers influence the generation of the scans themselves. Viewers could be invited to change the composition of the matter being scanned or to do a simple hand gesture over the scanner while a scan is in progress. Because the scanner is highly susceptible to changes in the environment, these small alterations in space and time will create digital artifacts and breaks in the continuity of the image that interpret and change the memory of each moment.

Display and Exhibition

The work has been displayed as printed single frames of animation (Figure 6) and as generated video playing on large screens.

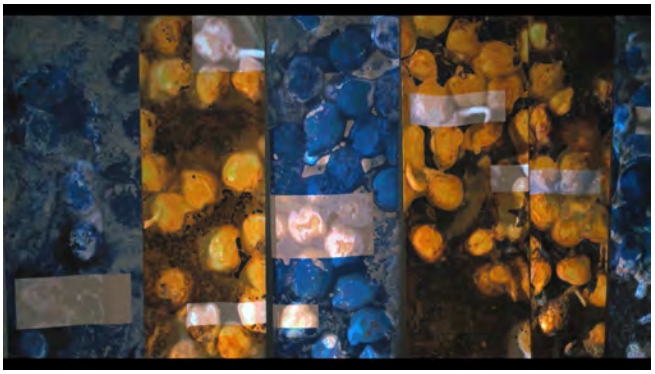


Figure 5: Silk panels from chickpea sprouts exhibition. Harder to see from this image is that the six panels were offset from each other in depth. ©authors

Our scan of sprouting (then dying) chickpeas has also been exhibited in a multi-layered projection map onto six silk-printed panels hung vertically from the ceiling, augmented with procedural audio based on the current projection details. The six panels were printed with a full scan of the chickpeas 10 days after the start of the Time Space scan. Some of the panels were printed as colour negatives to denote the underside, below-the-ground view we were capturing in our scanner set-up. Others were printed in their original colour to reveal the details of living, dying, and being consumed by new mold-forms of life. White rectangular cutouts were added to further reference the nature and shapes of the scans and to provide a clearer view of the back-projected images (Figure 5).

The sound design used both synthesized and pre-recorded audio generated and mixed in a Max/MSP patch. The TouchDesigner script sent the Max/MSP patch a message containing a random section of the current projection. This video sample was then used as data to synthesize sound gestures. The synthesized and pre-recorded sounds reference the inorganic machine nature of the scanner, and the organic nature of the chickpeas/molds, respectively. The pre-recorded audio samples were created with our voices while imagining sounds that might be made by sprouting and dying chickpeas and the various growing molds overwhelming them. By the time of recording, we had spent many hours with the chickpeas and molds and had developed a kind of kinship based on all the spatial and temporal details of their living and dying journey.

It should also be mentioned that we had been trying for months to create mold on the scanner bed but had been unable to do so because the light and heat from the scanner and the dry conditions prevented this kind of life to thrive. To give the chickpeas ideal moist conditions to sprout we put them underneath a patch of dirt collected from one of our walks through the forest. Keeping the dirt moistened as the scan progressed created ideal growing conditions for the naturally occurring mold in the dirt, and we were witness to compelling and unexpected interaction of living and dying matter.

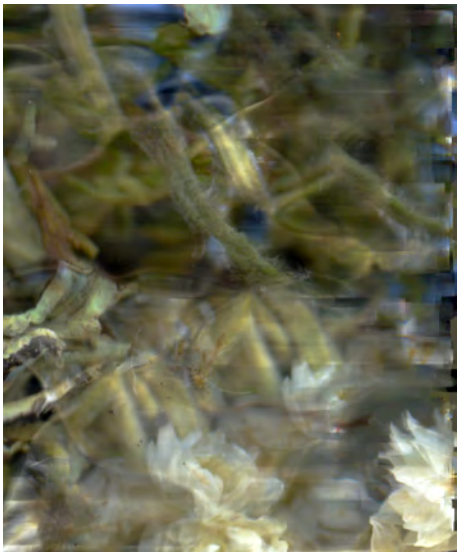


Figure 6: *Chief.* Squamish Chief, Squamish BC, Canada. August 25–30, 2017. 17,199 scans of Lichen, berries, Edelweiss, moss, bark, Northern Flicker feather, wind (fan), reconstituted and animated via TouchDesigner script. ©authors

Discussion

The Time Space Scanner is a kind of "hybrid datascape'[16]" that harks to ambient video work such as generated by Bizzocchis Re:Cycle Engine [4, 5], collages such as Hockneys Joiners series [11], Google Deep Dream generative engine [18], step-and-repeat animations pioneered by McLaren [14], and long exposure photographs and scans, most notably Lakes Extended Breathing and Reduced Performing series [12, 13]. In the taxonomy of temporal recombination techniques outlined by Bach et. al [1], the TSS technique is first performing a partial time flattening operation on a sparse space-time cube, followed by a non-planar surface cutting extraction, with some filling interpolation. In aesthetic intent, it also relates to the video granular synthesis created and used by Forbes and Villegas [9] where the space-time cube is divided into grains of varying sizes, then manipulated and recombined in various ways, though so far we have not experimented with spatial distortions.

The TSS method resists traditional ordered notions of time and space, creating instead a dynamic field of shifting double and triple images that nevertheless reference a timeless present. It is a method of capture that attempts to answer the question what does it feel like to be seaweed/lichen/strawberry? with all of its attendant spatial and time contingencies. In answering this question, we lean strongly in favour of phenomenal metaphorism as a way to access the withdrawn qualities of our subjects. Bogost argues that "in metaphorism we recognize that our relationship to objects is not first-person...It is not the objects perception that we characterize metaphoristically but the perception itself... [6]." By creating environments of interaction reconstituted in layered time and space, we attempt to bring forth the experience of being in forever contingent relation.

The Gaze of the Machine

We are very conscious of the unique role of the eye of the machine in this work. A scanner does not see as a human eye sees, or even as typical handheld camera sees. It has a roving perspective that creates a somewhat flattened image, which is remarkably apparent in Suzy Lakes work Reduced Performing series [13]. The scanner also has a very shallow depth of field further creating a sense of myopic interest hovering between alienation and intimacy. The gaze of the scanner further has environmental effects of operation such as the unrelenting light emanating from the traveling gantry and the resultant heat. The heat and light have an effect on the subject being scanned; most living things cannot sustain the machines gaze for long before withering, drying, and dying. There is a stark separation between the machines earnest desire to capture and its ability to sustain the object of its gaze. The glass itself hints at the forced separation. This kind of earnest stupidity is a quality shared by most current machines and one this work is peering back at. A secondary question this method attempts to answer is then: what are the edges of truth in the earnest machines gaze and how can these edges be made apparent?

Current and Future Work

Continuing with the earnest gaze of the machine, we plan to add a robotic arm fitted with a camera to scan our subjects in three dimensions. This arm, as well as providing an additional view, introduces temporal disturbances which manifest as glitches for the 2D scanner. Likewise, the light of the scanner troubles the 3D scanner. Blending the gaze of these two scanners may reveal another aspect of being of our subjects. We will also continue with procedural sounds and add the rhythmic scanner sounds, sounds gathered from the places where the organic matter was collected, contributed gallery sounds, and the dynamics of the animation.

We have begun a new Time Space scanning project called *The Epic Walk Diaries*. Our intent is to walk the full shoreline perimeter of Vancouver beginning at a central point (Vanier Point), then walking the Kitsilano, Spanish Banks, UBC and Fraser River Delta shoreline. Much like in Guy Debord's Dérive [7], where the wanderers "let themselves be drawn by the attractions of the terrain and the encounters they find there," we find our way around the shoreline in whatever ways are possible and intriguing.

The Epic Walk is necessarily broken into smaller parts. Each part of the walk lasts for 2–4 hours, where we gather organic materials that have caught our interest and reflect both the area and the time of year. We also record the unique sounds of the area and discuss whatever comes to mind. After the walk we document our wanderings by adding another layer of memory in the creation and publication of a poem containing our reflections. We publish the poem with a representative image, and simultaneously start a Time Space scan with the gathered materials. The next walk always starts where the last one left off, a project rule that gives us both a project framework and a new way of exploring our city in all its living changing details. The scanning area for the Epic Walks is that of the whole scanner bed, unlike earlier targeted

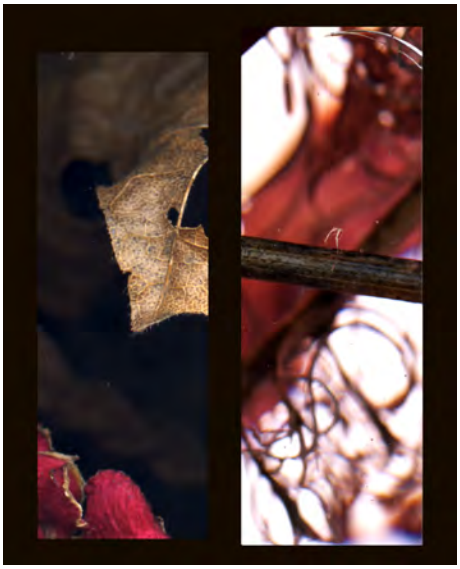


Figure 7: Epic Walk Diaries.Two individual scans from the November 18, 2018 walk. ©authors

Time Space projects. Each new scan sequence has identical scanning parameters (size of scan snippets, time of scan, and overall scanning area). This consistency allows us to take the data gathered throughout all the walks as inputs for a remix in time and space. Sound bites and poetic text from the walks are also woven into the final work. The resulting preliminary animations blend two scales, a close-up view where a blend of two randomly chosen snippets forms the background, and an overview where the snippets are sprinkled in and out. This new direction comes from the desire to share the beauty and fascination of individual scans as well as the collected whole (See Figures 7 & 8).

Conclusion

The Time Space Scanner began as an attempt to capture the transformation of organic matter with a 2D scanner that typically scans in time and space from top to bottom (i.e. ties the spatial beginning of the scan with its temporal beginning). We changed the operation of the scanner to decouple time and space, giving us a way to capture in greater fullness the interactions between the scanner and the organic life cycle. The animated reconstituted scans further highlight this decoupling through the interweaving of spatial and temporal elements in an infinite present. In this ongoing work, we rediscover and play with the many persistent illusions of time and space, as beautifully outlined by Carlo Rovelli who reminds us that ”the world is made up of networks of kisses, not of stones [17].” We foreground the dynamic entangled relations of a perceived past, present, and future as well as the healing attention to time scales other than our own.

Acknowledgments

This research was supported by the Social Sciences and Humanities Research Council of Canada. We are grateful for

Figure 8: Epic Walk Diaries. A recomposited view of the November 11 2018 walk. ©authors

the forbearance of Myszka, Arden Jansen, Alan Goldman, Hongzhu Zhao, and many others who have endured the persistent fragmented tones of the scanner. Thank you to Julie Andreyev for giving us a space to display and gather feedback on the work. Finally, we acknowledge all those who love this land and understand we are not separate from it. Thank you.

References

[1] Bach, B.; Dragicevic, P.; Archambault, D.; Hurter, C.; and Carpendale, S. 2014. A review of temporal data visualizations based on space-time cube operations. In *Eurographics conference on visualization*.

[2] Bergson, H., and Pogson, F. L. 1913. *Time and free will : an essay on the immediate data of consciousness*. London : G. Allen & Company, Ltd ; New York : The Macmillan Company.

[3] Bergson, H. 1999. *Duration and simultaneity: Bergson and the Einsteinian Universe*. Number 199 in The library of liberal arts. Manchester: Clinamen Press, 2nd ed edition.

[4] Bizzocchi, J.; Ben Youssef, B.; Quan, B.; Suzuki, W.; Bagheri, M.; and Riecke, B. E. 2009. Re:Cycle - a Generative Ambient Video Engine. In *Proceedings of the Digital Arts and Culture Conference*.

[5] Bizzocchi, J. 2008. The Aesthetics of the Ambient Video Experience. *The Fibreculture Journal* (11).

[6] Bogost, I. 2012. *Alien phenomenology, or, What it's like to be a thing*. Number 20 in Posthumanities. Minneapolis: University of Minnesota Press.

[7] Debord, G., et al. 1958. Theory of the dérive. *Internationale situationniste* 2(20.05):2015.

[8] Derivative. TouchDesigner.

[9] Forbes, A. G., and Villegas, J. 2015. Video granular synthesis. In *Proceedings of the workshop on Computational Aesthetics*, 195–201. Eurographics Association.

[10] Hass, A. 2009. Technological Visibility. Master's thesis, Emily Carr University of Art + Design, Vancouver B.C.

[11] Hockney, D. 1988. *Hockney On Photography*. London: Random House UK, first edition edition edition.

[12] Lake, S. 2008a. Extended Breathing in the Garden.

[13] Lake, S. 2008b. Reduced Performing: Blinking and Breathing #1.

[14] McLaren, N. 1968. Pas de deux.

[15] SANE - Scanner Access Now Easy.

[16] O'Rourke, K. 2013. Hybrid Datascapes: Envisioning Space and Time. In *Walking and mapping: artists as cartographers*, Leonardo. Cambridge, Massachusetts: The MIT Press. 153–175.

[17] Rovelli, C. 2018. *The order of time*. London: Allen Lane, an imprint of Penguin Books. OCLC: on1008759974.

[18] Szegedy, C.; Liu, W.; Jia, Y.; Sermanet, P.; Reed, S.; Anguelov, D.; Erhan, D.; Vanhoucke, V.; and Rabinovich, A. 2014. Going Deeper with Convolutions. *arXiv:1409.4842 [cs]*. arXiv: 1409.4842.

Authors Biographies

Alex Hass is a multi-disciplinary artist, designer and instructor. Her creative practice is based on exploring the tensions and overlaps that exist between nature and technology - visually amplifying the moments when this hybrid practice creates fresh insights and experiences for the viewer. Her design practice encompasses art direction, brand + book design as well as image creation. Alex studied illustration and art direction at the Alberta College of Art and Design, received her design degree in Visual Communication from Nova Scotia College of Art and Design University and her Masters in Applied Art, Media stream from Emily Carr University. She has taught various aspects of design at ECU, SFU and BCIT for the last eighteen years.

Maria Lantin is a media artist and the Director of the Basically Good Media Lab at Emily Carr University of Art + Design. Her work is informed by a desire to rethink digital beauty and the path to the aesthetic experience of being in the forest, of performing together, of being, witnessing, and remembering together. Formative experiences include a BSc and PhD in Computing Science (Dalhousie University and Simon Fraser University), a wonderful stint at Mainframe Entertainment working on the first ever stereoscopic animation for the IMAX screen, three fantastic years at the ground-breaking Banff New Media Institutes Advanced Art and Technology (A.R.T) labs, and now heading into thirteen years at Emily Carr.

Simon Lysander Overstall is a computational media artist, and musician/composer from Vancouver, Canada. He develops works with generative, interactive, or performative elements. He is particularly interested in computational creativity in music, physics-based sound synthesis and performance in virtual environments, and biologically and ecologically inspired art and music systems. He has produced custom performance systems and interactive art installations that have been shown in Canada, the US, Europe, and China. He has also composed sound designs and music for dance, theatre, and installations. He has an MA in Sound in New Media at Aalto University in Helsinki, a BFA in Music Composition from the School for Contemporary Arts at Simon Fraser University, and an Associate in Music (Jazz) Diploma from Vancouver Island University.

Twinkle: A Flying Lighting Companion for Urban Safety

Honghao Deng*, Jiabao Li*, Allen Sayegh
Harvard Graduate School of Design
48 Quincy Street, Cambridge, MA 02138, USA
honghao.deng@gmail.com, stephlijiabao@gmail.com
* These authors contributed equally to this work

Abstract

Today's urban lighting system still lacks coverage for many walkways, inducing feelings of insecurity and promoting the probability of crime. Ubiquitous surveillance is an intrusion on privacy and does not allow real-time action. The cold, lifeless light shines in the dark, trapping people in the solitude of silence. These absences motivated us to create Twinkle—a luminous transformative creature which inhabits on light posts. They are curious, aerial animals attracted by human activity. During the day, they rest on urban light posts, expanding their solar panels for charging. At night, they react to pedestrians on the street based on various distinct personalities. Twinkle is an indirect solution to urban security without the need for surveillance. We envision a future where technology goes beyond its form and becomes a companion to us.

Keywords

Affective computing; UAV; Urban Lighting; Autonomous Aircraft; Interactive; Play.

Figure 1a. Twinkles can lead people's way back home.

Introduction

Imagine a city with flying light: as night falls and darkness creeps in, all of the sudden a bright sparkle appears, and then another–one-by-one lighting up the city street. Soon, the sullen city comes alive, orchestrated with the natural rhythm of "Twinkle".

Lighting is a major part of urban infrastructure, providing visibility to pedestrians and contributing significantly to feelings of safety [1, 2]. Farrington et al. suggested that crime can be prevented by environmental measures that directly affect offenders' perceptions of increased risk and decreased reward [3]. However, the current urban lighting system leaves many areas uncovered. Especially in remote regions with less population, sparse and dim street lights can lead to feelings of insecurity and increased criminal activity. One way urban environment can be improved is through closed-circuit television (CCTV) cameras. However, these surveillance systems invade people's privacy, and do not promote real-time action, as most of them become evidence to crimes that had already occurred in the past.

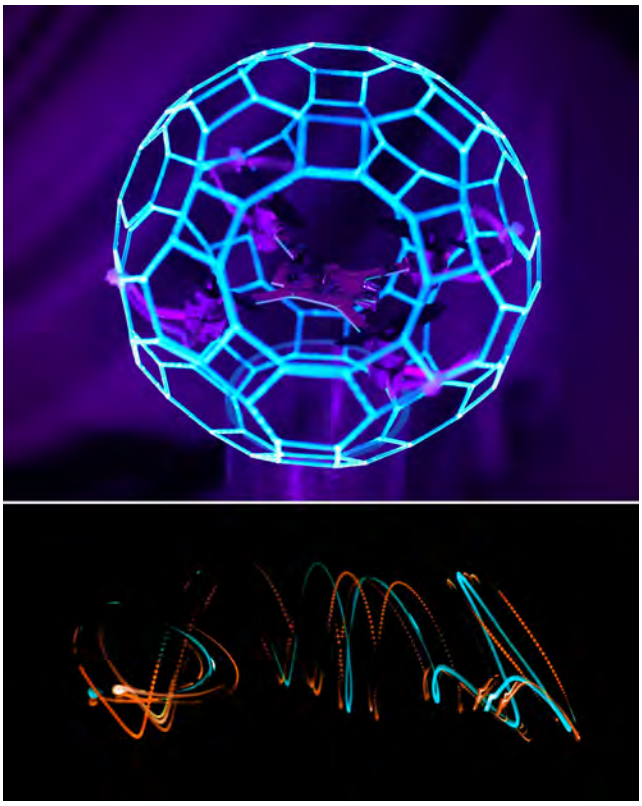


Figure 1b. "Puppy" Twinkle prototype and its flight trajectory.

These absences motivated us to create Twinkle–a dynamic lighting companion that light up areas on demand and prevent crime (fig 1). Twinkles are luminous transformative creatures inhabit on light posts. They are aerial animals, like fireflies, and are curious, playful and alerted by human activity. During the daytime, they rest on urban light posts, expanding their solar panels for charging, which double as shade for pedestrians. At night, they fly to each passing individual to offer increased visibility for their pathway ahead. Twinkle is an indirect solution for improving urban safety without the need for surveillance. Twinkle's behavior helps each nearby pedestrian achieve a better view of their surroundings. At the same time, their presence prevents crime by dazzling light and revealing the identity of individuals who attempt to misbehave.

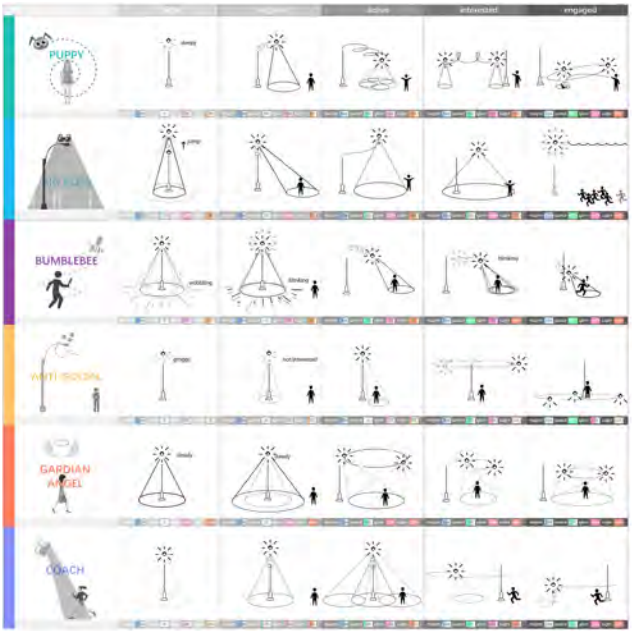


Figure 2. Twinkles embody a personality based on their surroundings. Personalities are quantified by height, speed, glim, and light. The five states are: idle, triggered, active, interested, and engaged.

Personality

Twinkles are living creatures sharing the same space with humans. Like humans, they express various emotions and personalities.

We selected speed, reaction time, altitude, power and consistency as key characteristic factors for each drone (fig. 2). These physical properties result in the drone's distinct behaviors and hence lead to their unique personalities.

From friendly to annoying, and active to inactive, these flying creatures interact with people in distinct ways: "Puppy", with trusting and affectionate characteristic, is interested in playing with children. It feels comfortable when getting close to people. It flies around with intermediate motions moving altitude up and down without a consistent, predictable path. It's naughty and curious, turning the night into a playground. "Big Boss", embracing confidence and discipline, sits at high altitude to maintain awareness of its territory. During an emergency, it quickly reacts to lead people away from danger by projecting evacuation directions with its light skin. Its powerful light reflects high visibility even in smoky and foggy areas. It can turn into an alarm or light up in dark areas for smoother evacuation. Its consistent, fast, and strong. "Bumblebee" is sensitive to suspected misbehavior and acts accordingly. Being suspicious and nervous, it looks around for danger all the time. Once detected, it attacks the criminal with dazzling light and at full speed. By exposing the potential criminal, it performs pre-crime preventions. "Antisocial Guy" is not interested in anything happening around. It's reserved, insensitive, and buried in its own world. When a person comes into view, it wobbles a little (and may bump into things) and returns to its original position, keeping a distance from people. Sporadic light appears indistinctly depending on its mood. "Coach" guides people in training and helps optimize training routes. During outdoor workouts, it keeps a steady distance ahead of the person, and illuminates the pathway ahead. It cheers trainees up when they are tired and sets the pace fit for their health.

Figure 3. Twinkle's skin helps convey emotion, protect the propellers, and change its shape and function.

Skin

The outer polyhedron skeleton is Twinkle's skin. It serves three roles: (1) convey Twinkle's emotion, (2) prevent direct contact to its propellers, and (3) change Twinkle's shape and function (fig. 3). When Twinkle expresses an emotional state, the LED lights in the node will display colors, frequencies, and rhythms specific to the personality. The light travels through the optical fiber to the entire skin (fig. 4).

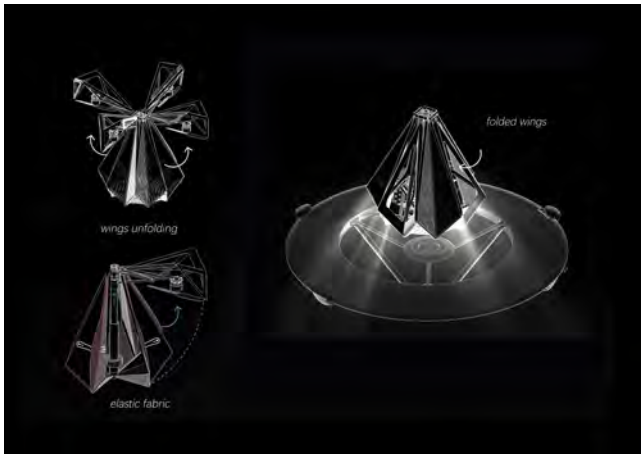


Figure 4. Twinkle's skin is made of translucent, flexible waterproof fabric. Under its wing, a near-invisible seam allows the fabric to unfold when Twinkle spreads its wings. When contracted, the wings gather into the main structure through an open seam.

Light

The light attaches to the quadcopter body via a three-axis gimbal for maximum degree of freedom (fig. 5). Equipped with a 100w LED omnidirectional flood light, each Twinkle has the capability of a wide range of light intensity and directional control. Combined with the Glimmer on Twinkle's skin, the two systems make it possible for Twinkle's personalities and versatile applications to shine through.

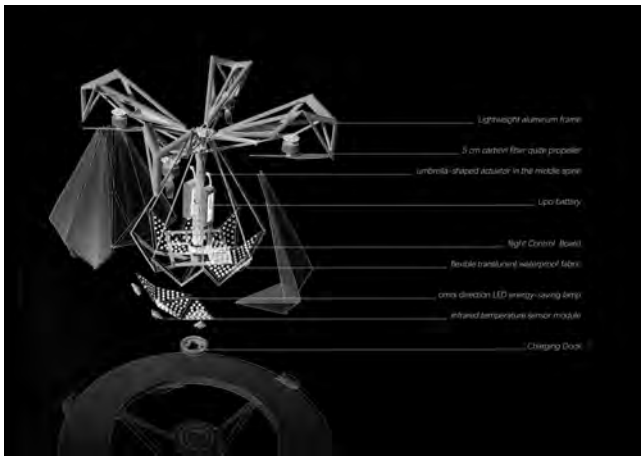


Figure 5. The anatomy of a Twinkle: optical fiber skeleton, flood light, solar panel film, quadcopter, actuator, and LED's. Twinkle's nest consists of a charging dock and behavior sensor.

For example, Bumblebee blinks a cautionary yellow at rapid pace on their skin when suspicious people are nearby. The blink frequency gradually increases when the suspect gets closer. Certain behaviors, like screaming, triggers Twinkle's flood light to maximum brightness without buffer time. Bumblebee sheds intense light directly on people, unlike other personalities. When the suspect moves closer, the light beam will steadily focus on the suspect's face through parabolic reflectors, leaving an unpleasant flash. These lighting features encourage people to flee the scene, much like people's reaction to real-life bees. On the other hand, Anti-social Guy blinks with a sleepy rhythm, like he's in a constant state of grogginess. He hardly gets triggered by surrounding activity. And when he is, his reaction is so slow in intensity that he dims down just before reaching full brightness, because he loses interest. Twinkle's various light functions can play a key role in promoting safety and security to the urban lifestyle through a multitude of scenarios (fig. 6).

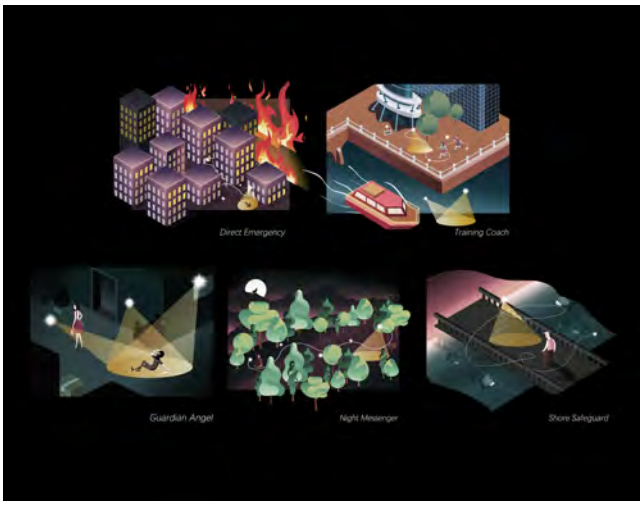


Figure 6. Example scenarios where Twinkles plays a key role.

Nest

The base nest station (fig. 7) offers multiple twigs to host more than one Twinkle. During the daytime, when Twinkle expands its solar sail to charge, the nest stores excessive electricity. In case of insufficient sunlight, it transmits power to Twinkle through a wireless charging dock. At night, it serves as the data hub for signal collection and analysis. Whenever someone enters the responsive range, it captures and analyzes the location information of pedestrians to guide Twinkle's flight path.

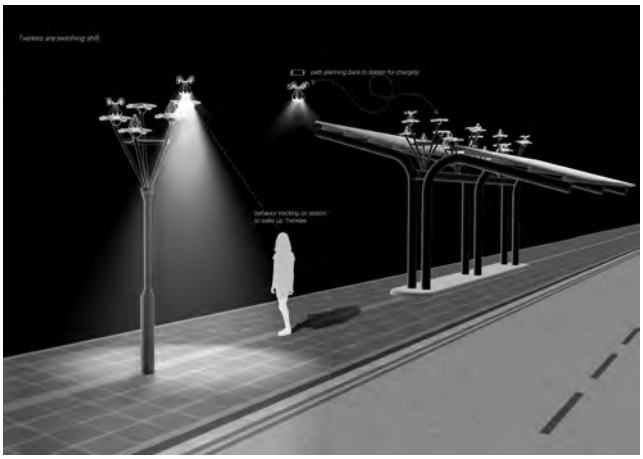


Figure 7. Nest stations analyzes pedestrian behavior and position and sends data to Twinkles.

Transformative Elytron

We also explored a transformative structure to make Twinkle more expressive. Its skeleton is based off the octahedron-cuboctahedron jitterbug transformation (fig. 8).

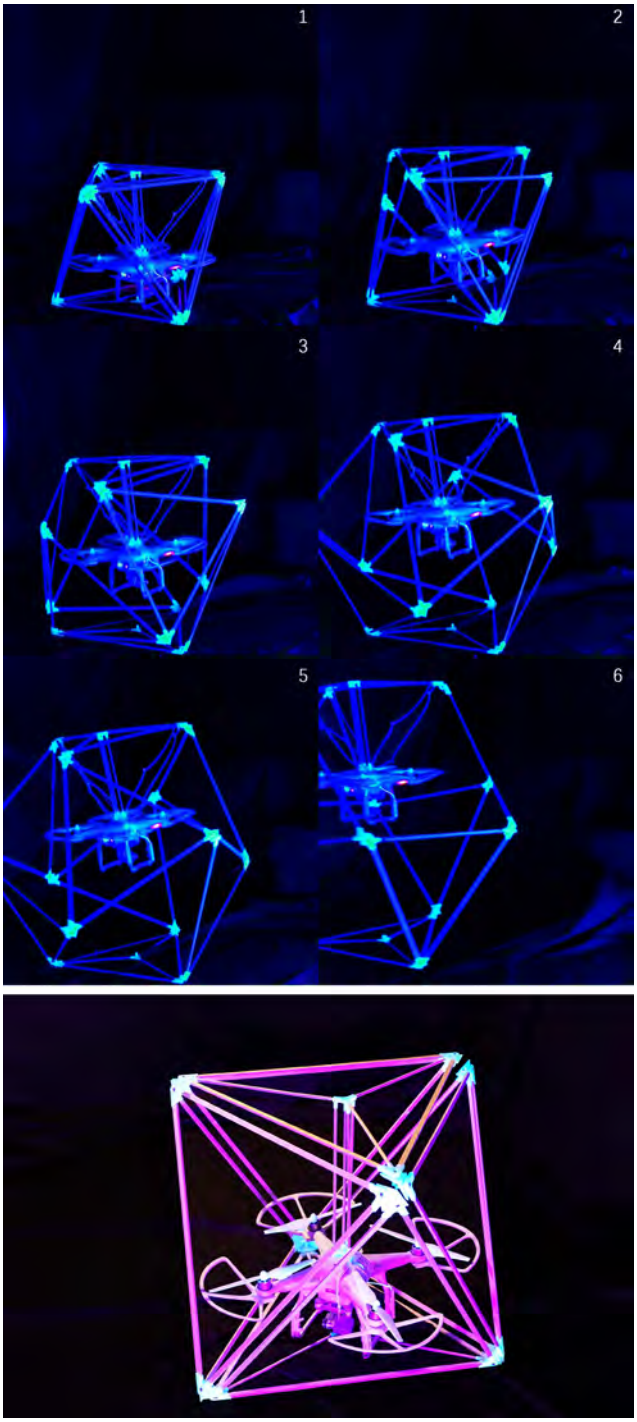


Figure 8. Twinkle's skeleton mimics the octahedron-cuboctahedron jitterbug structure.

At night, the triangle frames are compressed into a smaller-profile octahedron shape to minimize the impact on the center quadcopter aerodynamics (fig. 8). During the day, an actuator pushes the bottom and top triangle frames to trigger the symmetry rotation of each triangle frame on the rotation nodes. This transformation gradually reveals the thin-film solar cell folded in quadrangle gap between the isosceles triangle structures. When the actuator extends the structural height to twice as the original, the skin is fully expanded to a cuboctahedron skeleton, covered with six square solar panels. This design provides solar absorbance to a size as large as the original octahedron surface area and supplies shade protection for pedestrians from the sun. The structure is wrapped back to its octahedron form to improve mobility and prevent solar cells from blocking light after sunset.

Impact on Human Lives

Urban lighting is no longer a cold, immutable infrastructure, but a new form of companionship with personality and feedback. Community-wise, Twinkle's habitual nature promotes public security, and therefore improves city environments. Flying with pedestrians indirectly obstructs crime, reshaping a dangerous neighborhood to a safe neighborhood. The companionship reduces not only crimes but also misbehavior, like public graffiti and littering. As a result of Twinkle's personality, an unsafe neighborhood would attract more Bumblebee's and Guardian Angel's. Twinkle will be able to transform its personality in accordance with city development and ultimately form a dynamic autonomous lighting solution (fig. 9). Communities will steadily be reshaped by Twinkles and soon discover a new vitality in people's lives both at day and at night.

Figure 9. Twinkle as a flying companion to guide people in the dark.

References

[1] J. R. R. Naik N, Philipoom and C. Hidalgo. Streetscore: Predicting the perceived safety of one million streetscapes. CVPR Workshop on Web-scale Vision and Social Media., 2014.
[2] Worry Associated with Different Travel Modes, KFB, Stockholm, 2000.

[3] David P. Farrington & Brandon C. Welsh (2002) Improved street lighting and crime prevention, Justice Quarterly, 19:2, 313-342, DOI: 10.1080/07418820200095261
[4] J. Cauchard, K. Zhai, M. Spadafora, J. Landay, "Emotion Encoding in Human-Drone Interaction", *The Eleventh ACM/IEEE International Conference on Human Robot Interaction*, pp. 263-270.
[5] Cirque du Soleil, ETH Zürich, and Verity Studios, SPARKED: A Live Interaction Between Humans and Quadcopters, SIGGRAPH, Computer Animation Festival, 2015.
[6] Sky Magic. 2016. Sky Magic Live at Mt.Fuji : Drone Ballet Show by MicroAd, Inc. Video. Retrieved July 15, 2017 from https://vimeo.com/163266757
[7] Intel. 2016. Intel's 500 Drone Light Show. Retrieved July 15, 2017 from https://www.intel.com/content/www/us/en/technology-innovation/aerial-technology-light-show.html
[8] B. Kim, HY. Kim, J. Kim, Getting Home Safely with Drone, UBICOMP/ISWC, 2016. http://dx.doi.org/10.1145/2968219.2971426
[9] F. Mueller, M. Muirhead. 2015. Jogging with a Quadcopter. In Proc. CHI '15, ACM Press, Seoul, Korea. DOI: 10.1145/2702123.2702472
[10] H. Agrawal. S. Leigh, P. Maes. L'evolved: Autonomous and Ubiquitous Utilities as Smart Agents. *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, 2015, pp. 487-491.

Author Biographies

Honghao Deng is a computational designer and artist. He holds a Master of Design Studies with distinction at Harvard GSD and has served as a research fellow in the City Science Group at MIT Media Lab. Recognition gained in the design and interaction community include: Golden A' Design Award, iF Design Award, Fast Company World Changing Ide-as Award, 1st Place Future Cities Contest, Ubicomp/ISWC Design Award. His work has been covered by Domus, CCTV, ArchDaily, Designboom, Milan Design Week, The National, and Metropolis Magazine.

Jiabao Li works at the intersection of emerging technology, art and design. Her work opens questions about technology's influence on human perception, identity, and emotion. Her research-based projects range from wearables, projections, drones, installations to scientific experiments. She holds a Master of Design in Technology degree with Distinction from Harvard GSD. Jiabao's work has been featured in Domus, TechCrunch, Yahoo, CCTV, Yanko Design, and The National. Her work has been shown in Milan Design Week, Dubai De-sign Week, SIGGRAPH, CHI, AR in Action, and PRIMER. She is the winner of iF Design Award, Fast Company World Changing Ideas Award, Future Cities Contest, ISWC Design Award, and Harvard Best Thesis Award.

Developing Creative AI to Generate Sculptural Objects

Songwei Ge*, Austin Dill*, Eunsu Kang*, Chun-Liang Li*, Lingyao Zhang
Manzil Zaheer, Barnabas Poczos
Carnegie Mellon University
Pittsburgh, PA, United States
{chunlial, eunsuk, songweig, lingyaoz, abdill, manzil, bapoczos}@andrew.cmu.edu

Abstract

We explore the intersection of human and machine creativity by generating sculptural objects through machine learning. This research raises questions about both the technical details of automatic art generation and the interaction between AI and people, as both artists and the audience of art. We introduce two algorithms for generating 3D point clouds and then discuss their actualization as sculpture and incorporation into a holistic art installation. Specifically, the Amalgamated DeepDream (ADD) algorithm solves the sparsity problem caused by the naive DeepDream-inspired approach and generates creative and printable point clouds. The Partitioned DeepDream (PDD) algorithm further allows us to explore more diverse 3D object creation by combining point cloud clustering algorithms and ADD.

Keywords

Partitioned DeepDream, Amalgamated DeepDream, 3D, Point Cloud, Sculpture, Art, Interactive Installation, Creative AI, Machine Learning

Introduction

Will Artificial Intelligence (AI) replace human artists or will it show us a new perspective into creativity? Our team of artists and AI researchers explore artistic expression using Machine Learning (ML) and design creative ML algorithms to be possible co-creators for human artists.

In terms of AI-generated and AI-enabled visual artwork, there has been a good amount of exploration done over the past three years in the 2D image area traditionally belonging to the realm of painting. Meanwhile, there has been very little exploration in the area of 3D objects, which traditionally would belong to the realm of sculpture and could be easily extended into the area of art installations. The creative generation of 3D object research by Lehman et al. successfully generated "evolved" forms, however, the final form was not far from the original form and could be said to merely mimic the original [22]. Another relevant study, Neural 3D Mesh Renderer [20] focuses on adjusting the rendered mesh based on DeepDream [28] textures. In the art field, artist Egor Kraft's Content Aware Studies project [11] explores the possibilities of AI to reconstruct lost parts of antique Greek and Roman sculptures. Nima et al. [27] introduced Vox2Net adapted from pix2pix GAN which can extract the abstract shape of the input sculpture. DeepCloud [5] exploited an autoencoder to generate point clouds, and constructed a web interface with analog input devices for users to interact with the generation process. Similar to the work of Lehman et al [22], the results generated by DeepCloud are limited to previously seen objects.

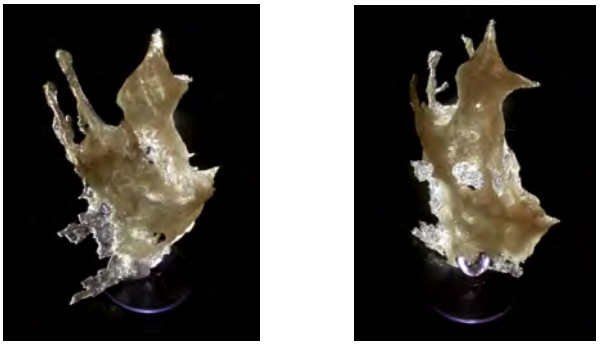


Figure 1: Sculpture generated by creative AI, PDD.

In this paper, we introduce two ML algorithms to create original sculptural objects. As opposed to previous methods, our results do not mimic any given forms and are original and creative enough not to be categorized into the dataset categories. Our method extends an idea inspired by DeepDream for 2D images to 3D point clouds. However, simply translating the method generates low-quality objects with local and global sparsity issues that undermine the integrity of reconstruction by 3D printing. Instead we propose Amalgamated DeepDream (ADD) which utilizes union operations during the process to generate both creative and realizable objects. Furthermore, we also designed another ML generation algorithm, Partitioned DeepDream (PDD), to create more diverse objects, which allows multiple transformations to happen on a single object. With the aid of mesh generation software and 3D printing technology, the generated objects can be physically realized. In our latest artwork, it has been incorporated into an interactive art installation.

Creative AI: ADD and PDD

Artistic images created by AI algorithms have drawn great attention from artists. AI algorithms are also attractive for

*Equal contribution

their ability to generate 3D objects which can assist the process of sculpture creation. In graphics, there are many methods to represent a 3D object such as mesh, voxel and point cloud. In our paper, we focus on point cloud data which are obtained from two large-scale 3D CAD model datasets: ModelNet40 [38] and ShapeNet [9]. These datasets are preprocessed by uniformly sampling from the surface of the CAD models to attain the desired number of points. Point cloud is a compact way to represent 3D object using a set of points on the external surfaces and their coordinates such as those shown in Figures 2 and 3. We introduce two algorithms, ADD and PDD, which are inspired by 2D DeepDream to generate creative and realizable point clouds. In this section, we will briefly discuss the existing 3D object generation methods, and then elaborate the ADD and PDD algorithms and present some of the generated results.

Figure 2: ModelNet40 [38]

Figure 3: ShapeNet [9]

Learning to Generate Creative Point Clouds

Using deep learning to generate new objects has been studied in different data types, such as music [35], images [15], 3D voxels [39] and point clouds [1, 23]. An example of a simple generative model is shown in Figure 4.

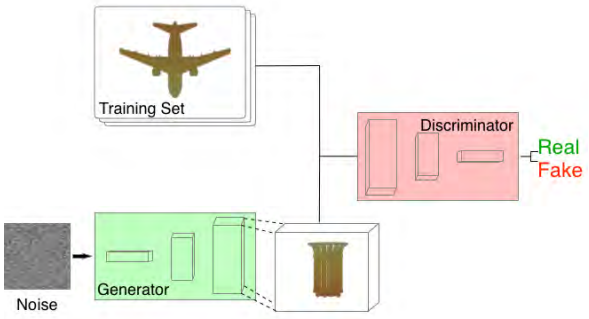


Figure 4: An example of generative model.

Here a low-dimensional latent space h of the original object space x is learned in accordance with the underlying probability distribution.

$$p(x) = \int_h p(h)p(x|h)dh \tag{1}$$

A discriminator is usually used to help distinguish the generated object $\hat{x}$ and a real object x. Once the discriminator is fooled, the generator can create objects that look very similar to the original ones [15]. However, these generative models only learn to generate examples from the "same" distribution of the given training data, instead of learning to generate "creative" objects [13, 27].

One alternative is to decode the convex combination $\hat{h}$ of latent codes h_1, h_2 of two objects in an autoencoder to get final object $\hat{X}$. Specifically, an autoencoder is a kind of feedforward neural network used for dimensionality reduction whose hidden units can be viewed as latent codes which capture the most important aspects of the object [30]. A representation of the process of encoding to and decoding from latent space can be seen in Figure 5.

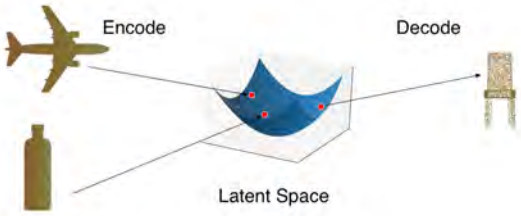
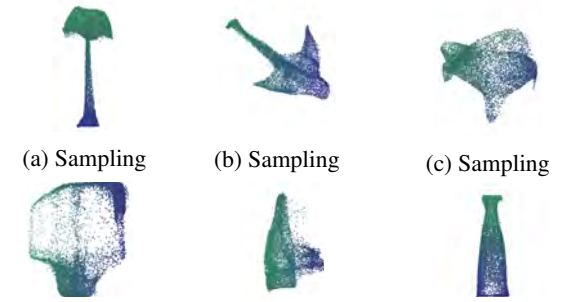


Figure 5: Encoding and decoding in latent space

$$\hat{h} = t \cdot h_1 + (1-t) \cdot h_2$$
$$\hat{x} = \texttt{Generator}(\hat{h}),$$

where $0 \leq t \leq 1$. Empirical evidence shows that decoding mixed codes usually produces semantically meaningful objects with features from the corresponding objects. This approach has also been applied to image creation [7]. One could adopt encoding-decoding algorithms for point clouds [40, 17, 23] based on the same idea. The sampling and interpolation results based on Li et al. [23] are shown in Figure 6.



(a) Sampling (b) Sampling (c) Sampling

(d) Interpolation (e) Interpolation (f) Interpolation

Figure 6: Results of Li et al. [23].

Inspiration: DeepDream for Point Clouds In contrast to simple generative models and interpolations, DeepDream leverages trained deep neural networks by enhancing patterns to create psychedelic and surreal images. For example in Figure 7, the neural network detects features in the input images similar to the object classes of bird, fish and dog and then exaggerates these underlying features. Given a trained neural network f_θ and an input image x, DeepDream aims to modify x to maximize (amplify) $f_\theta(x; a)$, where a is an activation function of f_θ. After this process, x is expected to display

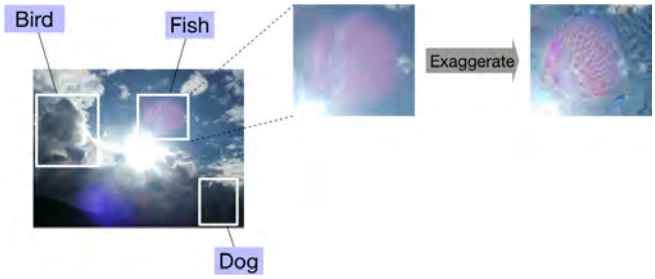


Figure 7: 2D DeepDream visualized

some features that are captured by $f_\theta(x; a)$. Algorithmically, DeepDream iteratively modifies x via a gradient update with a certain learning rate γ.

$$x_t = x_{t-1} + \gamma \nabla_x f_\theta(x; a). \quad (2)$$

An extension of DeepDream is to use a classification network as f_θ and we replace a with the outputs of the final layer corresponding to certain labels. This is related to adversarial attack [33] and unrestricted adversarial examples [6, 24].

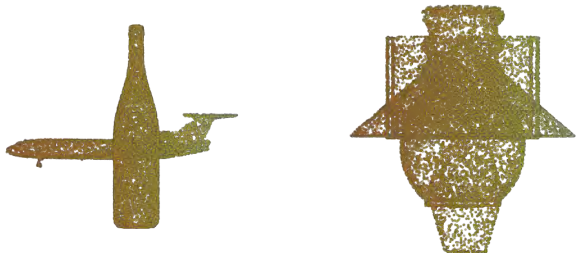
Figure 8: Naive DeepDream with undesirable sparse surface.

Unfortunately, directly extending the idea of DeepDream to point clouds with neural networks for sets [29, 41] results in undesirable point clouds suffering from both local and global sparsity as shown in Figure 8. To be specific, iteratively applying gradient update without any restrictions creates local holes in the surface of the object. Besides, the number of input points per object is limited by the classification model. Consequently the generated object is not globally dense enough to transform into mesh structure, let alone realize in the physical world.

To avoid local sparsity in the generated point cloud, one compromise is to run the naive 3D point cloud DeepDream with fewer iterations or a smaller learning rate, but it results in limited difference from the input point cloud. Another approach to solving the sparsity problem is conducting post-processing to add points to sparse areas. However, without prior knowledge of the geometry of the objects, making smooth post-processed results is non-trivial [19]. For this reason, we simply take inspiration from the gradient update strategy of DeepDream, while developing our novel algorithms.

Amalgamated DeepDream (ADD)

As opposed to images, mixing two point clouds is a surprisingly simple task, which can be done by taking the union of two point clouds because of their permutation invariance property. For example, the union of two or three objects is shown in figure 9. This observation inspires us to use a set-union operation, which we call amalgamation, in the creation process to address the drawbacks of naive extension.



(a) Union of airplane and bottle (b) Union of cone, vase and lamp

Figure 9: Amalgamated input for ADD.

Algorithm 1: Amalgamated DeepDream (ADD)

input : trained f_θ and input X
output: generated object $\hat{X}$
for $x = X_0, \ldots, X_n$ **do**
  $x_0 = x$
  for $t = 1 \ldots T$ **do**
    $\hat{x} = x_{t-1} + \gamma \nabla_x f_\theta(x_{t-1}; a)$
    $x_t = \hat{x}$
    if t *is divisible by 10* **then**
      $x_t = x_t \cup x$
      down-sample x_t to fix the number of points
    end
  end
  $\hat{X} = \hat{X} \cup x_T$
end

For object X with any number of points, we first randomly take it apart into several subsets with the number of points that is required by the classification model, and then modify the input image through gradient updating (2). In the end, we amalgamate all the transformed subsets into a final object. By doing this we can generate as dense objects as we want as long as the input object allows. To solve the local sparsity, when running the gradient update (2) for each subset we amalgamate the transformed point clouds with the input point clouds after every 10 iterations. To avoid exploded number of points, we also down-sample the object after each amalgamation operation. We call the proposed algorithm Amalgamated DeepDream (ADD) as shown in Algorithm 1.

(a) Input (b) Iteration 10 (c) Iteration 100

Figure 10: Transforming a bottle into a cone via ADD.

(a) Input: bowl; Target: chair (b) Input: keyboard; Target: car

Figure 11: ADD with single object input.

Experiments and results To test our methods, we use DeepSet [41] with 1000 points capacity as our basic 3D deep neural network model. We randomly sampled 10000 points from the CAD models and feed them into ADD model for 100 iterations with learning rate set to 1. A running example of ADD targeting the transformation of bottle into cone in ModelNet40 [38], which is the same as Figure 8, is shown in Figure 10. During the transformation process, ADD enjoys the advantage of deforming objects based on gradient updates with respect to a trained neural network as DeepDream without creating obviously local sparse areas. It can also better preserve the features of input point clouds with the amalgamation operation when we create new features based on DeepDream updates. In addition, the amalgamation of several transformed subsets from original objects allows us to generate denser objects that are realizable in the physical world. More created point clouds from the objects in Figure 2 are shown in Figure 11.

ADD with amalgamated inputs In addition to using union during the transformation process, we can push this idea further by using amalgamated point clouds as input instead of a single object. We keep the experimental setting the same. Note that now we could have multiple of 10000 points as input. The results of ADD with the union objects in Figure 9 are shown in Figure 12. Compared with Figure 11, ADD with multiple objects as input results in objects with more geometric details benefited from a more versatile input space.

(a) Input: airplane, bottle; Target: toilet (b) Input: cone, vase, lamp; Target: person

Figure 12: ADD with dual and triple object input.

Figure 13: Segmentation results of an airplane with 4 clusters.

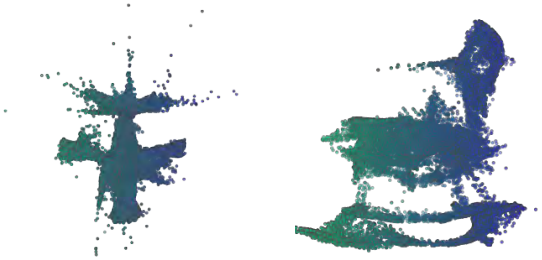
Partitioned DeepDream (PDD)

As the example shown in Figure 7, applying DeepDream to images produces more than one surreal patterns on each of the images [28]. In contrast, the nature of ADD is to deform the whole object simultaneously into a certain shape. It is essential to extend such a basic algorithm in order to allow multiple, separate transformations on a single object. Therefore, we propose Partitioned DeepDream as shown in Algorithm 2 which can be implemented based on various point cloud segmentation algorithms. When compared with ADD, PDD provides a more controllable method for artists to explore with and effectively increases the diversity of creation.

Algorithm 2: Partitioned DeepDream (PDD)

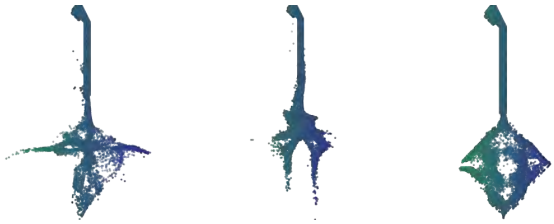
input : trained f_θ, number of segments k, input X and targets a
output: generated object $\hat{X}$
$S = \text{PCSegmentation}(X, k)$
for $x = S_1, \ldots, S_k$ **do**
  Standardize x by $x = (x - \bar{x})/\sigma_x$
  $\hat{x} = ADD(f_\theta, x)$
  Recover $\hat{x}$ by $\hat{x} = \hat{x} * \sigma_x + \bar{x}$
  $\hat{X} = \hat{X} \cup \hat{x}$
end

In contrast to the simplicity of mixing two point clouds, segmentation of point clouds is relatively hard and has been studied in depth [16, 26, 34]. Mainstream segmentation algorithms can be categorized into edge-based segmentation [31, 37], region growing segmentation [4], model-fitting segmentation [2, 14], hybrid segmentation [36] and machine learning segmentation [25]. In our work, manual segmentation is shown to obtain high-quality results but is extremely tedious and delegates too much responsibility to the artist.



(a) Input: airplane (b) Input: chair

Figure 14: PDD targeting on random classes



(a) Target: airplane (b) Target: person (c) Target: bowl

Figure 15: PDD with guitar body only

Instead, we explore machine learning methods which can automatically divide the object into several meaningful parts. For example, the segmentation results of an airplane with k-means are displayed in Figure 13. Note that this method requires the number of segments as input.

We extend ADD explained in Algorithm 1 with the k-means point cloud segmentation algorithm in our experiments. First, the input object is automatically divided into several segments using k-means. Each segment must be standardized before it is fed into ADD, in order for it to be treated as one distinct object. With this preprocessing step ADD allows us to produce the desired features on different parts independently. In the end, we cancel the normalization and reunion all segments into one object.

Experiments and results The same data preprocessing methods and ADD model configurations are used here as mentioned in the aforementioned ADD experiments. As for the partition strategies, one can randomly select some targeted categories for different parts and PDD results are displayed in Figure 14. This process is totally automatic with little human involvement. However, the random factors would lead to some undesired scattered points. Another more reasonable method is to create novel objects with more human participation by deforming the separate segments by design. As shown in Figure 15, we create some point clouds from a guitar shown in Figure 3 by only hallucinating on their body parts, while keeping the neck part intact. As we can see, the created objects are only locally modified while the over layout remains that of a guitar.

(a) Input: bottle; Upper target: person; Lower: toilet (b) Input: ashcan; Upper target: cone; Lower: night_stand

Figure 16: PDD on uniformly segmented objects

PDD with manual segmentation strategies In addition to automatic segmentation algorithms, two manual segmentation strategies have been tested. First, for highly symmetric objects it is reasonable to uniformly divide it into several parts. As shown in Figure 16, we manually partition a bottle and an ashcan from their middle, and run PDD with some selected targets on two segments separately.

Another intuitive way to segment point clouds is to uniformly segment the whole spaces into many cubic blocks and treat the points in each block separately. The results based on this strategy are presented in Figure 17 and 18. We partition the whole space containing the airplane into $3 \times 3 \times 2$ blocks alongside three axes, and generate features on each block with either a random class or cone class using PDD. In comparison to ADD, PDD can generate more delicate objects since it can manipulate different units of a single object. Besides, this also indicates a more expansive space for generating creative 3D objects.

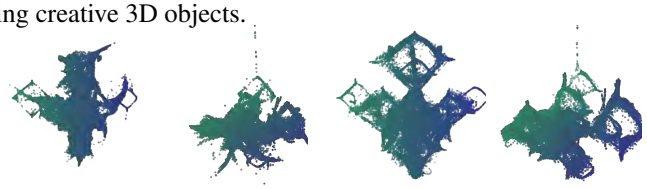


Figure 17: PDD with block segmented objects targeting random categories.

Figure 18: PDD with block segmented objects targeting cone.

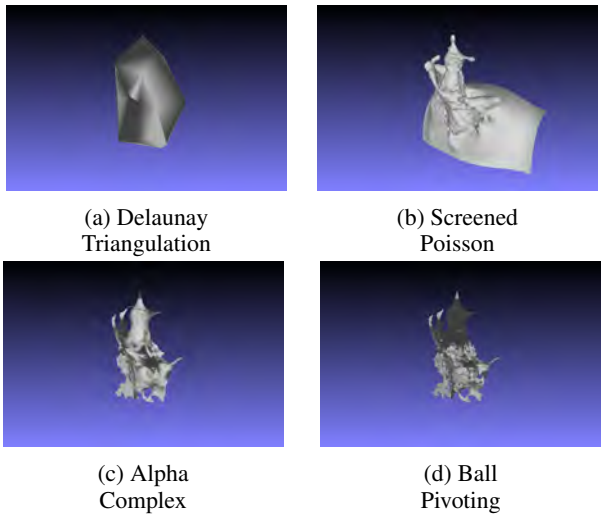
Realization of Sculptural Object

From points clouds to mesh Given a novel point cloud, our task becomes generating a mesh – a description of an object using vertices, edges, and faces – in order to eliminate the spatial ambiguity of a point cloud representation. While mesh generation, also known as surface reconstruction, is readily provided in the free software package MeshLab [10], each possible algorithm has its own use case, so this task involves experimenting with each available algorithm to find what generates the best reconstruction for a given point cloud.

Our experiments focused on the following reconstruction algorithms: Delaunay Triangulation [8], Screened Poisson [21], Alpha Complex [18], and Ball-Pivoting [3]. While each of these algorithms has its uses, ADD results in point clouds with a greater variance in sparsity than typical point clouds generated from real-world objects.

For all experiments, we limited the number of points to 10,000. If a generated point cloud had more than this number, we reduced using Poisson Disk Sub-sampling [12]. This sub-sampling method is more intelligent than a simple uniform resampling and produces points that appear to balance sparsity with finer definition.

An illustration of our findings can be found in Figure 19. Typically, Delaunay Triangulation produces a mesh that eliminates all detail of the point cloud. This approach will therefore only be appropriate when it is applied to an exceptionally sparse point cloud, as it would contain minimal detail



(a) Delaunay Triangulation (b) Screened Poisson (c) Alpha Complex (d) Ball Pivoting

Figure 19: Reconstruction techniques

regardless of the reconstruction technique. Screened Poisson extrapolates from the original point cloud, producing interesting shapes that are unfortunately misleading of the underlying structure. Alpha Complex and Ball-Pivoting are the two most consistent reconstruction methods and they both produce similar meshes. One important difference is that Alpha Complex produces non-manifold edges, all but making faithful 3D printing impossible.

As a result of these trials, we settled on Ball-Pivoting after Poisson Disk Sub-sampling to produce our final mesh.

From mesh to realizable 3D sculptures Our final goal is to create 3D sculptures in the real world. We use standard software Meshmixer [32] to solidify the surfaced reconstructed point cloud created by ADD. The solidified version of Figure 19d can be seen in Figure 1. We then use Lulzbot TAZ 3D printer with dual-extruder, transparent PLA, and dissolvable supporting material to create the sculpture of the reconstructed mesh. The printed sculptures of the point cloud in Figure 12 (RHS) are shown in Figure 21.

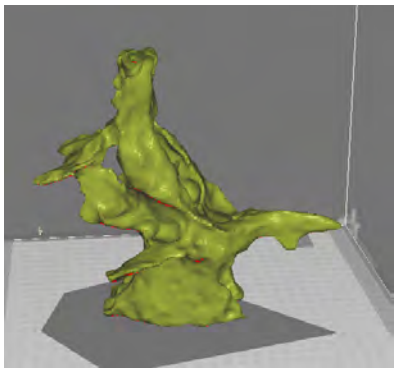


Figure 20: Screen capture from Cura-Lulzbot software for 3d printing

Figure 21: Created sculpture from ADD.

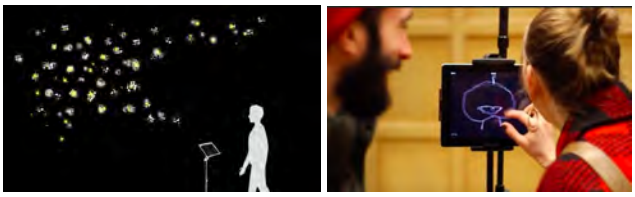


Figure 22: Sketch of Aural Fauna: Illuminato art installation and a Photo from the touch-sound interaction test with tablet computer interface

Conclusion

This paper describes our development of two ML algorithms for point cloud generation, ADD and PDD, which possess the ability to generate unique sculptural artwork, distinct from the dataset used to train the underlying model. These approaches allow more flexibility in the deformation in the underlying object as well as the ability to control the density of points required for meshing and printing 3D sculptures.

Through our development of ADD and PDD for sculptural object generation, we show AI's potential for creative endeavours in art, especially the traditional field of sculpture and installation art. One challenge in the development of creative AI is the contradiction between the need of an objective metric for evaluating the quality of generated objects in the ML literature and the desire for creative and expressive forms in the art community. Reconciling these goals will require a mathematical definition of creativity that can help guide the AI's generative process for each specific case. We will undertake these deep computational and philosophical questions in future work.

In the meantime, the realized 3D objects are an integral part of our ongoing project that is an interactive art installation. This project, Aural Fauna: Illuminato, presents an unknown form of organism, aural fauna, that reacts to the visitors sound and touch. Their sound is generated using machine learning. The creatures bodies are the generated sculptural objects by ADD and PDD. The sculptural objects could be installed on the wall or be hung from the ceiling like a swarm and the participant may interact with them using the touch-screen interface and their voice input as seen in Figure 22. This project aims to encapsulate the joint efforts of human artists and Creative AI as well as the viewer as partners in the endeavor.

References

[1] Achlioptas, P.; Diamanti, O.; Mitliagkas, I.; and Guibas, L. 2017. Learning representations and generative models

for 3d point clouds. *arXiv preprint arXiv:1707.02392*.

[2] Ballard, D. H. 1981. Generalizing the hough transform to detect arbitrary shapes. *Pattern recognition* 13(2):111–122.

[3] Bernardini, F.; Mittleman, J.; Rushmeier, H.; Silva, C.; and Taubin, G. 1999. The ball-pivoting algorithm for surface reconstruction. *IEEE transactions on visualization and computer graphics* 5(4):349–359.

[4] Besl, P. J., and Jain, R. C. 1988. Segmentation through variable-order surface fitting. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 10(2):167–192.

[5] Bidgoli, A., and Veloso, P. 2018. Deepcloud: The application of a data-driven, generative model in design.

[6] Brown, T. B.; Carlini, N.; Zhang, C.; Olsson, C.; Christiano, P.; and Goodfellow, I. 2018. Unrestricted adversarial examples. *arXiv preprint arXiv:1809.08352*.

[7] Carter, S., and Nielsen, M. 2017. Using artificial intelligence to augment human intelligence. *Distill*.

[8] Cazals, F., and Giesen, J. 2006. Delaunay triangulation based surface reconstruction. In *Effective computational geometry for curves and surfaces*. Springer. 231–276.

[9] Chang, A. X.; Funkhouser, T.; Guibas, L.; Hanrahan, P.; Huang, Q.; Li, Z.; Savarese, S.; Savva, M.; Song, S.; Su, H.; et al. 2015. Shapenet: An information-rich 3d model repository. *arXiv preprint arXiv:1512.03012*.

[10] Cignoni, P.; Callieri, M.; Corsini, M.; Dellepiane, M.; Ganovelli, F.; and Ranzuglia, G. 2008. MeshLab: an Open-Source Mesh Processing Tool. In Scarano, V.; Chiara, R. D.; and Erra, U., eds., *Eurographics Italian Chapter Conference*. The Eurographics Association.

[11] Content aware studies. http://egorkraft.art/#cas.

[12] Corsini, M.; Cignoni, P.; and Scopigno, R. 2012. Efficient and flexible sampling with blue noise properties of triangular meshes. *IEEE Transaction on Visualization and Computer Graphics* 18(6):914–924. http://doi.ieeecomputersociety.org/10.1109/TVCG.2012.34.

[13] Elgammal, A.; Liu, B.; Elhoseiny, M.; and Mazzone, M. 2017. Can: Creative adversarial networks, generating" art" by learning about styles and deviating from style norms. *arXiv preprint arXiv:1706.07068*.

[14] Fischler, M. A., and Bolles, R. C. 1981. Random sample consensus: a paradigm for model fitting with applications to image analysis and automated cartography. *Communications of the ACM* 24(6):381–395.

[15] Goodfellow, I.; Pouget-Abadie, J.; Mirza, M.; Xu, B.; Warde-Farley, D.; Ozair, S.; Courville, A.; and Bengio, Y. 2014. Generative adversarial nets. In *NIPS*.

[16] Grilli, E.; Menna, F.; and Remondino, F. 2017. A review of point clouds segmentation and classification algorithms. *The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences* 42:339.

[17] Groueix, T.; Fisher, M.; Kim, V. G.; Russell, B. C.; and Aubry, M. 2018. Atlasnet: A papier-mache approach to learning 3d surface generation. *arXiv preprint arXiv:1802.05384*.

[18] Guo, B.; Menon, J.; and Willette, B. 1997. Surface reconstruction using alpha shapes. In *Computer Graphics Forum*, volume 16, 177–190. Wiley Online Library.

[19] Hoppe, H.; DeRose, T.; Duchamp, T.; McDonald, J.; and Stuetzle, W. 1992. *Surface reconstruction from unorganized points*.

[20] Kato, H.; Ushiku, Y.; and Harada, T. 2018. Neural 3d mesh renderer. In *CVPR*.

[21] Kazhdan, M., and Hoppe, H. 2013. Screened poisson surface reconstruction. *ACM Transactions on Graphics (TOG)* 32(3):29.

[22] Lehman, J.; Risi, S.; and Clune, J. 2016. Creative generation of 3d objects with deep learning and innovation engines. In *Proceedings of the 7th International Conference on Computational Creativity*.

[23] Li, C.-L.; Zaheer, M.; Zhang, Y.; Poczos, B.; and Salakhutdinov, R. 2018. Point cloud gan. *arXiv preprint arXiv:1810.05795*.

[24] Liu, H.-T. D.; Tao, M.; Li, C.-L.; Nowrouzezahrai, D.; and Jacobson, A. 2018. Adversarial geometry and lighting using a differentiable renderer. *arXiv preprint arXiv:1808.02651*.

[25] Lu, X.; Yao, J.; Tu, J.; Li, K.; Li, L.; and Liu, Y. 2016. Pairwise linkage for point cloud segmentation. *ISPRS Annals of Photogrammetry, Remote Sensing & Spatial Information Sciences* 3(3).

[26] Nguyen, A., and Le, B. 2013. 3d point cloud segmentation: A survey. In *RAM*, 225–230.

[27] Nima, D.; Luca, S.; and Mauro, M. 2018. Vox2net: From 3d shapes to network sculptures. In *NIPS*.

[28] Posted by Alexander Mordvintsev, C. O., and Tyka, M. Inceptionism: Going deeper into neural networks. https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html.

[29] Qi, C. R.; Su, H.; Mo, K.; and Guibas, L. J. 2017. Pointnet: Deep learning on point sets for 3d classification and segmentation. *CVPR*.

[30] Robert, C. 2014. Machine learning, a probabilistic perspective.

[31] Sappa, A. D., and Devy, M. 2001. Fast range image segmentation by an edge detection strategy. In *3-D Digital Imaging and Modeling, 2001. Proceedings. Third International Conference on*, 292–299. IEEE.

[32] Schmidt, R., and Singh, K. 2010. Meshmixer: an interface for rapid mesh composition. In *ACM SIGGRAPH 2010 Talks*, 6. ACM.

[33] Szegedy, C.; Zaremba, W.; Sutskever, I.; Bruna, J.; Erhan, D.; Goodfellow, I.; and Fergus, R. 2013. Intriguing properties of neural networks. *arXiv preprint arXiv:1312.6199*.

[34] Trevor, A. J.; Gedikli, S.; Rusu, R. B.; and Christensen, H. I. 2013. Efficient organized point cloud segmentation with connected components. *Semantic Perception Mapping and Exploration (SPME)*.

[35] Van Den Oord, A.; Dieleman, S.; Zen, H.; Simonyan, K.; Vinyals, O.; Graves, A.; Kalchbrenner, N.; Senior, A. W.; and Kavukcuoglu, K. 2016. Wavenet: A generative model for raw audio. In *SSW*.

[36] Vieira, M., and Shimada, K. 2005. Surface mesh segmentation and smooth surface extraction through region growing. *Computer aided geometric design* 22(8):771–792.

[37] Wani, M. A., and Arabnia, H. R. 2003. Parallel edge-region-based segmentation algorithm targeted at reconfigurable multiring network. *The Journal of Supercomputing* 25(1):43–62.

[38] Wu, Z.; Song, S.; Khosla, A.; Yu, F.; Zhang, L.; Tang, X.; and Xiao, J. 2015. 3d shapenets: A deep representation for volumetric shapes. In *CVPR*.

[39] Wu, J.; Zhang, C.; Xue, T.; Freeman, B.; and Tenenbaum, J. 2016. Learning a probabilistic latent space of object shapes via 3d generative-adversarial modeling. In *NIPS*.

[40] Yang, Y.; Feng, C.; Shen, Y.; and Tian, D. 2018. Foldingnet: Point cloud auto-encoder via deep grid deformation. In *CVPR*, volume 3.

[41] Zaheer, M.; Kottur, S.; Ravanbakhsh, S.; Poczos, B.; Salakhutdinov, R. R.; and Smola, A. J. 2017. Deep sets. In *NIPS*.

Authors Biographies

Songwei Ge is a Masters student in the Computational Biology Department at Carnegie Mellon University.

Austin Dill is a Masters student in the Machine Learning Department at Carnegie Mellon University.

Chun-Liang Li is a PhD candidate in the Machine Learning Department of Carnegie Mellon University. He received IBM Ph.D. Fellowship in 2018 and was the Best Student Paper runner-up at the International Joint Conference on Artificial Intelligence (IJCAI) in 2017. His research interest is on deep generative models from theories to practical applications.

Dr. Eunsu Kang is a Korean media artist who creates interactive audiovisual installations and AI artworks. Her current research is focused on creative AI and artistic expressions generated by Machine Learning algorithms. Creating interdisciplinary projects, her signature has been seamless integration of art disciplines and innovative techniques. Her work has been invited to numerous places around the world including Korea, Japan, China, Switzerland, Sweden, France, Germany, and the US. All ten of her solo shows, consisting of individual or collaborative projects, were invited or awarded. She has won the Korean National Grant for Arts three times. Her researches have been presented at prestigious conferences including ACM, ICMC, ISEA, and NeurIPS. Kang earned her Ph.D. in Digital Arts and Experimental Media from DXARTS at the University of Washington. She received an MA in Media Arts and Technology from UCSB and an MFA from the Ewha Womans University. She had been a tenured art professor at the University of Akron for nine years and is currently a Visiting Professor with emphasis on Art and Machine Learning at the School of Computer Science, Carnegie Mellon University.

Lingyao Zhang earned her Master's degree in the Machine Learning Department at Carnegie Mellon University.

Manzil Zaheer earned his Ph.D. degree in Machine Learning from the School of Computer Science at Carnegie Mellon University under the able guidance of Prof Barnabas Poczos, Prof Ruslan Salakhutdinov, and Prof Alexander Smola. He is the winner of Oracle Fellowship in 2015. His research interests broadly lie in representation learning. He is interested in developing large-scale inference algorithms for representation learning, both discrete ones using graphical models and continuous with deep networks, for all kinds of data. He enjoys learning and implementing complicated statistical inference, data-parallelism, and algorithms in a simple way.

Dr. Barnabs Pczos is an associate professor in the Machine Learning Department at the School of Computer Science, Carnegie Mellon University. His research interests lie in the theoretical questions of statistics and their applications to machine learning. Currently he is developing machine learning methods for advancing automated discovery and efficient data processing in applied sciences including health-sciences, neuroscience, bioinformatics, cosmology, agriculture, robotics, civil engineering, and material sciences. His results have been published in top machine learning journals and conference proceedings, and he is the co-author of 100+ peer reviewed papers. He has been a PI or co-Investigator on 15+ federal and non-federal grants. Dr. Poczos is a member of the Auton Lab in the School of Computer Science. He is a recipient of the Yahoo! ACE award. In 2001 he earned his M.Sc. in applied mathematics at Eotvos Lorand University in Budapest, Hungary. In 2007 he obtained his Ph.D. in computer science from the same university. From 2007-2010 he was a postdoctoral fellow in the RLAI group at University of Alberta, then he moved to Pittsburgh where he was a postdoctoral fellow in the Auton Lab at Carnegie Mellon from 2010-2012.

Reasonable Weirdness: Integrating Machine Perspective in Visual Creativity

Sey Min, Jihye Lee
Sogang University, Aalto University
Korea, Finland
sey.min@randomwalks.org, rosalee1129@gmail.com

Abstract

Artificial intelligence (AI) has become a much more familiar topic to the public as a result of the several attempts at making a computer and a human compete in a specifically mental sport competition such as Go or chess. Moreover, since recently, issues pertaining to AI have become as important to artifact creation as issues relating to the concept or styles of paint are to painting. It is not that AI and art necessarily share goals, but much of the knowledge about AI and its methods can contribute to human creativity, especially art making. This paper reviews several recent works that examined these issues in the context of creativity and visual aesthetics. Throughout the literature review and case analysis, this paper investigates AI creativity from several examples and practically applies AI creativity to the visualization of music. This research work investigated the concept with the creation described below. The application visualizes the similarities and relationships of many audio chunks from a single audio track. From this visualization, it is possible to see how many audio events happened in one audio file. In addition, the chunks are heard as time series. Every audio file has different sonic events and feature distinctions. Each music file can have its own form and figure in this visualization. Ultimately, this research work brought together a collection of research results and practice experiences that together helped illuminate this significant new and expanding area. In particular, it is suggested that this paper points towards a much-needed critical language that can be used to describe, compare, and discuss AI in the context of creativity.

Keywords

artificial intelligence, machine learning, AI creativity, visualization, sound visualization

Introduction

The contemporary creators are regarded as people who love struggling to push the boundaries around them. They adopt sharply emerging technologies and sociocultural trends to create new artifacts blurring the conventional boundaries. In accordance with the development of technology, human creativity has evolved, expanded, and changed. Personal computer and design software are broadly used by artists and designers, changing the way of creating visual contents.

On the other hand, artificial intelligence (AI) is a new thread in issues relating to the concepts related to creativity. After Google announced the "Deep Dream" AI software for creative purposes in the arts realm in 2015, a research experiment that changes visual images to beyond-ordinary images was conducted. As AI is currently still in its early stage of development, however, it cannot be expected that the question of how AI will influence human creativity can be conclusively answered. Based on the changes caused by AI in the creative realm, this research work investigated the creative role that AI plays. More specifically, this research work investigated the visual aesthetics and creativity that could be found in the AI-driven visual arts, and how to experiment on AI algorithms in visual forms.

Thus, the answers to the following questions needed to be found: What is creativity? What sort of creativity is created by AI? To find the answers to these questions, first, this paper will explore the diverse notions of creativity and define machine creativity as opposed to human creativity. Through literature review, the term "creativity" will be reviewed, and AI-driven artworks will be defined in the context of creativity. To find the creative aspects of AI and its unique aesthetics found in AI-driven artworks, this research work investigated examples of machine-learning-oriented sound analysis visualization through literature review, case analysis, and application.

The foregoing requires an investigation of the notions of the creativity of humans as well as of machines throughout the history of the application of machines to the creative realm. Based on the notion of AI creativity defined in this paper,

the research cases will be explored, and more specifically, an application will be created and experimented on. More specifically, three different AI-generated works covering visual arts and writings will be investigated. Based on the example of AI creativity in visual art, the machine perspective will be represented by using sound data in the application.

Artificial intelligence and Creativity

Artificial Intelligence

In this paper, the term "artificial intelligence (AI)" is used in general, but the current AI-based creative artifacts are used for machine learning (ML). It is noted how ML works in the AI field, or how a system can develop task performance based on its past learning. In addition, ML is regarded as important for determining how learning is investigated by algorithms using data, apart from human programming, in each process of what a software is required to do[1]. It was clarified that the current AI-based creation examples use ML precisely in technics, but this paper uses the term "AI" instead in general to establish this paper as a basic research work arguing for the potential application of AI in the creativity realm.

There have been several articles of late about different types of AI: translation AI, game AI, AI maps, auto-driving cars, and AI-enhanced assistants like Apple's Siri, Facebook's M, and Amazon's Echo. These algorithms are now in people's pockets, powering speech recognition [2] and in our e-mail clients, filtering spam [3]. They are captioning images [4], translating text [5], and driving cars [6]. According to Millington et al.[7], AI is "about making computers able to perform the thinking tasks that humans and animals are capable of" (4p). The term "artificial intelligence (AI)" is said to have been coined in 1956 at Dartmouth as an effective approach to writing a huge program that simultaneously presents a logical cognition and an appropriate knowledge of the world [8]. The early AI, however, was developed by several computing pioneers, such as Turing, Von Neumann, and Shannon, from the 1940s to the 1950s, and the following philosophical questions were posed in relation to it: "What produces thought?" "Could an inanimate object be given life?" "What is the difference between a cadaver and the human it previously was?" [7].

Despite AI's achievement, however, as represented by its victory in computer chess in the 1990s, Lewis-Kraus argues that AI has not sufficiently approximated humans, or humans could not sufficiently approximate AI. As revealed by [9] in their research work on AI development, experts believe that high-level AI will be advanced in around the years 2040-2050, with the chances for such rising to 90% by 2075. In addition, most of the experts who participated in the survey articulated negative opinions on the implications of AI for humanity[9]. Thus, it seems that AI still does not wield a sufficient positive influence on human lives.

Nonetheless, the authors were eager to discuss the positive attempts at applying AI, such as for promoting human creativity. Applying advanced computation, such as through an algorithm, to stimulate artworks already has a history in the creativity realm, as represented by generative art, fractal art, etc. Artists have attempted to create artworks using algorithms. Creators called "digital artists," who use sophisticated graphical software, have been distinguished from creators who create their own tool to create an artwork. Prior to the discussion of the role of AI in the creativity realm, the following section will present a short history of the use of computation for creative activities.

As mentioned earlier, AI produces diverse results in accordance with how they are originated through a human's input data or intention. To determine whether and how AI products can become creative, this paper adopts the theory of analysis of creative products, which assesses the results produced by appropriate experts. Using such theory, this paper will analyze several significant AI works in the next section. For the application of the experts' standard in defining the elements that make AI-produced works creative, this research work investigated several perspectives to define the elements of creative production.

Creativity

Creativity has been a widely discussed topic among scholars from diverse disciplines. Creativity is the ability to produce a work that is both novel and appropriate [10]. Creativity can mean working at both the individual and societal levels in diverse task domains. At the individual level, creativity is seen as important in problem-solving, and at the societal level, in obtaining new findings from scientific experiments, artistic innovations, and effecting a social shift to a new paradigm [10]. However, despite creativity's importance and contribution to the society at both the individual and societal levels, it has been applied mostly in the realm of psychology[10]. The aforementioned two researchers approached the study of creativity from the "mystical, psychoanalytic, pragmatic, psychometric, cognitive, and social-personality" perspectives [10](4p). However, the concept of creativity was originated by scholars from the biblical story of the Creation, God's work on Earth [11]. Thus, even though the contemporary concept of creativity has evolved, the "mystical" approach [11], focusing on the "extraordinary-ness" of a specific person, for the sake of creativity, seems to have been implicitly noted by scholars until today. The implicit theories were much developed [10], who provided a rationale for it using the psychometric approach by trying to fairly measure and evaluate creativity in association with intelligence. When intelligence is defined with its characteristics, however, such as the ability to solve problems with a goal-oriented sense and fluid thinking, etc., creativity measured in association with a "creative" person's intelligence seems controversial.

As mentioned earlier, creativity has been considered only a part of human nature because of its subjective and expressive aspects. In the age of AI, however, AI produces its own creativity, apart from that produced by humans. What then is AI creativity? In section III, AI creativity and

its characteristics will be looked into based on research cases.

Creativity in the Age of Machines : AI Creativity

This research work considered the recent AI artworks as revealing machine perception more differently from human understanding, even though AI networks were developed after the human brain system was. One example illustrating this is the "Deep Dream" AI software created by Google in 2015. It is a computer vision program that uses a convolutional neural network (i.e., CNN) to find and enhance patterns in images via algorithmic pareidolia. The project involves verified ML, which has a dependency on input data; as such, the results are diverse and are visually presented with a dreamlike hallucinogenic appearance, as shown in Fig. 1.

Figure 1. <Deep Dream>, 2015 (Courtesy Google Research)

In the ML methodology, the AI systems interpret images with learned features among large databases in the beginning, but exceed the human level in terms of repeating and increasing tasks [12]. As shown in Fig. 1, it can be seen how bizarre and unique visualization can be done through the repeated use of the AI system. This visualization accomplished via AI will be called unpredictable and unique but with a computationally logical characteristic, as "reasonable weirdness," and will be defined as AI creativity. AI creativity as reasonable weirdness is found broadly, apart from the different formats of the algorithm.

Fig. 2 <Sunspring> by Oscar Sharp shows the dependency of the training data written by the LSTM (Long- Short-Term Memory) algorithm, which performs highly in time series information learning. The LSTM algorithm is often used for speech recognition, language modeling, translation, image captioning, and story generation.

The filmmaker Oscar Sharp directed the aforementioned film, with a screenplay generated by the LSTM software named "Benjamin." Sharp trained Benjamin with hundreds of classic science fiction films, like "Blade Runner," "Alien," and "Brazil." After processing the learning obtained, Benjamin created a script that included the directions for the actors. The movie is about three people in a future scenario who are in a love triangle. They hold conversations during the entire movie runtime of around 8 minutes. The film has a dark atmosphere, and the individual sentences are fully structured, but the actors' dialogue does not make any sense. The movie script written by the AI system features strange conversations running through the entire script, streaming from the beginning to the end. After watching this 8-minute short film full of nonsensical conversations, at least a consensus can be arrived at: the existence of a love triangle in the film as well as a tragedy and a future world. The actors in the movie follow the script written by the AI system to the letter. Watching the film based on the script generated by AI creativity will give the audience an uncanny experience.

Figure 2. <Sunspring> by Oscar Sharp, 2016

Humans are not likely to write anything like this script with nonsensical conversations, but machines do, and even though such script sounds quite weird to humans, it may be clear to machines because it was written based on what the machine learned, as mentioned previously. AI creativity may be found in this nonsensical beauty because it showcases the uniqueness of machines.

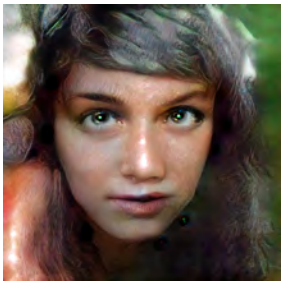


Figure 3. <I see you, Portraits of Imaginary People> by Mike Tyka, 2017

Fig. 3 <I see you, Portraits of Imaginary People> explores the latent space of human faces by training an artificial neural network to imagine and generate portraits of non-existent people (Ars Electronica, 2017). The portraits were generated from GAN (Generative Adversarial Networks), a framework for estimating generative models via an adversarial process. In this network, two models are simultaneously trained: the discriminator and generator (Generative Adversarial Networks, 2014). The generator model generates fake images while the discriminator distinguishes real photos from generated ones. As the generator generates more realistic images, the discriminator improves in return. Similar to "Deep Dream"

or "Sunspring," this project is also dependent on training datasets and on the visuals that AI creates, which cannot be imitated or imagined by humans.

To sum up, this research work explored several AI-generated artworks that could be represented as showcasing AI creativity. The following components of state-of-the-art in AI creativity can be found in the above examples: (1) dependency on training data; and (2) a weird conclusion with a clearly logical procedure.

With the previously presented concept of AI creativity, this research work conducted an experiment on how AI creativity can be used in information visualization. More specifically, the experiment was conducted to understand, from the machine perspective, how to interpret and visualize music under the concept of AI creativity.

The development of visualization in the concept of AI Creativity

To test how reasonable weirdness, which this paper defines as a value of AI creativity, is presented in information visualization, this research work attempted to visualize sound data through AI-driven analysis described as the machine perspective.

Machine perspective as a creative singularity of AI

Section 3 showed how machine perception can be differentiated. Therefore, even if AI generated outputs unfamiliar to human creativity and experiences, the training datasets explain the reasonable contexts behind such bizarre results. To investigate how reasonable weirdness is presented in data visualization art and design, this research work visualized sound data via AI-driven analysis. The visualization represents clustering examples of sound data through the machine perspective with imagination in visual form.

Objectives of visualizing sound data in AI analysis and clustering

Machines and humans approach music differently. Machines understand music in terms of analytics and in data-driven ways while humans understand music in abstract ways. Moreover, with AI, machines can understand music (sound data) at a higher dimension, or beyond the time dimension. That is, while humans listen to music as time series, machines analyze and re-organize music through sonic feature distinction. These AI-driven characteristics of high-dimensional understanding and representation embody reasonable weirdness because the data similarities in the high dimensions cannot be understood by and are not familiar to humans. Only machines can create such visual form and logic.

Visualization experiment process

The experiment on "What if machines can see music…?" had the following characteristics:

- The visualization tested the sonic-event similarities and relationships of many audio chunks from a single audio track.
- The visualization displayed the relationships of many audio events from a single audio track. This clustering is an AI-driven visual form and not a visual form created by humans.
- The audio chunks played one after another as time series while the visualization animated.
- Each music file could have its own form and figure because each music source has its own sonic-event pattern distinguishable from those of other music sources.

Experiment development

The experiment on "What if machines can see music…?" had the following characteristics:

1.Data Analysis

- As input, a single audio track (a song) was divided into many audio chunks.
- Such audio chunks occurred when discrete sonic events began in the input audio.
- With librosa lib (mel-spectrogram), the features were extracted from the audio chunks.
- As a result, 26 features were extracted from each chunk.
- The chunks were clustered via t-sne, according to the feature similarities.

This method is a variant of Gene Kogan's audio T-SNE example.

2.Tests featuring similarities in diverse music sources

- First test: Classical music

Figure 4. Audio source from "Only" by Alex Mason and The Minor Emotion

In Fig. 4, one audio file can be chunked into many small files according to its sonic events, via mel-spectrum analysis.

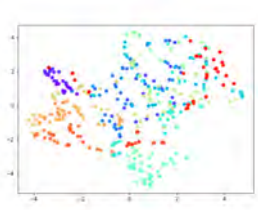


Figure 5. Audio chunks from "Only" by Alex Mason and The Minor Emotion clustered in 2D via t-SNE.

In Fig. 5, pre-discrete audio chunks are clustered according to their feature similarities via the t-sne algorithm. Colors are applied to the first to the last chunk, from red to purple (rainbow colors). From this 2D visualization, the intro part (red group) and the ending part (purple group) can be distinguished from the rest. This cannot be said to be a general characteristic of classical music, but it can be said to be a characteristic of the audio source "Only."

- Second test: Electronic music

Figure 6. Audio source from "CosmoF" by Sanmi

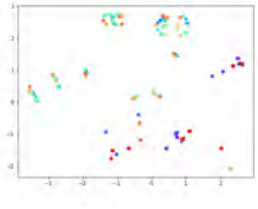


Figure 7. Audio chunks from "CosmoF" by Sanmi clustered in 2D via t-SNE.

Fig. 7 shows audio chunks in mel-spectrum analysis. The audio chunks are plotted in 2D via t-SNE analysis, as shown in Fig. 7. From this visualization, it can be understood that the sonic events in "CosmosF" are very distinguishable from one another,and are not blurred. These are outstanding characteristics of "CosmosF."
This procedure was applied to diverse music sources, such as the following jazz pop song that became popular in the 1980s as well as contemporary indie music and K-pop.

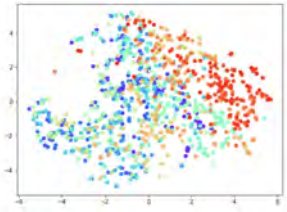


Figure 8. Audio chunks from "Just the Two of Us" by Bill Withers and Grover Washington Jr. clustered in 2D via t-SNE.

Fig. 8 shows that the '80s jazz pop song "Just the Two of Us" by Bill Withers and Grover Washington Jr. has a total of 1,051 chunks. The intro, middle, and ending parts of the song have noticeable characters, which is why the chunks have clear clusters.

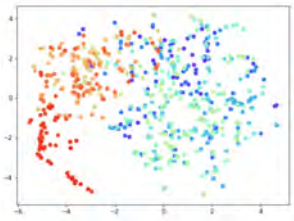


Figure 9. Audio chunks from "As Usual as Today" by Noname clustered in 2D via t-SNE.

Fig. 9 shows that the Korean indie song "As Usual as Today" by Noname has an isolated cluster on the left bottom side (red group) because the song's intro part has a strong ambient sound, which was not applied to the rest of the song.

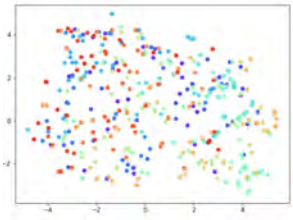


Figure 10. Audio chunks from "Limitless" by NCT127 clustered in 2D via t-SNE.

Fig. 10 shows that "Limitless" by NCT127, a techno-genre K-pop song, generates sound chunks that are mixed and not grouped clearly. There is no clear distinction among the intro, middle, and ending parts of the song.

3.Visualization

From the previous analysis, new datasets were generated to project the audio chunks in a three-dimensional space according to their sonic similarities. Comparing the 26 features from each audio chunk via the t-SNE algorithm creates a position for each (X, Y, and Z). The previous plottings showed only 2D results after the analysis, but the next visualization expanded the visual experience further with imagination. The visualization was accomplished using the following two tracks: (1) first track: as time order, where all the chunks are shown at the bottom, one after another (this process represents the human understanding of music, and the size of each box represents the length of the audio chunk); and (2) second track: the audio chunks were placed in a 3D space according to their feature similarities generated from comparing the 26 features of each chunk with those of the other chunks. This visualization not only shows all the results at once but also animated the figures. This visualization represents the machine understanding of music with imagination. Regarding sound, every audio chunk is played according to its time order, one by one. For the sound result, the viewers can hear and distinguish all the chunks that AI made from a single audio file. For the visual result, every audio file

can have its own form and shape, as shown in Fig. 11. The same procedure was applied to Fig. 12-16.

Figure 11. Final visual in the front view of "Only" by Alex Mason and The Minor Emotion

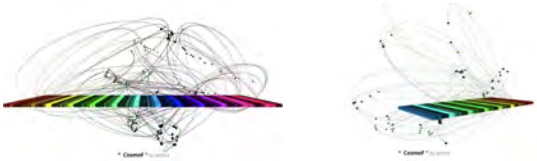


Figure 12. Visuals in the multiple view of "CosmosF" by Sanmi

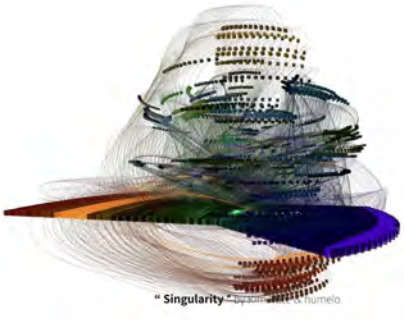


Figure 13. Visual in the multiple view of "Singularity" by Kim Kate & Humelo

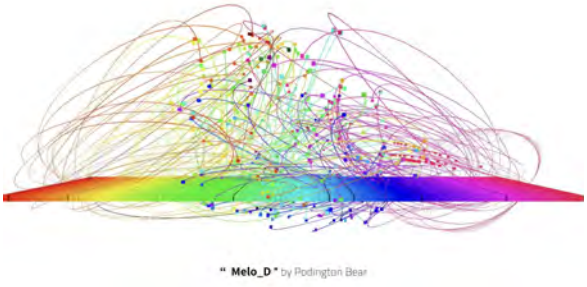


Figure 14. Final visual in the front view of "Melo_D" by Podington Bear

Figure 15. Visual tests in the multiple views of "Just the Two of Us" by Bill Withers and Grover Washington. Jr.

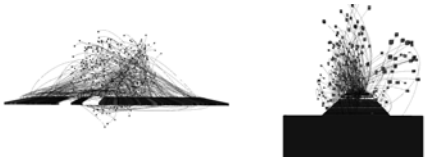


Figure 16. Visual tests in the multiple views of "Limitless" by NCT127

Conclusion

Throughout this research work, the specialty found in artificial-intelligence-(AI)-oriented artworks was showcased. This unique aesthetic can be achieved in or with machine learning (ML) environments. This research work investigated how this unique aesthetic is represented in AI-generated artworks using several recent research cases, emphasizing its common value as it can be found regardless of the specific format of the algorithm. This research work conducted an experiment on visualization to find the answer to the question "What if machines can see music…?," so as to determine how AI creativity is applied from complex and non-visible data. Throughout the experiment, the sonic-event similarities and relationships of many audio chunks from a single audio track were found. Based on clustering, the relationships of many audio events from one audio file were visually displayed within the AI system. The audio chunks play one by one as time series with the visualization. As a result, each music file can have its own form and figure because each music source has its own sonic-event pattern. This whole procedure was conducted within an AI-generated system (i.e., machine learning or ML), but the results were aesthetically unique and different from human creativity.

This paper emphasized how AI creativity is different from human creativity in the earlier section. Creativity has been considered only a part of human nature because of its subjective and expressive aspects. In the age of AI, however, AI produces its own creativity, apart from that created by humans. Through literature review, case analysis, and experimentation, an attempt was made to define AI creativity and to determine how it can be applied.

This research is still in the earlier stage because AI-driven creative works and algorithm development still have many questions to answer. Only one outstanding aesthetic is described in this paper, but in the future, more positive values of AI creativity are expected to be found.

As a next step, to expand the application of AI-driven creativity among the public, researches on understandable methods of data visualization of AI-driven creativity should be carried out at a general level. To do this, more creative contents integrated with AI should be published, with easy accessibility, and the visualization should well

explain how the networks work and how the data flow. Ultimately, this research work aimed to be a fundamental study for the future AI-generated creative works and its related communities.

References

[1] T.M. Mitchell, Machine Learning. McGraw-Hill Science /Engineering /Math, 1997.

[2] G. Hinton, D. Li, D. Yu, D. Dahl, A.R. Mohamed, N. Jaitly, An. Senior, V. Vanhoucke, P. Nguyen, T. Sainath, and B. Kingsbury, "Deep Neural Networks for Acoustic Modeling in Speech Recognition," IEEE Signal Processing Magazine, pp. 2-17, November 2012.

[3] T.S. Guzella, and W.M. Caminhas, "A Review of Machine Learning Approaches to Spam Filtering," Expert Systems with Applications, vol. 36, pp.10206-10222, 2009. http://dx.doi.org/10.1016/j.eswa.2009.02.037

[4] A. Karpathy, and F.F. Li, "Deep Visual-Semantic Alignments for Generating Image Descriptions," 2015., in press.

[5] I. Sutskever, O. Vinyals, and Q.V. Le, "Sequence to Sequence Learning with Neural Networks," 2014. https://arxiv.org/abs/1409.3215 (accessed on 31st March, 2018)

[6] S. Thrun, M. Montemerlo, H. Dahlkamp, D. Stavens, A. Aron, J. Diebel, P. Fong, J. Gale, M. Halpenny, G. Hoffmann, K. Lau, C. Oakley, M. Palatucci, V. Pratt, and P. Stang, Journal of Field Robotics vol 23 no 9, pp. 661-692, 2006.

[7] I. Millington, and J. Funge, Artificial Intelligence for Games (Second Edition), CRC Press, 2016.

[8] G. Lewis-Kraus, "The Great A.I. Awakening," The New York Times., in press. 2016. https://www.nytimes.com/2016/12/14/magazine/the-great-ai-awakening.html?_r=1 (accessed on 11st Jan, 2017)

[9] V.C. Müller and N. Bostrom, "Future Progress in Artificial Intelligence: A Survey of Expert Opinion," Fundamental Issues of Artificial Intelligence of the series, Synthese Library, vol 376, pp. 555-572, Springer, 2016.

[10] R.J. Sternberg and T.I. Lubart, "The Concept of Creativity: Prospects and Paradigms," in R.J. Sternberg., Handbook of Creativity. Cambridge University Press, 1999.

[11] R.S. Albert, and M.A. Runbo, "A History of Research on Creativity," in R.J. Sternberg., Handbook of Creativity. Cambridge University Press, 1999.

[12] W. Samek, T. Wiegand, K.R. Müller, "Explainable Artificial Intelligence: Understanding, Visualizing and Interpreting Deep Learning Model," 2017., in press.

Authors Biographies

Sey Min is a data visualization artist and designer, who is interested in dealing with live data sets in various media formats. She makes projects that reimagine how humans relate to technologies, to societies and cities, and to environments. Combining elements of environmental studies, visual art, programming, and data storytelling, her projects range from building a real-time interactive information graphics system for a music club (Gender Ratio, 2007) to visualizing Seoul City expenditure data (City DATA: Seoul Daily Expenditure, 2014).Her work has been shown at NIPS 2018, National Museum of Modern and Contemporary Art, Korea; TED 2011; TEDGlobal 2012; Art Center Nabi in Seoul, and Lift Conference, and featured on CNN Asia, Lift09 etc. After serving as an urban information design researcher at MIT SENSEable City Lab, She was selected as a 2011 TED Fellow and Senior Fellow from 2012 to 2013. Her work is also available at ttoky.com.

Jihye Lee is an interactive media experience designer and researcher. Currently she is working as a post-doctoral researcher in AI based AR/VR with UX design perspective, at the Mobile Cloud Computing Group in Aalto University, Finland. After completing PhD in Film and Digital Media Design in Hong Ik university in Seoul, she has published several journals in a field of convergence between AR/VR, design and UX design research including: *Investigating Sociocultural Specificity of Mobile Augmented Reality (2017), Context-based Design Methodology For Augmented Reality Contents (2017), Augmented Reality and Art (2018), Multimodal based Storytelling Experience Using Virtual Reality in Museum (2018) and An Analysis and Directional Suggestion for Digital Cultural Heritage Education (2018)*. She has participated in several projects for smart city, and digital museum in Korea(2015-2017) and now design projects using AI based AR&VR in Finland (2018-).

Political Crystals: Numinous Hashtags

Clarissa Ribeiro, Ph.D.
CrossLAB, University of Fortaleza
Fortaleza, Brazil
cr@clarissaribeiro.com / www.clarissaribeiro.com

Abstract

This paper presents and critically discusses the installation "Political Crystals: Numinous Hashtags" (2018) – a poetic exploration of the ironic numinous aspects of Brazilian 2018 presidential elections. Combining parametric modeling generative strategies for data visualization with digital fabrication, the work includes the algorithmic design of a series of geometrically intricate models using as raw data Twitter APIs to perform sequential data analysis and conversions having as the Search phrase hashtags related to Brazilian 2018 presidential elections Twitted from defined geolocation. From one perspective, the 3D shapes can be seen as aggressive and sharp materialization of online hashtags' wars that includes metadata tags. From another perspective, the translucent 3D shapes and its sophisticated data-based generative modeling evoke sublime and numinous aspects of natural crystal cluster such as quartz crystals while hiding the dramatic force of a manipulated faithful army in spreading hate discourses against minorities, defending a populism that returns to its fascist origins in Latin America.

Keywords

Data Visualization, Hashtag wars, Twitter, Brazil Presidential Elections, Social Media, Assembly of God, trolls, bots, Political Crystals, Silicon Valley, Digital Fabrication, Altered Reality, Virtual Reality, Digital Fabrication, Parametric Design, Morphogenetic Design, Algorithmic Design.

Introduction

Considering its relation to ISEA 2019 major topic, "Political Crystals: Numinous Hashtags" (2018) explores computational aesthetics from data visualization considering noise and sequential data conversions in parametric 3D modeling environment as the main morphogenetic strategy embedded in its poetics. The work navigates research fields such as Computer Graphics, Socio-Technical Systems, Data Science, Complex Network, Data Visualization and Analysis and Computational Aesthetics in a transversal move that incorporates Digital Fabrication and Altered Reality strategies for its ultimate materialization as an art piece - as a contemplative invitation for critically consider the challenging political situation in Brazil dramatically depicted and offered as a superposed and conflicting immersive environment.

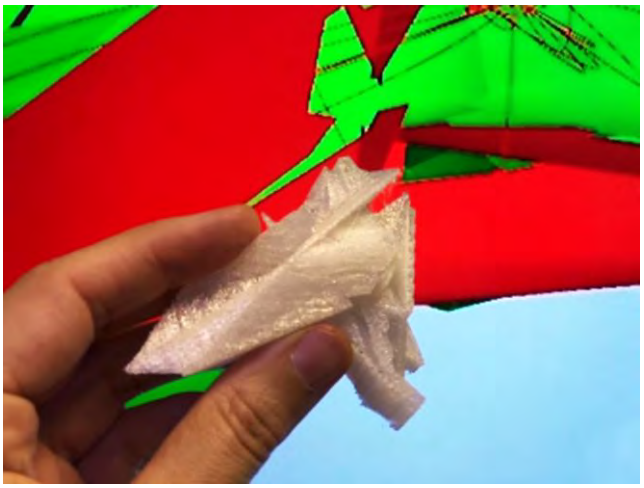


Figure 1. Political Crystals: Numinous Hashtags (2018) 3D printed complex geometry generated using hashtag #EleNão (#NotHim) twitted by users in the city of Fortaleza (-3.718333, -38.542778) November 2018 as the Search phrase for accessing Twitter APIs. 3D printer filament color: natural PLA (no pigments) Image by the author.

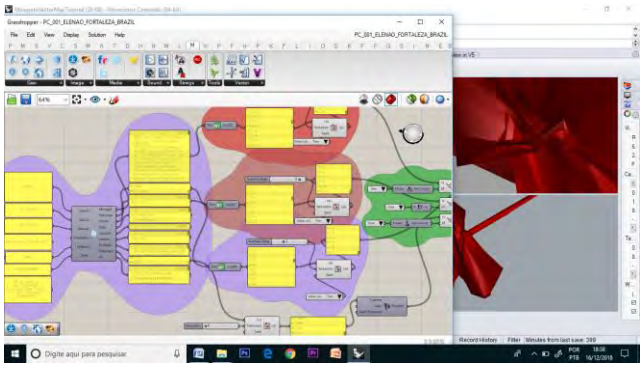


Figure 2. Political Crystals: Numinous Hashtags (2018) Grasshopper graphical algorithm editor script superposed to Rhinoceros 3D interface where the generated shape is visualized. Computer screenshot by the author

Using a plug-in suite for the Grasshopper graphical algorithm editor integrated with Rhinoceros 3D modeling tools that allows extracting location, profiles, images and messages from social media platforms such as Facebook and Twitter, a scrip is designed to derive complex geometry

from data translated into a network of points in space (x, y and z axes). Time is an additional dimension since the choice for using Twitter data tracking specific hashtags from a given search allows navigating a stream of events imprinted in short messages that cannot exceed 280 characters.

Numinous Hashtags

> NUMINOUS (adjective) Having a strong religious or spiritual quality; indicating or suggesting the presence of a divinity. id 17th century: from Latin numen, numin- 'divine will' + -ous. [1]

Ishaan Tharoor, Washington Post columnist, who was a senior editor at Time magazine, opens his article for World View on September 21 with the following affirmation – "We're entering the run-up to perhaps the most important election in the Western Hemisphere this year"[1] considering Brazilians were about to elect in 2018 new governors and legislatures in each of its 27 states; all members of the lower house of Congress, around two-thirds of the Senate and a new president.

The spirituous words choices of the columnist picture the former army captain who ended up being elected as the next president of Brazil, as someone who like Trump, has "[…] marshaled widespread disaffection to build a viral, anti-establishment movement" and promises sweeping, bludgeoning reform […] while pandering to a socially conservative base of voters, particularly an increasingly influential bloc of evangelical Christians. Tharoor quotes the considerations of professor Federico Finchelstein, a historian at the New School, who said that the Brazilian former army captain "[…] represents a new brand of populism in Latin America, one that returns to its fascist origins across the world […]" and his "[…] rise should serve as a reminder that we are experiencing a worldwide crisis of democracy, one not limited to Trumpism or the rise of the extreme right in Europe."[2]

Adding a seemingly surrealist layer to this conversation we propose as part of an artistic exercise to ironically and critically highlight the numinous aspects of Brazilian presidential elections. Though the former army captain is Catholic, he maintains close links to Brazil's powerful Evangelical movement – he attends an Evangelical church and his wife and sons are both evangelicals. Before the elections, sixty-six percent of self-identified Evangelicals said they were considering vote for him and almost 50 percent of the Brazilian Catholics. Brazil had been under military rule since 1964, when a coup brought down the democratically-elected president experiencing a fast economic expansion while critics of the regime went into exile and opposition faced all kinds of violence, including torture, censorship and death. As Chayenne Polimédio (the deputy director of the political reform program at New America) points out in an article published in The Atlantic GLOBAL on January 24, 2018 [3], under the dictatorship, Brazil's evangelical community largely stayed out of politics. Nevertheless, as the dictatorship crumbled, Brazil's evangelicals came to recognize their new strength considering, as Polimédio reaffirms [3], democracy as a "numbers game" while growing their army of the faithful. It was in 1985, at a gathering in An polis in the rural state of Goi s, that "[…] the leaders of the Assembly of God, a popular evangelical church, announced they would begin endorsing and supporting candidates to run for office and thus be part of the "Constituent Assembly" which would write a new constitution for Brazil." [3] The Assembly of God, founded in 1911, with this organized participation in politics sets up the beginning of a new era – in the following years, its donations to the Christian Social Party (PSC) fed up and invigorate church's political enterprises. As Chayenne Polimédio underlines, in May 2016, the same month former Brazilian President Dilma Roussef was impeached, the next elected president was in Jordan and on May 12 a prominent leader of the Assembly of God and the head of the Christian Social Party, baptized him in the Jordan River. Polimédio considers [3] this was his most important act in formalizing his relationship with Evangelicals – a relationship he spent the early part of this decade cultivating.

Hashtags' Wars

In an analysis by Yoni Heisler for Boy Genius Report (BGR) on Twitter's decision in changing the most defining feature of the service – brevity –, the main concern is considered to be that "Twitter timelines would morph from easily digestible tidbits of information into an unreadable litany of screeds."[4] Nevertheless, according to Heisler [4] in a conference on February 2018, Twitter CEO Jack Dorsey said that as an immediate impact of the decision, the percentage of users who abandon tweets has declined while overall user engagement has increased. The decision more than an experiment, is a strategic move. Despite a year after Twitter doubled its character limit data shows that users are "[…] being more polite, using fewer abbreviations, and replying to more tweets" [5] the social media was the stage for a hashtags' war, feed and influenced by pervasive armies of troll and bots infiltrated in each fraction of the Web territory delineating the most nefarious face of neoliberal political enterprises – a mask that hides together religious, military, far-right populists and Nazis as the vivid expressions of the genetic code of an era of political aberrations. From this mechanism an ex-paratrooper, pro-gun and torture, populist, hostile to LGBT, women, African descendents and indigenous communities and Brazilians religious inclination to syncretism was elected the next president of Brazil. The pretended main character in this pulp magazines' plot is the one who, according to Professor Monica de Bolle, cited by Mayra Rodriguez Valladares [6] is making markets happy because market participants think that he will be market friendly no matter "[…] the military was very interventionist. They got policies wrong for 20 years. Think of the hyperinflation. Their record was not good." [6]

140 characters and no Nazis?

The troll and bots versus humanity battlefield was recently accurately depicted in an event reported and analyzed by Austin Carr and Harry McCracken for Fast Company published online on April 2018 – when "Yair Rosenberg wanted to troll the trolls." [7] According to the columnists, the senior writer for Jewish-focused news-and-culture website Tablet Magazine, who became a leading target of anti-Semitic Twitter users during 2016 U.S. presidential campaign, was gnawed by a type of Twitter troll who posses as minorities using stolen photos of real people and then infiltrating high-profile conversations to infect and influence their tonic. As Rosenberg observes, according to Carr and McCracken [7] "Unsuspecting readers would see this guy who looks like an Orthodox Jew or a Muslim woman saying something basically offensive," he explains. "So they think, Oh, Muslims are religious. Jews are religious. And they are horrifically offensive people."[7] As Rosenberg decided to fight back creating an automated Twitter bot called Imposter Buster (starting on December 2016) inserting itself into the same Twitter threads and politely exposing the trolls he was attacked by racists who reported him to Twitter and the company reaction was to suspend his the bot for spammy behavior. Rosenberg, with assistance of the Anti-Defamation League got that decision reversed in 2018, despite the targets continued to file harassment reports, and Twitter on December 2017, once again, blacklisted Imposter Buster without giving a direct explanation to the user giving the company the "[…] racists a win by technical knockout." [7] The columnists point out that,

> "For all the ways in which the Imposter Buster saga is unique, it's also symptomatic of larger issues that have long bedeviled Twitter: abuse, the weaponizing of anonymity, bot wars, and slow-motion decision making by the people running a real-time platform. These problems have only intensified since Donald Trump became president and chose Twitter as his primary mouthpiece. The platform is now the world's principal venue for politics and outrage, culture and conversation–the home for both #MAGA and #MeToo." [7]

This perverse mechanism that has helped improve the company's fortunes is apparently considered as part of Twitter's effort and commitment in making it safer for its users. In a moment in which social media platforms are systematically being corrupted for evil intentions Facebook and Google have come under heightened scrutiny since the U.S. presidential election events that revealed how their platforms is used to manipulate citizens' opinions and directing choices and actions. If a few years ago Alex Macgillivray, first general counsel who later served as deputy CTO in the Obama administration, said, according to Carr and McCracken [7] "Let the tweets flow," now we must assume it is proved naïve – the commitment to free speech opened the door for the platform to be "hijacked and weaponized"[7]. As a consequence of a sequence of recurrent naïve postures and lack of action, as mentioned by Carr and McCracken [7] the era of Silicon Valley self-policing can be close to give its last breath – "[…] lawmakers in Maryland, New York, and Washington are already working to regulate political ads on social networks," Alex Macgillivray has mentioned [7].

Talking to Peter W. Singer and Emerson Brooking, authors of the recent "LikeWar: The Weaponization of Social Media", Sean Illing, interviews writer for Vox who has taught politics and philosophy at a university and before that was a paramedic in the United States Air Force, asks why technology companies such as Twitter and Facebook have so far failed to take responsibility for their platforms. The authors observe that, by creating this powerful and easy to use tool of mass connection, it became the supreme media for absolutely every material and immaterial trade – "from commerce to news, and like everything else, it's weaponized". On the interview, the authors place the question if the Internet can be considered the most effective or powerful weapon, considering that in some cases "[…] it clearly has been. Some nations have used it to achieve the traditional goals of war without ever having to fire a bullet. And some nations, like Russia, get it in ways other nations, like America, don't." [8]

And finally we reach the point where I explain why I'm here writing an academic full paper without quoting texts from academia – the academia publishing system is slower than online frenetic news generators. Up to date, fast and furious, this is the reality we face. The choice here was a tentative of grasping the instant. The impression is that we were all teleported to an Ayn Rand's universe nightmare where Silicon Valley geeks are some of the most powerful actors in war and politics controlling the platforms that factually set the battles' rules. And so, here we are – belonging to mediated worlds were "[…] social media reduced everything to theater, where it's all about performance and branding, and yet, on the other hand, it has raised the stakes and made it easier to spread actual violence and chaos across the globe."[8]

Expanded Unconsciousness (?)

> "We are living in a time of the transient hypothesis, the infinitely mobile point of view, the flexible, transformative text, in which a permissive paradox prevails and incompleteness is the form. We fly on the wings of aporia, where everything may be what it seems not to be, bathed in a negotiable semiosis." [9]

At this point, I do recall the Greeks; and will quote academics. To ensure that consciousness prevails and to navigate this turbulent mode of existence a good help can be to go back in time and understand how the principles of logic shaped the Internet social media structure. Beyond cyber-

netics, crossing the Art of Memory [10] oceans, the language that builds this rhizomatic schizophrenic [11] panacea, from an absolutely synthetic code for a forkbomb [12] to sophisticated algorithms [13] – is essentially logic (logos) based – an entire universe modeled according to maieutics. And simply because of it, this giant complex system of communication can be seen and actually works as a sort of 'Socratic machine' [14]. If not from this basilar understanding, Roy Ascott will never risk affirming that "We are living in the time of the transient self, embodying the identity of ambiguity — actually multiple identities — acting in a variety of realities, which are themselves incomplete and generative"[9] additionally advocating "[…] This is perhaps the most hopeful time in our assumed evolutionary ascent, leading us beyond dumb sentience to an expanded consciousness."[9]

Despite confused by the grey clouds of the political typhoon, forcing the most convicted optimistic to face the evil side of social media platforms, we have in our hands a worldwide platform for examination of concepts, ideas, some that seem to lack any concrete definition – similarly to key moral concepts at Socrates or Plato's time as the virtues of temperance and justice. Such a powerful and pervasive platform, far beyond privileging far-right political groups, can potentially exponentially run superposed examinations challenging an indefinite list of beliefs of the interlocutors – Twitter and Facebook hordes of users –, bringing out inadequacies and inconsistencies in their beliefs, recurrently resulting in aporia and potentially leading to the emergence of consciousness from doubting and unavoidable continuous questioning.

Political Crystals

"Political Crystals: Numinous Hashtags" (2018) explores critically in its poetics the religious and ethical implications of the recent Brazilian presidential elections. The dubious posture of Social Media companies' executives such as Twitter and Facebook in dealing with the fact a media that has deeply revolutionized human socialization from eating, traveling, dating, to business, now drastically reshapes and potentiate the dark side of politics, terrorism and war all around the globe. Ingrained in this nefarious mechanism effective strategies to spread discourses de-signed to convince a massive vulnerable 'audience' using religion, ethics and security and order – like a 'dialectic virus' – spreads to every corner of our World Wide Web. One of the problems is that, as observed by Emerson T. Brooking and P.W. Singer in a article on The Atlantic Daily from November 2016, "Social-media platforms reinforce "us versus them" narratives, expose vulnerable people to virulent ideologies, and inflame even long-dormant hatreds," [15] leading to the emergence of colossal clouds of mass opinion that are at the moment difficult to predict and dissipate. As a reflection on the situation, The 'political crystals' works as metaphors encapsulating the dichotomy of the issue – translucent and elegantly seducing in its intricate computer generated geometry, exhibiting its potentially dangerous sharpness derived from Twitter data parametric manipulation to be converted in points in virtual space.

Combining parametric modeling generative strategies for data visualization with digital fabrication the work integrates the generation of 10 small 3D printed 'political crystals'. Each crystal is algorithmically generated using as raw data (input) in a Grasshopper script Twitter APIs accessed by having as the Search Phrase hashtags #EleNão (#NotHim) and #EleSim (#YesHim) related to Brazilian 2018 presidential elections in each region largest city. Brazil has a high level of urbanization: 82 out of every 100 Brazilians live in cities. The criteria used by the IBGE (Brazilian Institute of Geography and Statistics) geopolitically divided the country into 5 (five) regions. Each region is composed of three or more states. North, 17.7 million – largest city Manaus, Northeast 56.9 million – largest cities Salvador and Fortaleza, Central-West 15.6 million – largest city Brasília, Southeast 86.3 million – largest cities São Paulo, Rio de Janeiro e Belo Horizonte, South 29.4 million – largest city Curitiba. Our choice considering the 2018 presidential elections result was to access Twitter APIs from the largest cities of the country belonging to each one of the regions. According to most recent IBGE available data, the list of 10 largest cities in Brazil include São Paulo 12.106.920, Rio de Janeiro 6.520.266, Brasília 3.039.444, Salvador 2.953.986, Fortaleza 2.627.482, Belo Horizonte 2.523.794, Manaus 2.130.264, Curitiba 1.908.359, Recife 1.633.697, Porto Alegre 1.484.94.

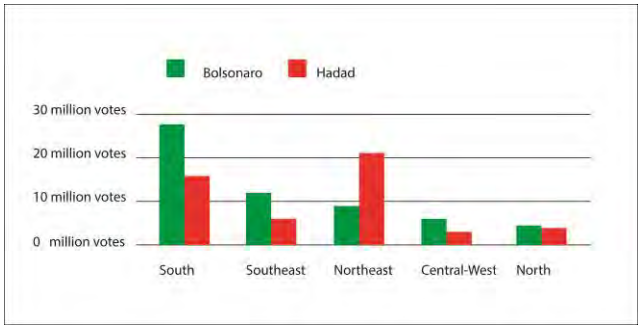


Figure 3. 2018 Brazil Presidential elections votes by region. Final result: Jair Bolsonaro (PSL) 55,13% and Fernando Haddad 44,87%. Chart by the author using BBC news [16] charts as a reference.

Figure 4. BBC News [16] Map showing 2018 Brazil Presidential elections votes by state: Map shows Bolsonaro (green) performance and Haddad (red) in the states - lighter colors indicate tighter win. Source: BBC news [16] charts as a reference.

The choice for the installation was to select the largest cities of the country by region considering having a representative sample of Twitter's users behavior concerning Twitts that includes two opposite hashtags that emphatically express the bipolarity observed in the results. In order to filter Twitter APIs geographically, the additional input must be the latitude and longitude coordinates of each one of the chosen cities:

Manaus	-3.1, -60.016667
Fortaleza	-3.718333, -38.542778
Salvador	-12.971111, -38.51083
Belo Horizonte	-19.816944, -43.955833
São Paulo	-23.550278, -46.633889
Rio de Janeiro	-22.902778, -43.207778
Curitiba	-25.429722, -49.271944
Porto Alegre	-30.032778, -51.23
Brasília	-15.793889, -47.882778
Recife	-8.050000, -34.900002

Date can be used as an input, considering the functionalities of the chosen component that access Twitter APIs and must be converted to milliseconds using a date to milliseconds converter.

EleNão(NotHim) versus #EleSim (YesHim)

Raw data is converted using a sequence of components (Figure 2) – from characters to numbers lists to points in x, y and z axes – building the spatial network from which an intricate and interlaced continuous surface is generated, and converted into a mesh. A smoothened representation of the mesh is calculated, not increasing the face count and allowing volume enhance specifications.

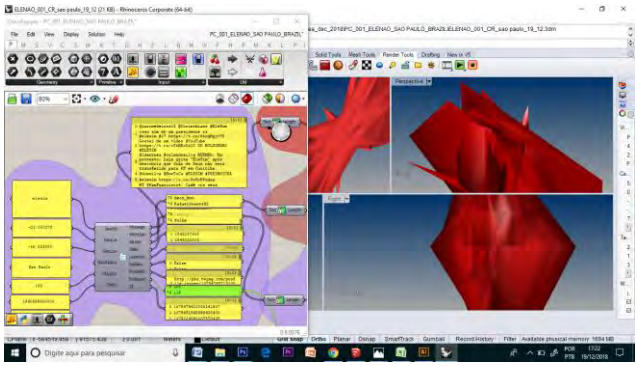


Figure 5. Political Crystals: Numinous Hashtags (2018) 3D model generated from Twitter APIs accessed using the hashtag #EleSim (#YesHim) twitted from Sao Paulo -23.550278, -46.633889; Grasshopper graphical algorithm editor script superposed to Rhinoceros 3D interface where the generated shape is visualized. Computer screenshot by the author

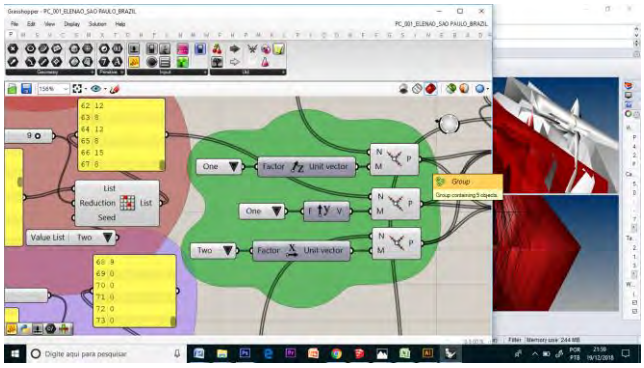


Figure 6. Political Crystals: Numinous Hashtags (2018) 3D model generated from Twitter APIs accessed using the hashtag #EleSim (#YesHim) twitted from Sao Paulo -23.550278, -46.633889; Grasshopper graphical algorithm editor script showing the final conversion from Twitter raw data (message, fromUser, toUser, Followers). Computer screenshot by the author

For the algorithmic generation of the final 3D geometry, 'Message' is the input for points in the unit vector Z, 'fromUser' the input for points in the unit vector Y, Followers the input for points in the unit vector X. Additionally, 'Followers' is used as the input to interpolate samples in the generation of the surface from the point in X, Y and Z.

The resultant geometry is baked and a material is applied in Rhinoceros 3D. After a sequence of tests, the choice for applying Water as the Rhino Material File was made due the subtleties in transparence nuances in the final model. The model is exported in two formats – .stl for 3D print and .obj with the .mtl together in a .zip file for VR (Virtual Reality) immersive visualization.

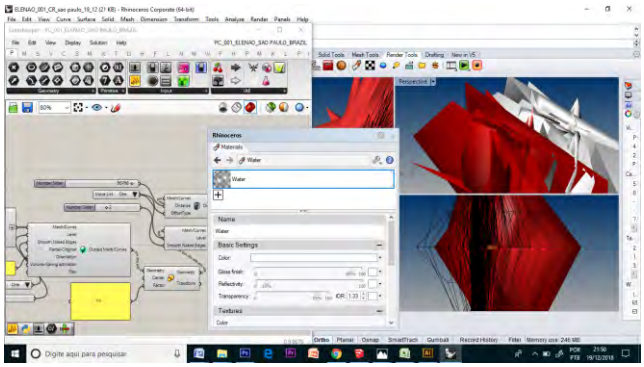


Figure 7. Political Crystals: Numinous Hashtags (2018) 3D model generated from Twitter APIs accessed using the hashtag #EleSim (#YesHim) twitted from Sao Paulo -23.550278, -46.633889; application of material (water) in Rhinoceros 3Dto give translucency to the shape visualization. Computer screenshot by the author

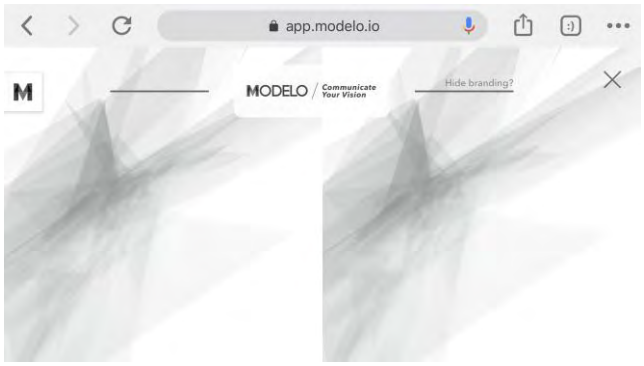


Figure 8. Political Crystals: Numinous Hashtags (2018) 3D model generated from Twitter APIs accessed using the hashtag #EleSim (#YesHim) twitted from Sao Paulo -23.550278, -46.633889 and exported as .obj with .mtl for VR immersive visualization. Smartphone screenshot by the author.

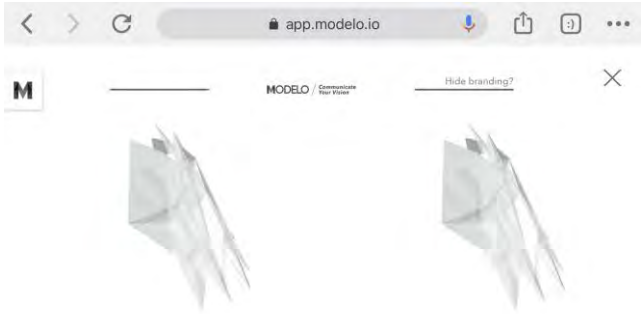


Figure 9. Political Crystals: Numinous Hashtags (2018) 3D model generated from Twitter APIs accessed using the hashtag #EleSim (#YesHim) twitted from Sao Paulo -23.550278, -46.633889 and exported as .obj with .mtl for VR immersive visualization. Smartphone screenshot by the author

Considering the artwork was not selected for ISEA 2019's juried exhibition, the small collection of 20 'political crystals' (10 crystals generated from #EleSim #YesHim hashtag and 10 from #EleNão #NotHim using tweets from the 10 largest cities in Brazil) will be shown at the oral presentation in two small wooden boxes.

Final Considerations

From one perspective, the 3D shapes can be seen as aggressive and sharp materialization of online hashtags' wars. From another perspective, the translucent 3D shapes and its sophisticated data based generative modeling evoke sublime and numinous aspects of natural crystal cluster such as quartz crystals, while hiding the dramatic force of a manipulated faithful army in spreading hate discourses against minorities, defending a populism that returns to its fascist origins in Latin America. The aesthetic reference to quarts is intentional. Pure quartz is transparent or translucent. Naturally occurring quartz crystals of extremely high purity, necessary for equipment used for growing silicon wafers in the semiconductor industry, are expensive and rare. The largest documented single crystal of quartz was found in Goiás, Brazil – right there in the region where back in 1985, at a gathering, the leaders of the Assembly of God announced they would begin endorsing and supporting candidates to run for office and thus be part of the Constituent Assembly who wrote the new constitution for the democratic Brazil.

Acknowledgements

The author would like to thank Erikson Queiroz Costa, a collaborator at the LIP – Lab for Innovation and Prototyping, who helped 3D printing the models.

References

[1] OXFORD Dictionary, "NUMINOUS (adjective)", accessed November 30, 2018, https://en.oxforddictionaries.com/definition/numinous

[2] Ishaan Tharoor, "Is Brazil about to elect its own Trump?" Washington Post WorldViews Analysis September 21 2018, accessed November 30, 2018, https://www.washingtonpost.com/world/2018/09/21/is-brazil-about-elect-its-own-trump/?noredirect=on&utm_term=.363dbbb3654a

[3] Chayenne Polimédio, "The Rise of the Brazilian Evangelicals – Meet Jair Messias Bolsonaro, the ultra-conservative military officer-turned-politician poised to capitalize on the fall of the Workers' Party", The Atlantic Global, JAN 24, 2018, accessed November 30, 2018, https://www.theatlantic.com/international/archive/2018/01/the-evangelical-takeover-of-brazilian-politics/551423/

[4] Yoni Heisler, "Twitter's 280 character limit increased engagement without increasing the average tweet length", BGR Apps and Software, February 8th, 2018, accessed December 18, 2018,

https://bgr.com/2018/02/08/twitter-character-limit-280-vs-140-user-engagement/
[5] Matt Southern, "Twitter Doubling its Character Limit from 140 to 280 Has Not Led to Longer Tweets", SEJ Search Engine Journal, October 31, 2018, accessed December 18, 2018, https://www.searchenginejournal.com/twitter-doubling-its-character-limit-from-140-to-280-has-led-to-more-polite-users/276035/
[6] Mayra Rodriguez Valladares, "Why The Brazilian Elections Should Matter To Financial Institutions", Forbes Banking & Insurance, Oct 6, 2018, accessed December 18, 2018, https://www.forbes.com/sites/mayrarodriguezvalladares/2018/10/06/brazilian-elections-should-matter-to-financial-institutions/#433283584374
[7] Austin Carr And Harry Mccracken, "Did We Create This Monster? How Twitter Turned Toxic", Fast Company Long Read 04.04.18, accessed December 18, 2018, https://www.fastcompany.com/40547818/did-we-create-this-monster-how-twitter-turned-toxic
[8] Peter W. Singer and Emerson Brooking, "How social media became a weapon of war: What Taylor Swift and ISIS can teach us about cyberwar", Interview by Sean Illing, Vox, Oct 9, 2018, accessed December 18, 2018, https://www.vox.com/world/2018/10/8/17884154/social-media-cyberwar-isis-taylor-swift-peter-singer
[9] Roy Ascott, "The Ambiguity of Self: living in a variable reality", in New Realities: Being Syncretic", ed. Ascott R., Bast G., Fiel W., Jahrmann M., Schnell R. (Edition Angewandte. Springer, Vienna, 2009)
[10] Frances A. Yates, *The Art of Memory: Selected Works of Fances Yates volume III*, (London and New York: Routledge, 2010, first edition 1966)
[11] Deleuze, Gilles and Félix Guattari, *A Thousand Plateaus*, Trans. Brian Massumi, (London and New York: Continuum, 2004, Vol. 2 Capitalism and Schizophrenia, 2 vols. 1972-1980)
[12] Jaromil, "Forkbomb shell", Year: 2002. Transmedialle Festival edition: 2012. Transmediale Art & Digitalculture. accessed December 18, 2018, https://transmediale.de/content/forkbomb-shell
[13] National Security Agency (NSA), "Cybersecuruty: What is NSA's role in U.S. cybersecurity?, accessed December 18, 2018, https://www.nsa.gov/what-we-do/cybersecurity/
[14] Plato, The Socratic Dialogues, (New York:Kaplan, Inc., 2009)
[15] by Emerson T. Brooking and P.W. Singer, "War Goes Viral: How social media is being weaponized across the world", The Atlantic Daily, November 2016, accessed December 18, 2018, https://www.theatlantic.com/magazine/archive/2016/11/war-goes-viral/501125/
[16] Amanda Rossi, "Bolsonaro presidente: Sudeste e Sul têm peso decisivo na eleição ao darem 6,5 milhões de votos a menos ao PT", BBC News Brasil, 29 outubro 2018, accessed December 18, 2018, https://www.bbc.com/portuguese/brasil-45997474

Author(s) Biography(ies)

Clarissa Ribeiro, Ph.D. in Arts, Former Fulbright Scholar in Arts, M.Arch, B.Arch, chair of the first Leonardo ISAST LASER talks to be organized in Brazil, directs the CrossLab research group and art collective and the LIP - Lab for Innovation and Prototyping at the University of Fortaleza. She was an Associate Professor for Roy Ascott Studio B.A. in Technoetic Arts in Shanghai in 2015, after one year (2013-2014) collaborating with the Art|Sci Center and Lab at UCLA in Los Angeles as a Fulbright Post-Doctoral Research Scholar in Arts. From 2009/2010 she was a Ph.D. researcher at the CAiiA node of the Planetary Collegium, University of Plymouth, UK, by the time she was a Ph.D. candidate at the University of Sao Paulo, and a member of Gilbertto Prado's art collective Poéticas Digitais. Her artistic and research interests converges in the exploration of consciousness and the self as emergences from local and nonlocal communication phenomena in macro, micro, molecular and subatomic scales.

"Resonance of the Heart": A Direct Experience of Embodied Sonic Meditation

Jiayue Cecilia Wu[1], **Donghao Ren**[2]
[1] College of Arts and Media, University of Colorado, Denver
[2] Department of Computer Science, University of California, Santa Barbara
[1] wuxiaoci.cecilia@gmail.com
[2] donghaoren@cs.ucsb.edu

Abstract

This paper presents the concept of Embodied Sonic Meditation (ESM) and its proof-of-concept art installation entitled "Resonance of the Heart." ESM artistically explores the theories of "embodied cognition" and "deep listening." The goal of this artistic practice is to improve laypersons' comprehension of the relationship between body gestures, sounds, and visuals. To practice this approach, we designed and built a real-time audio-visual interactive system. This system uses an infrared sensing device and touchless hand gestures to produce various sonic and visual results. An artificial neural network was implemented to track and estimate the performer's subtle hand gestures using the infrared sensing device's output. Six sound filtering techniques were implemented to simultaneously process audio based on the gesture. Selected Mudra hand gestures were mapped to seven 4-dimensional Buddhabrot fractal deformations in real-time. This project was applied in both college teaching and public art installation. It connects Eastern philosophy to cognitive science and mindfulness practice. It augments multidimensional spaces, art forms, and human cognitive feedback. It disrupts the boundary between cultural identities, machine intelligence, and universal human meaning.

Keywords

Embodied Sonic Meditation, machine learning in creative work, Buddhabrot rendering, gesture recognition, audio-visual interaction.

Introduction

The Musical Mind

In 1974, Pauline Oliveros disrupted traditional western music education by practicing an ancient eastern philosophical concept — meditating though sound. In Buddhism this is called "experiencing sonic Vedanā" [5]. Oliveros adopted this approach and further developed it into an improvising, composing, and teaching practice. In the 1970s, she composed a series of pieces called them "Sonic Meditations," and in the 1980s, she founded the Deep Listening Institute at Kingston, NY. Through sonic meditations, Oliveros advocated a "Deep Listening" practice [16] that trains our ears and mind to consciously appreciate all sounds to increase sonic awareness, thus creating profound effects on music making and listening. Actual sound making in Oliveros' sonic meditations was *"primarily vocal, with sometimes hand clapping or other body sounds. Occasionally, sound-producing objects and instruments are used"* [17]. Oliveros' work in sonic meditation focused on the cognition of sound.

The Embodied Mind

On the other hand, George Lakoff et al.'s "Embodied Cognition" theory argues that high-level concepts such as time, space, arts, and mathematics are grounded in sensorimotor experience — a view that our sensorimotor capacities, bodies and environment are all central to shaping our mental processes [13, 21]. In other words, we are not disembodied minds floating around; we are also made of flesh and bones — the fact that we have bodies strongly shapes our mind and cognition. We experience and learn about the world through motor-based exploration according to limitations of our sensorimotor and perceptual system. Therefore, if we wanted to give someone something to think about (cognitive process), we should give her/him something related to her/his bodily activities instead of something abstract. This is what "embodiment" means from the embodied cognition perspective.

Embodied Sonic Meditation

Embodied Sonic Meditation is an artistic practice and theory based on the combination of Tibetan contemplative cultural arts, sensing technology, and human sensibility [28]. It is situated in the practice of "embodied cognition" and "deep listening," coupled with the integration of our physical body movement to manipulate sounds and visuals, thus regulating people's attention and helping them to bring their focus back to their own body and mind.

During an Embodied Sonic Meditation practice, sensing technology augments one's physical body; and a proper designed audio system creates an intuitive body-sound mapping and relationship. Visual feedback can be applied to augment the person's embodiment experience for this practice. Thus, a person can generate, compose, and shape sounds and visuals by using her/his own body movement as a real-time controller. By listening to these sonic events that one is creating at the same time she/he is moving and navigating in a physical space, one experiences a highly-focused, meditative-like state of mind.

Through Embodied Sonic Meditation practice, we encourage people to better understand and appreciate abstract electroacoustic sounds, computer graphics, and how these sounds

and graphics are formed and transformed (cognitive process), by providing people interactive audio-visual systems that can tightly engage their bodily activities to simultaneously create, sculpt, and morph the sonic and visual outcomes themselves, using their body motions (embodiment).

According to the Embodied Sonic Meditation theory, there is no hierarchical relationship between mind, sound, visual, and body — they are integrated into an inseparable whole. Embodied Sonic Meditation connects media arts and Eastern philosophy of mind and body to cognitive science and mindfulness meditative practice.

In order to provide a direct experience of Embodied Sonic Meditation to a broader audience, we developed a proof-of-concept project named "Resonance of the Heart." *Resonance of the Heart* has two parts: the first part is the on-going interactive art installations; the second part is an electroacoustic vocal performance and its related music composition. *Resonance of the Heart* is the third proof-of-concept project of Embodied Sonic Meditation. The previous two projects, *Virtual Mandala* and *Tibetan Singing Prayer Wheel*, can be viewed at [25] and [26].

Related Work and Design Inspirations

The Zen Meditation Spirit

The name of the system — *Resonance of the Heart* — is borrowed from "印心", a "Kōan" story in Chinese Zen Buddhism, which describes a Zen master and his disciple's thoughts resonant without verbal communication [9]. For gestural input and control strategy, we applied ancient Buddhist hand gestures named *Mudras* [10] that have the hands and fingers crossed or overlapped, as shown in Figure 1, to trigger and manipulate corresponding sonic and visual effects. We chose optical sensing technology instead of wearables (e.g., gloves) because we strive to preserve the flexibility of the hand/finger motion as well as the original beauty of the ancient *Mudra* performance, which is barehanded. Using a small, non-attached sensor ensures that both the user and audience focus on the sound-Mudras performance. Because of its low price, lightweight and portability, as well as a lower latency and higher frame rate compared to other sensors such as the Microsoft's Kinect™ [20], a Leap Motion™ infrared sensor is chosen as our non-attached tracking sensor to realize the gestural instrument for this project.

Meanwhile, dynamic hand motion data are mapped to an audio-visual system to continuously control electroacoustic sound manipulations and a gestural data visualization of 4-dimensional Buddhabrot fractal deformations.

Gesture-Sound Embodied Mapping

For the audio system, six audio effects were implemented in the system for real-time audio manipulations. It is the first time that two novel audio filters — Throat-singing filter and Spectral-tilt filter — are introduced to the world in an artistic project. They were implemented in the Faust language [6] and ported to ChucK as ChuGins using faust2ck. Implementation details are available online [12]. The other audio effects such as delay, panning, and pitch-shifting effects,

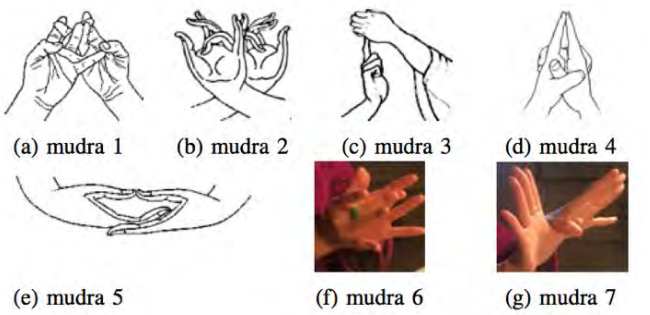


Figure 1: Seven examples of Mudras input gestures and output labels for gestural recognition.

were implemented and generated directly in the ChucK audio programming language environment [23].

Mapping the seven Mudra gestures to trigger seven different meditative sonic outputs was originally impossible for our project until we added the machine-learning component for gesture recognition. When the classifier recognizes a particular Mudra, it sends the detected type to ChucK, which plays the corresponding contemplative sound clip. Thus, these Mudra inputs serve as low-level one-to-one triggers and have the same functionality as normal button inputs.

However, from the artistic and user experience perspectives, forming various complex hand gestures in order to trigger specific sound effects and visuals that are symbolized in a contemplative way makes this mapping strategy much more engaging than simply pushing a button. The embodied cognitive process makes this Mudras-to-sound process more meaningful, as *"it inherently involves perception and action"* and it *"takes place in the context of task-relevant inputs and outputs"* [24].

Buddhabrot Fractal Deformations

For the visual system, a family of Buddhabrot fractals is rendered in real time and manipulated in a 4-dimensional space. Buddhabrot is a special method of rendering a Mandelbrot fractal. It tracks all the trajectories and renders them to produce the ghostly forms reminiscent of the Siddhārtha Gautama Buddha [7]. While the Mandelbrot set can be rendered fairly quickly with GPU acceleration, rendering a Buddhabrot is much more computationally intensive. Particularly, a real-time, high-resolution, 4-dimensional Buddhabrot rendering takes a considerable amount of computational power both on CPU and GPU. Therefore, it is a current technical challenge in the field.

Alexander Boswell described the challenge and showed how the Metropolis-Hastings Algorithm could be used for sampling c points [3]. Aluminum Studios has made a beautiful video using his custom rendering software [15]. Benedikt Bitterli used an importance sampling method to speed up the rendering of a Buddhabrot [2]. We will further discuss our unique approach of WebGL real-time rendering techniques in the section of "Buddhabrot Rendering."

System Architecture

The user gives the system data input via a Leap Motion™ sensor. The audio input is controlled and manipulated by the user's hand movement. The OSC protocol enables communications between the customized ChucK audio software for all the audio processing and Python software for gestural recognition. The visual processing software was written in JavaScript using WebGL2 API and can communicate with the tracking system through a wireless network. Recognition of one of the seven Mudras triggers the corresponding sound and visuals, while continuous hand motions control two novel filters and four other sonic effects for real-time vocal processing, as well as the visualization of a 4-dimensional Buddhabrot's trajectory deformation. Finally, the resulting sounds and graphics are amplified and projected into the performance space. Figure 2 shows the overall system architecture.

For flexibility and computational consideration, the data visualization system is designed to be independent from the audio processing and tracking system and can run synchronously with the rest of the system, connected by a wireless network. The system provides support for installations from basic desktop settings to multi-display performances.

Tracking Device and its Optimization Solutions

The Leap Motion™ controller is a small USB device that uses two monochromatic IR cameras and three infrared LEDs to sense hand motion in 3D space. The controller is well suited to this project due to its performance in recognizing subtle hand and finger movement. However, the sensor's small range greatly limits the expressiveness of a user's natural hand motion, impeding the exploration of a user's body-mind connectivity. Moreover, the sensor cannot track any gestural input when two hands/fingers are close to each other, or overlap above the sensor. The sensor typically generates no output in these two situations, and is essentially "frozen."

These sensor limitations cause errors, which heavily interrupt the audio-visual system — either no data or discontinuous data will be sent to the audio-video engine, interrupting the smoothness and enjoyment of the user experience. To solve this problem, we optimized and trained the tracking system and let it predict the hands' trajectories when they are out of the tracking range, and to classify overlapping hand gestures in real-time, with minimum errors. Both instances are approached using machine learning and are framed as classification problems. The optimization method is able to predict a time series of what it guesses the user's hands might be doing while out of range or overlapping.

The tracking algorithms are implemented in Python. We implemented supervised learning algorithms and an artificial neural network to estimate and track the subtle motions of ten fingers, which are not typically captured by existing sensing devices. Two historically intractable problems of the Leap Motion™ sensor are addressed: 1) the sensor cannot detect overlapping hand gestures, and 2) the sensor's detection range is spatially limited. Training examples included seven Tibetan Buddhist Mudras (see Figure 1) that are overlapping hand gestures as well as fifty hand trajectories where a hand goes out of the sensor's range and later returns. Hand gestures were

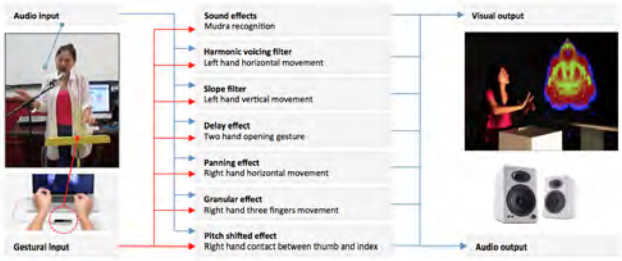


Figure 2: System architecture

treated as a classification problem and the best performing model was k-nearest neighbours with 62% accuracy. The detailed algorithms and implementation method can be viewed at [27].

With the system optimization solutions, a user's hand trajectory is predicted when the tracking device loses track. Instead of losing track and interrupting the smoothness of the gestural input and control, at least there are some data to be processed, thus improving the coherence and wholeness of the user experience. This preliminary research shows the general potential of applying machine learning to build robust creative work.

Gestural Control and Data Mapping Strategies

Since there is a broad range of possible two-hand gestures that can serve as data input, we decided to use a one-to-one mapping strategy on both audio and visual layers to simplify the design process [11]. Because of the interconnectedness among ten fingers, movements on x, y, and z positions, as well as the limitation and interference due to palm orientations and positions as a whole, even the simplest one-to-one mapping can produce a rich sonic and visual result through hand movements. This is not necessarily desirable in terms of increasing the system's transparency to the audience. However, as a tool for encouraging the user to pay close attention and be aware of subtle sonic and visual outcomes that are tightly synchronized with her or his hand movement, it is efficient and does a good job of enhancing the user's sonic awareness and the audience's visual delight.

We mapped the gestural data input to the audio effects controls in order to "translate user's actions into parameter values needed to drive the sound processing" [22]. Most of the gestural mappings are direct control mechanism while the throat-singing filter is an adaptive control mechanism that involves pitch tracking, equalization, and pitch shifting. To ensure continuous control, we implemented interpolation and a one-pole filter to smooth the raw input data, as well as implementing this machine learning prediction model to make up the missing data when the hands are overlapping or leave the tracking range. This approach ensures control intimacy and thus enhancing the experience of "Embodiment."

Mudra Gesture Recognition and Mappings

Mapping the seven Mudras gestures to trigger seven different meditative sonic and visual outputs was originally impossible for this project until we added the machine-learning component for gesture recognition. When the classifier recognizes a

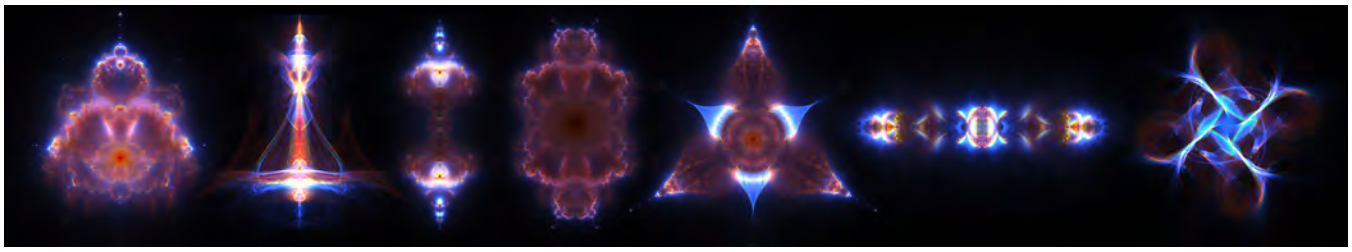


Figure 3: Seven 4-dimensional Buddhabrot deformations and their mathematical representations (from left to right): Buddbabrot: $z^2 + c$; Aquarius: $rz^2 + 2rz + c$; Vajra: $rz^3 + 0.5z + c$; Double Buddha: $z^3 + c$; Lotus: $\bar{z}^2 + c$; Keyūra: $rz^3 + 0.97rz + c$; Shrivatsa: $\bar{z}^3 + rz + c$

particular Mudra, it sends the detected type to ChucK, which plays the corresponding contemplative sound clip. Thus, these Mudra inputs serve as low-level one-to-one triggers and have the same functionality as normal button inputs.

However, from the artistic and user experience perspectives, forming various complex hand gestures in order to trigger specific sound effects and visuals that are symbolized in a contemplative way, makes this mapping strategy much more engaging than simply pushing a button. The embodied cognitive process makes this Mudras-to-sound-and-visuals process more meaningful, as it inherently involves perception and action and it takes place in the context of task-relevant inputs and outputs.

When the user is not forming a Mudra, hand movement can control the size, orientation, and layout of a 4-dimensional Buddhabrot fractal deformation in an intuitive way.

We chose optical sensing technology instead of wearable (e.g., gloves) because we strive to preserve the flexibility of the hands/fingers motion as well as the original beauty of the ancient Mudra performance, which is barehanded. Using a small, non-attached LeapMotion sensor ensures that both the vocalist and audience focus on the vocal-Mudras performance and perceive the sound-body as a whole.

Right Hand Dynamic Gestural Mappings

There are also six ways that dynamic hand motions are mapped to continuously manipulate the real-time audio processing:

a) Three-fingers' vertical movement → individually turns on (vertically move down) or turns off (vertically move up) three random frequencies in three ranges of perceivable low (60–200hz, controlled by index finger); mid (200–1000hz, controlled by middle finger); and high (1000–6000hz, controlled by ring finger).

b) Palm's vertical movement → roll-off of a Spectral Tilt filter.

c) Palm's horizontal movement → spatial panning: moving the right hand from left to right gradually pans the sound output from the left speaker to the right speaker, and vice versa.

Left Hand Dynamic Gestural Mappings

a) Palm's horizontal movement → manipulates the audio frequencies of different harmonic partials based on the audio input's pitch by a throat-singing filter. When the left hand is at the far left from the sensor's center, this filter emphasized the 2nd harmonic partial; when the left hand nears the sensor's center position, the filter emphasized the 13th harmonic partial. The left hand moving horizontally between these two positions generates the intervening harmonic partials.

b) When the thumb and index finger touch (a "pinch" gesture), the vertical movement shifts the pitch of the simulated Tibetan throat singing — higher distance controls higher pitch, and vice versa. A pitch recognition function from faust2ck [4] called "PitchTrack" tracks the pitch of the input voice. Then "PitchShift" and several "BPF (band pass filters)" from Chuck's "Unit Generators" library were implemented to shift and filtering the original voice pitch in a harmonic way to simulate the undertone harmonic partials. Theses harmonic partials stand with the original audio together to simulate the deep undertone vocal performance, known as throat Singing [14].

c) The horizontal distance between two hands controls the delay time. The delay time is proportional to distance; when two hands are closest to each other, all audio effects are switched off.

Buddhabrot Rendering

Buddhabrot is a fractal technique derived from the Mandelbrot set. Recall that the Mandelbrot set is the collection of points c in the complex plane for which the iterative formula:

$$z_{n+1} = z_n^2 + c \tag{1}$$

starting from $z_0 = 0$ do not go to infinity. The Buddhabrot image can be generated by computing the 2-dimensional density map of all the z sequences what goes to infinity given a uniform random sample of c values.

Real-time performance requires a Buddhabrot renderer that supports interactive parameter updates. Meanwhile, this project is designed for public exhibition in an interactive way. Therefore, implementing such a renderer in HTML5 with WebGL seems the ideal solution. Our investigation indicates that WebGL2's transform feedback support provides a method to perform fractal iterations in the GPU. A modern graphics card can render at around 10–20fps with reasonable quality.

We created the renderer following Benedikt Bitterli [2]'s importance sampling approach. The algorithm is outlined as below:

a) Performs importance sampling in a GPU shader. This basically draws a Mandelbrot set, and records the number of iterations at each location.

b) Sample points with respect to the importance values (points closer to the Mandelbrot set are more likely to be sampled). This part is implemented in WebAssembly for best performance.

c) Iterate through the sampled points with transform feedback, and then marks the ones that do escape.

d) Iterate again and render the points according to a given 4-dimensional space to 2-dimensional projection.

Seven iterative equations were implemented to achieve the visual outcomes. The interpolability of these equations makes real-time high quality deformations possible. Figure 3 shows the seven deformations.

Based on the appearance of these newly discovered fractals in the Buddhabrot family, we coin the five terms of "Aquarius," "Vajra [18]," "Double Buddha," "Keyūra [8]," and "Shrivatsa [1]" to describe the Buddhist metaphor accordingly (in Figure 3, from the second left to the right, from the top to the bottom). The top left in Figure 3 is the original Buddhabrot and the button left is the "Space Lotus," which was named by Aluminum Studios.

The renderer we implemented is open source [19], and a live demo can be viewed here: `https://donghaoren.org/buddhabrot/`.

We encourage readers to change the mathematical equations' parameters in the demo and obtain interesting Buddhabrot rendering results in their own interests.

In addition, the renderer accumulates previously rendered frames so the quality will progressively improve if the parameters stay the same (when the user stop moving her/his hands). This is useful for real-time fast rendering because the resolution of the visual outcome becomes higher and thus making better visual outcomes. This approach ensures the deformation to be smoother and more visually appealing while using less computational power. When the parameters are changing, the accumulation produces a running average effect.

Applications

Currently, *Resonance of the Heart* has been used as a pedagogical tool in college teaching and as an interactive audio-visual system that is open to the public for art exhibitions and electroacoustic vocal performances.

Pedagogical Tool in College Teaching

Resonance of the Heart was used in teaching an upper division, college-level course named *"Embodied Sonic Meditation — A Creative Sound Education,"* at the College of Creative Studies (CCS) through its Composition Program at University of California Santa Barbara. The UCSB CCS Music Composition major is geared toward preparing students for graduate school or for careers as professional composers. Students developed their personal compositional vocabularies while building a foundation in composition techniques. I encouraged the students to explore the abstract concepts of computer music and electronic arts using mediated technology and audio-visual systems, such as *Resonance of the Heart* and *Tibetan Singing Prayer Wheel*.

Figure 4: "Embodied Sonic Meditation" class activities

All the students had the chance to play around with sound synthesis and processing through their bodily activates to better understand the subtle or dramatic sound transformations and different compositional approaches in electronic music. At the end of the course, five groups of students showcased their own gestural-controlled audio systems and demonstrated their ability to use these systems to compose and perform music. Figure 4 shows a group of students practicing Embodied Sonic Meditation in class and using multiple *Resonance of the Heart* systems to perform their music composition.

It is worth mentioning that the first author also conducted a human subject research entitled *"Effectiveness of embodied sonic meditation methodology in teaching undergrads students"* to collect student evaluation data to further examine the instructional method of using this tool and Embodied Sonic Meditation practice in teaching electronic music and composition in higher education.

The survey's results indicate that within this considerably small pool, our creative development of musical instructional materials utilizing computer-based, multimedia, and technology-mediated Digital Musical Instruments enhance student learning in electronic music composition and complex electronic music theory. The exit survey indicates that 10 out of 13 students enjoyed their embodied sonic meditation experience. While the results seemed promising, further empirical studies with a bigger subject pool should be conducted in future teaching before we can draw a concrete conclusion.

The Interactive Art Installation

An interactive audio-visual art installation was realized on June 1st, 2018 at the California NanoSystems Institute at University of California Santa Barbara. Around 100 people participated, with participants consisting mostly of undergraduate and graduate students, researchers, faculty members, and the community members of UCSB and the California NanoSystems Institute. An illustration of the sound installation is presented in Figure 5.

Figure 5: "Resonance of the Heart" installation at the California NanoSystems Institute on June 1st, 2018

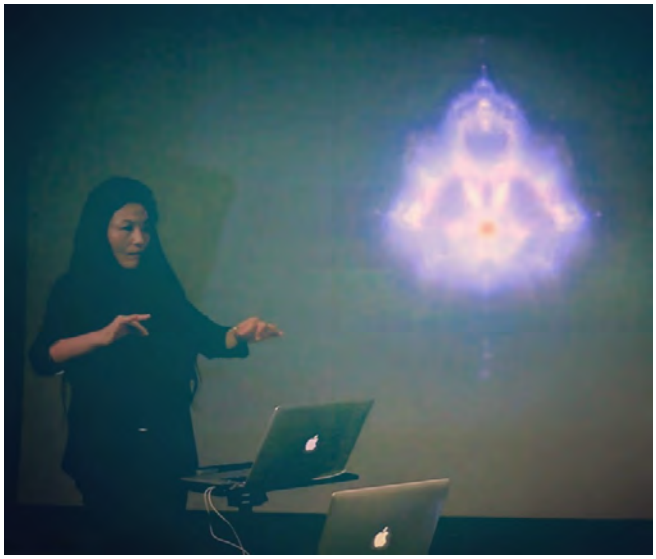


Figure 6: The "Resonance of the Heart" live electroacoustic vocal performance at the IEEE VIS Arts Program on October 23, 2018

The Electroacoustic Live Performance

An electroacoustic live performance was realized on October 23, 2018 at the IEEE VIS Arts Program in Berlin, Germany. Around 300 people attended, with audience consisting mostly of computer science researchers, media artists, research psychologists in HCI and in data visualization, faculty members in higher education, and the community members of IEEE VIS. An illustration of the electroacoustic live performance is presented in Figure 6.

This performance artistically explores new ways of using human movement data to manipulate auditory and visual feedback in real time. It connects Eastern philosophy to cognitive science and mindfulness meditative practice through body expression, voice, electric sound, and visualization. It augments multidimensional spaces, art forms, and human cognitive feedback. It disrupts the boundary between cultural identities, machine intelligence, and universal human meaning.

Observation and Discussion

From the above applications, the whole system proves to be easy to use and reliable. The audio-visual system produces the same results every time. The tracking system works well when the users move their hands slowly and meditatively.

The CCS course provides evidence of our creative development of instructional materials utilizing computer-based, multimedia, and technology-mediated audio-visual interface to enhance student learning in electronic music composition and theory. The exit survey of the course indicates that 10 out of 13 students enjoyed their Embodied Sonic Meditation experience. While the results seemed promising, further empirical studies with a bigger subject pool should be conducted in future teaching before we can draw a concrete conclusion.

The art installation at the California NanoSystems Institute provides evidence of the success of our system design that can meet a broader audience's satisfaction. From our observation, using real-time body movement to control and modify sonic and graphical properties helps laypersons and children to experience electronic arts in an intimate and fun way, thus enhancing their Embodied Sonic Meditation experience. Most of the participants seemed to be able to catch subtle changes of the sound and visuals with their own gestural control and bodily activities. Playing the system provides an intuitive way to connect users' physical movements to their sound experience, as they are making, and "aesthetically" appreciating, perceiving, and enjoying sound with their own physical form.

The live performance at the 2018 IEEE VIS Arts Program shows that the system is easy to use and reliable, and produces similar results every time. The concert provides evidence of strong theatricality when using this system; it also shows the added expressive possibilities that this system provides to the performer. The mapping relationship between the performer's dramatic gestures and the musical expression is transparent to the audience.

Overall, people's experiences of engaging with Embodied Sonic Meditation and *Resonance of the Heart* were positive when they generated and effected sounds and visuals using their own hand gestures. The playability of our system for both professional music performers and broader audience is high. Although further scientific investigation needs to be done, the original goal of creating a direct Embodied Sonic Meditation experience for a broader audience had been realized.

From the artistic exploration perspective, multidimensional reality merges two layers of space. The first layer is the user manipulating Buddhabrot deformations and sounds in a 3-dimensional space. The second layer is the 4-dimensional Buddhabrot deformalizing and being projected on a 2-dimensional screen. The mindful fact that artistic expressions in different dimensions, forms, and cultures can be merged and presented in one unified space symbolizes the concept of "All beings can discover their Buddha nature."

Conclusion

Through *Resonance of the Heart*, we show how the theoretical concept of Embodied Sonic Meditation can be applied and interpreted in a real-life scenario; we bring the richness of Tibetan contemplative culture and present its ancient East-

ern philosophy and aesthetics to a broader Western audience through media arts and technology; we also discover that media arts and technology have the potential to open new windows onto underrepresented cultural groups.

Acknowledgments

We thank the University of Colorado Denver's College of Arts and Media and Office of Research Services for their funding support. We also thank Dr. Julius Smith, Dr. Matt Wright, Marc Rau, Yun Zhang, and Yi Jun Zhou for their collaborations on the previous research related to this paper.

References

[1] Beer, R. 2003. *The handbook of Tibetan Buddhist symbols*. Serindia Publications, Inc.

[2] Bitterli, B. Rendering a Buddhabrot at 4K and other bad ideas. https://benedikt-bitterli.me/buddhabrot/. Accessed 2019-03-18.

[3] Boswell, A. The Buddhabrot. http://www.steckles.com/buddha/. Accessed 2019-03-18.

[4] ChucK: [Extend]. http://chuck.stanford.edu/extend/. Accessed 2019-03-18.

[5] De Silva, P. 1995. Theoretical perspectives on emotions in early buddhism. *Emotions in East Asian thought: A dialogue in comparative philosophy* 109–122.

[6] FAUST: Functional programming language for real time signal processing. http://faust.grame.fr/. Accessed 2019-03-18.

[7] Green, M. 2012. The Buddhabrot technique. *Superliminal Software*.

[8] Guglielminotti Trivel, M. 2006. Archaeological evidence from the 'Buddhist Period' in the longmen area.

[9] Heine, S., and Wright, D. S. 2000. *The Koan: texts and contexts in Zen Buddhism*. Oxford University Press on Demand.

[10] Hirschi, G. 2016. *Mudras: Yoga in your hands*. Weiser Books.

[11] Hunt, A.; Wanderley, M. M.; and Paradis, M. 2003. The importance of parameter mapping in electronic instrument design. *Journal of New Music Research* 32(4):429–440.

[12] Jiayue Cecilia Wu, Julius Smith, Y. Z., and Wright, M. Resonance of the Heart. https://ccrma.stanford.edu/~jos/CeciliaROH/. Accessed 2019-03-18.

[13] Lakoff, G., and Johnson, M. 1999. *Philosophy in the Flesh*, volume 4. New york: Basic books.

[14] Lindestad, P.-Å.; Södersten, M.; Merker, B.; and Granqvist, S. 2001. Voice source characteristics in mongolian "throat singing" studied with high-speed imaging technique, acoustic spectra, and inverse filtering. *Journal of Voice* 15(1):78–85.

[15] Milberry, W. "under the bodhi tree" — an exploration of the 4d mandelbort set on the z-plane (aka., buddhabrot). http://aluminumstudios.com/under-the-bodhi-tree-an-exploration-of-the-4d-mandelbort-set-on-the-z-plane-aka-buddhabrot. Accessed 2019-03-18.

[16] Oliveros, P. 2005. *Deep listening: A composer's sound practice*. IUniverse.

[17] Osborne, W. Pauline Oliveros' deep listening and the sonic meditations. http://www.osborne-conant.org/oliveros.htm. Accessed 2019-03-18.

[18] Ray, R. A. 2002. *Secret of the vajra world: The tantric Buddhism of Tibet*. Shambhala Publications.

[19] Ren, D. A realtime Buddhabrot fractal renderer. https://github.com/donghaoren/buddhabrot-renderer. Accessed 2019-03-18.

[20] Tormoen, D.; Thalmann, F.; and Mazzola, G. 2014. The composing hand: Musical creation with Leap Motion and the BigBang Rubette. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME'14)*, 207–212.

[21] Varela, F. J.; Thompson, E.; and Rosch, E. 2017. *The embodied mind: Cognitive science and human experience*. MIT press.

[22] Vines, B. W.; Krumhansl, C. L.; Wanderley, M. M.; and Levitin, D. J. 2006. Cross-modal interactions in the perception of musical performance. *Cognition* 101(1):80–113.

[23] Wang, G. 2008. *The ChucK audio programming language. "A strongly-timed and on-the-fly environ/mentality"*. Princeton University.

[24] Wilson, M. 2002. Six views of embodied cognition. *Psychonomic bulletin & review* 9(4):625–636.

[25] Wu, J. C., and Conti, F. 2015. The virtual Mandala. In *Proceedings of the 21st International Symposium on Electronic Art (ISEA'15)*.

[26] Wu, J. C.; Yeh, Y.-H.; Michon, R.; Weitzner, N.; Abel, J. S.; and Wright, M. 2015. Tibetan singing prayer wheel: a hybrid musical-spiritual instrument using gestural control. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME'15)*, 91–94.

[27] Wu, J.; Rau, M.; Zhang, Y.; Zhou, Y.; and Wright, M. 2017a. Towards robust tracking with an unreliable motion sensor using machine learning. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME'17)*, 42–47.

[28] Wu, J. C.; Smith, J. O.; Zhou, Y.; and Wright, M. J. 2017b. Embodied sonic meditation and its proof-of-concept: "Resonance of the Heart". In *Proceedings of the International Computer Music Conference (ICMC'17)*, 110–114.

Authors Biographies

Dr. Jiayue Cecilia Wu Originally from Beijing, Dr. Wu is a scholar, composer, multimedia performer, and audio engineer. She earned her Bachelors of Science degree in Design and Engineering in 2000. In 2013, She obtained her Master's degree

in Music, Science and Technology from Stanford University. In 2018, She obtained her Ph.D. in Media Arts and Technology from University of California Santa Barbara, where she studied music composition and media arts with Dr. Curtis Roads. As an audio engineer, she received a grant award from Audio Engineering Society. As a musician, she received an award from the California State Assembly for being a positive role model in sharing Chinese culture. As a multimedia artist, she received the "Young Alumni Arts Project Grant Award" from Stanford University. As a scholar, she has been awarded a multi-year UC Central Campus Fellowship and a National Academy of Sciences Sackler Fellowship. Currently, Dr. Wu is an Assistant Professor at the University of Colorado Denver's College of Arts and Media.

Donghao Ren Donghao Ren is a Ph.D. candidate in the Department of Computer Science at the University of California, Santa Barbara. He received a B.S. degree from Peking University. Donghao's primary research focus is on the design and implementation of user interfaces for visualization construction. He also works on designing visualizations for machine learning, as well as visualizations in virtual and augmented reality. His recent work "Charticulator" (see https://charticulator.com/) won the honorable mention award at InfoVis 2018, the most selective venue for information visualization. Find more information about Donghao at https://donghaoren.org/.

Legend of Wrong Mountain: AI Generated Opera

Lingdong Huang, Zheng Jiang, Syuan-Cheng Sun, Tong Bai, Eunsu Kang, Barnabas Poczos
Carnegie Mellon University
Pittsburgh, PA, United States
{lingdonh, zjiang1, syuanchs, tongb, eunsuk, bapoczos}@andrew.cmu.edu

Abstract

As one of the oldest forms of Chinese Opera since the 16th century, *Kunqu* (崑曲) features literary virtuosity in its scripts, sophisticated vocal techniques in its singing, emotional and elegant yet rigorous bodily motions and facial expressions in its performance. Over its history, *Kunqu* has developed established modes and patterns, which makes it especially suitable for neural networks to learn. In order to generate *Kunqu* literature and performance computationally, we applied multiple machine learning and computer vision techniques. Our result, Legend of Wrong Mountain, is novel twofold: it is the first and only generated opera at the time of this writing, and it is a machine's attempt at *Gesamtkunstwerk* [12], "the Total Artwork". It explores the marriage between contemporary technologies and traditional art form. By studying historical scripts, musical notations and traditional methods for creating *Kunqu*, we tweaked existing algorithms and devised new ones to conform to the traditional rules and norms as closely as possible. We presented this project as a video accompanied by audio.

Keywords

Opera, Kunqu, Audiovisual, Machine Learning, Artificial Intelligence, AI Art, Total Art, Gesamtkunstwerk, LSTM, pix2pix, RNN, Markov Chain, OpenPose

Introduction

Kunqu is one of the oldest form of Chinese Opera. Featuring literary virtuosity in its scripts, sophisticated vocal techniques in its singing, and emotional and elegant yet rigorous bodily motions and facial expressions in its performance, Kunqu originated in the Wu cultural area and dominated the Chinese theatre for hundreds of years from c. 1573 to 1820, and is still being played today. Over its history, Kunqu has developed established modes and patterns, which makes it especially suitable for neural networks to learn. Our goal was to generate novel Kunqu literature and performance computationally.

According to the script generated by machine, our result, Legend of Wrong Mountain, the first Kunqu Opera generated by machine intelligence, is a story about an emperor, his lords and their intrigues. It includes ten scenes with about 15,000 Chinese characters.

We believe the piece is novel twofold: it is possibly the first and only generated Opera at the time of this writing, and it is a machine's attempt at Gesamtkunstwerk, the total work of art.

This paper explains the overall pipeline and detailed description of each process, sharing a clear blueprint of generating a piece of Chinese Kunqu Opera using machine learning. Techniques used in this project include Long Short-Term Memory (LSTM) [6], pix2pix [7], pix2pixHD [13], Recurrent Neural Networks (RNNs) [4], Markov Chain, OpenPose [9] and Detectron [5], as well as tools such as Canny Edge [2], PIL and SketchUp). By studying historical scripts and musical notations and researching traditional methods for creating Kunqu, we tweaked existing algorithms and devised new ones so that our implementation conforms to the traditional rules and norms as closely as possible. Our results were presented in two art forms; an actual woodblock printing script book and a machine learning generated video accompanied by audio.

Methods

The figure 1 shows the pipeline of this project, which has five main sections; music, script, performance, background scene and book generation.

Music Generation

The music of *Kunqu* are composed of melodies with established patterns. Because the melody is the most important part in Kunqu, the materials of Kunqu only contain melody information with lyrics. A hundred images containing traditional *Kunqu* sheet music were downloaded from *Kunquwang*[1] using a scraper script. We present our own algorithms to accomplish this task. First, we locate and identify all the numbers and various symbols in the image. Afterwards, we try to make sense of these symbols and generate a string representation containing all the information to be learned by neural networks [10].

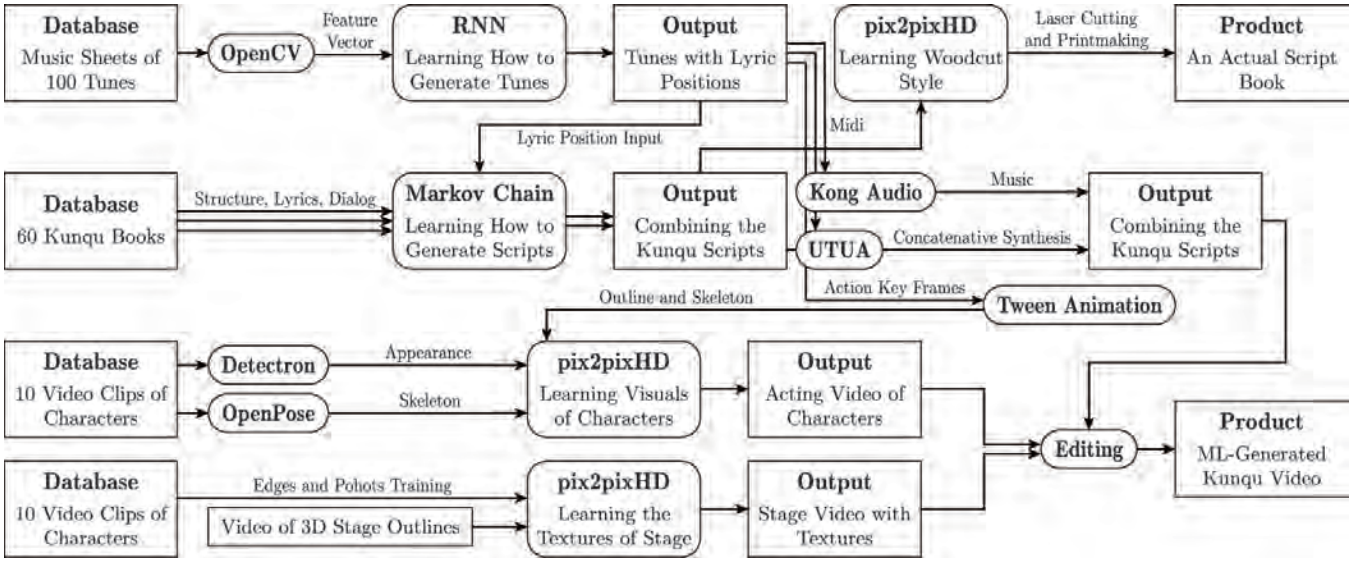


Figure 1: Workflow Pipeline

Music Sheet Analysis In this part we introduce the procedure to extract information from the image data. The *Kunqu* sheets use Numbered Notation (Ziffersystem or 簡譜), a common format for notating Traditional Chinese music, which we wrote a new computer-vision based algorithm to parse. The result is displayed as figure 2, with overlain annotations over the input image. Rather than creating standard bitmaps of numbers and using them to convolute images to guess the numbers, we developed a more precise technique: We isolated the horizontal region where numbers occur for each line, then we used a single bitmap, containing the mean of bitmaps of all 10 numbers, to convolute the region. This estimates coordinates of where any of the numbers occur. These detected numbers are then classified into 0 to 9 by simply multiplying their region element-wise with the standard bitmaps 0 to 9 and selecting the one with the highest score. Since there is a multitude of classes of symbols in the musical notation, each with a different difficulty level to detect, our strategy is therefore to start with the easiest class, erasing each instance from the image after successful detection, and proceeding to the next, more difficult class until we are done. Our system achieves above 98% accuracy with symbols it is programmed to recognize, while outputting visually similar guesses with rare, unseen ones.

Figure 2: Optical Music Recognition Output

```
|G_4:8+|A_4:8-|C_6:2+|A_5:8-|G_5:8-|E_5:8+|G_5:1-|D_5:16-|D_5:
2-|C_5:2-|A_4:4-|G_4:4-|A_4:8+|D_5:4-|D_5:2-|E_5:2+|G_5:1-|D_5
:2-|C_5:2-|A_4:4-|G_4:4-|A_4:8+|0:8-|D_5:4-|D_5:4-|E_5:4+|G_5:
4-|A_5:1-|E_5:4-|D_5:2+|E_5:8-|E_5:4-|G_5:4-|G_5:4-|E_5:8-|D_5
:8-|D_5:4+|E_5:4-|E_5:2-|E_5:2-|D_5:8-|C_5:8-|C_5:8+|D_5:2-|D_
5:2-|E_5:2-|G_6:4-|0:2-|A_5:6-|G_5:1-|E_5:8+|G_5:1-|D_5:4-|C_5
:8+|C_5:8+|E_5:1-|E_5:2-|E_5:8+|G_5:8-|A_5:8-|E_5:2-|D_5:2-|D_
5:2-|C_5:2-|A_4:16-|A_4:16-|G_4:2-|E_4:8+|G_4:12+|C_5:8+|D_5:1
6-|E_5:4-|E_5:2-|D_5:2-|C_5:8+|C_8:1-|D_5:4+|E_5:4-|0:2-|D_5:2
-|C_6:4-|A_5:2-|B_5:2-|G_5:4-|E_5:8-|D_5:2-|C_5:2+|E_5:8-|D_5:
12-|D_5:4-|C_5:8-|D_5:8-|C_5:16-|D_5:8+|E_5:4-|A_4:8+|C_5:8+|A
_5:1-|G_5:8-|A_5:16+|G_5:8-|E_5:4+|A_5:4-|G_5:2+|G_5:2-|C_5:4-|
-|G_4:16-|C_5:8-|C_5:8+|D_5:8-|C_5:12+|C_5:8+|A_4:4+|A_4:4+|0
:2-|G_4:2-|E_4:8-|G_4:8-|A_4:12+|G_4:4-|A_4:4+|A_4:4-|C_5:4-|D
_5:8+|E_5:16-|D_5:8-|D_5:12-|G_5:2+|C_6:2-|E_5:4-|G_5:8+|G_5:
```

Figure 3: Sample melody represented by our notation

Melody Generation using RNN Recurrent Neural Network is one of the state-of-art tools to generate sequence samples as melody. We used charRNN([8]) to generate the melody for our opera. Instead of using the conventional method of encoding note-down-per-tick as a 128D vector, we observed that a large part of pitch levels will not be used in actual music. For example, we will never use a very low pitch like C1 or C2 in Kunqu. Therefore, we adopted a novel representation method in our intermediate data structure. We concisely represented them with descriptive ASCII strings. For example, an 8th note middle C accompanied by lyric is `|C_4:8+|`. The pitch class information makes the structure easier for the learning model to grasp. The format can also be easily converted into MIDI and vice versa.

As the notation can also be seen as a character sequence, we naturally selected a character-based recurrent neural net-

work (charRNN) to learn it. The output, which has the same format as the input,are sent to the next stages of our generated opera: The melody itself is converted to MIDI and used for rendering the music, while the lyric position information is used for lyric generation, described in later sections.

Script Generation

To learn the hierarchical structure of *Kunqu* scripts, we introduced a nested system with different Markov Chains at each level. The method is capable of producing outputs containing reasonable large-scale structure for chapters, dialogues, prompts and lyrics, as well as smooth sentences within the structure. We also experimented with newer techniques such as LSTM and RNN in place of Markov chains, but eventually found the quality of results to be similar.

We used the first chapter of the first book generated by our finished algorithm as the script for the machine learning opera. The book has the generated title *Legend of Wrong Mountain* (錯山記), and contains 10 chapters in total, where the main plot involves the emperor, his lords and their intrigues.

Learning Structure of Kunqu Libretto Many text generation algorithm suffer from the problem of incoherence caused by short memory. Therefore, the method we propose is a trade off by manually inserting some domain knowledge in higher-level structures instead of solely relying on machine learning to learn these information: Our method combines systems for generating larger, chapter and paragraph level structures that reasonably resembles the corpus, with those for generating smaller, sentence and character level structures that reads smoothly.

Our dataset is a collection of 60 books of Kunqu script written by various Chinese playwrights from 10th to 19th century. In `.txt` format, the corpus can be easily analyzed with regular expressions for structural information. The dataset contains around 3,000,000 Chinese characters and is 9.1MB in total size.

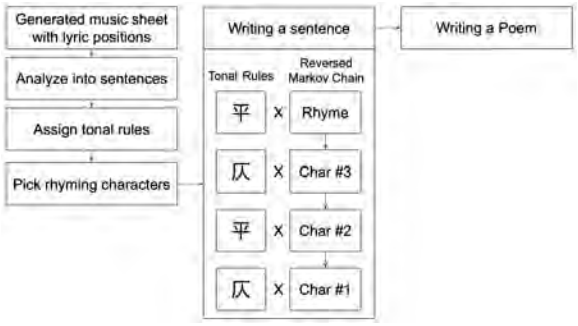


Figure 4: Poem generation pipeline

Qu Poetry Generation The sung parts of *Kunqu* were typically written in *Qu* (曲), a form of classical Chinese poetry consisting of characters that conforms to tonal rules from melodies. To generate them, our algorithm first analyze the corresponding melody generated in the previous step, and split them into sentences. Then, we reversed each sentence,

【簫聲漸】

古今去看。看那一派簫聲漸。
暮雨紛紛片翅飛。燕對鶯亂遮羞臉。
染征塵塵。浪浪熟油蜜槍。

The Flute Fades

In times new and old,
Hearken to the fading music of flutes, and behold
As the twilight rain splattered on their wings,
Swallows flew in disarray across her bashful face.
And the burning oil from the dressing case
Tainted the the ashes on the warriors' road.

Figure 5: Sample generated poem and rough translation

(a) Original (b) Label Map (c) Instance Map

Figure 6: Detection Results

such that the last, rhyming character is first determined, and all the previous characters are predicted backwards using a Markov chain trained on the reversed corpus. To ensure that the tonal rules are met, our algorithm multiplied the probability for outputting a character given by traditional Markov chain with the normalized distance between its tone and the tonal requirement (*Ping (平)*, *Ze (仄)*, or *no requirement (中)*) for the given position (figure 4). Thus, our generated poems read smoothly, rhyme, and adhere to the traditional tonal rules. Sample output and rough translation can be found in figure 5.

Plot Summary The story of our generated script mainly revolves around the Emperor and his court: There was once a lord who was greatly trusted by the Emperor yet coveted the throne in secrecy. While he was conspiring with his friend, his family started to fell apart: he left his wife for breaking a bath tub, while his daughter-in-law turned out to be a drug addict. Kicked out by his father, the lord's son ventured to the capital city to take the imperial exam, flirting with various women on his way. Meanwhile, a mysterious couple assassinated a friend of the Emperor's envoy, and the fates of all the characters were tied together when they chanced upon each other in the very same road-side bar...

Performance Generation

Detecting people & pose with OpenPose & Detectron To understand character information of Kunqu, several video clips of different Kunqu characters were picked as the dataset. We used OpenPose to get the pose information (coordinates of keypoints on human bodies) and Detectron to get the semantic information (silhouette of human bodies) in parallel. OpenPose is a real-time multi-person keypoint detection library for body, face, hands, and foot estimation. After that,

generated maps and send them to Pix2pixHD. The procedure is illustrated in figure 6.

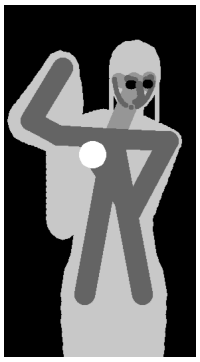


Figure 7: Generated Pose

Procedurally generating new poses and segmentation data We used python and PIL to generate animated images of new actor poses from scratch. A custom, minimal 3D engine that calculates rotation and offset for each joint in a skeleton was made. And for the costumes, pseudo-3D effects are created with polygons, with simple physics implemented using linear interpolation and numerical integration. A GUI is also design for quick annotation and generation of poses. The sample is displayed in figure 7.

Figure 8: Generated Actors

Generating costumes and faces with pix2pixHD pix2pix and pix2pixHD learn the correspondence between two sets of images. These procedurally generated semantics were then fed back into pix2pixHD which rendered them back to the photographic appearance of the performers. We had 9 pix2pixHD networks trained on characters of a variety of gender, age and costumes from the input videos. Thus by feeding the network 9 sequences of frames each containing a different generated animation, we obtained 9 corresponding photographic performances, ready to be used in the final video. 6 sample results can be seen in figure 8.

Scene Generation

Traditionally, Chinese Opera were often performed in tea houses. To honor this important part of Kunqu opera culture, we generated a virtual tea house to stage the performances using a combination of manual annotation and neural networks.

To construct the input for the network, we first built a 3D model of an traditional Chinese opera house using Google SketchUp, containing only the general outlines and without any textural information. Then we wrote a Ruby script to move the virtual camera in simulation of the perspective of a potential opera-goer, and exported the line work of the scene as a sequence of frames.

Figure 9: Canny edge detection result as training data

To train the network, 80 photographs of real Chinese stages and interiors were used as the dataset. We extracted the edges of these photos using Canny edge detection, and paired them with original photographs as input to a pix2pixHD network (figure 9). Pix2pixHD would thus output believable textures and lighting automatically according to the line work (figure 11). Finally, the sequence of generated images were prepended to the final video as a video walk-through of the space ere the beginning of the performance.

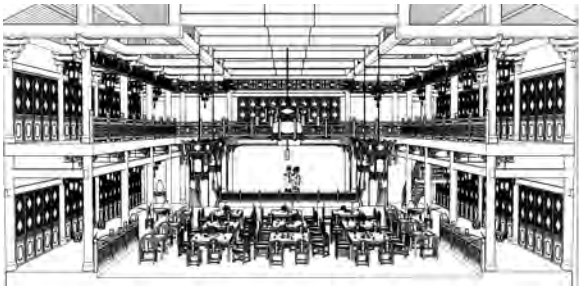


Figure 10: Tea House Reconstruction in Google SketchUp

Book Generation

We printed and bound 8 physical books containing the script of the opera, in traditional woodcut press style. First, a pix2pix network is trained on images of Chinese characters and their woodcut counterparts, which is then used to render the characters in our script. A custom software is then written to typeset all the pages in our book, before they were sent to a laser cutter (figure 12). The laser cutter prepared the printing blocks by engraving the pages onto 6mm wood pieces. Then, following traditional techniques, we applied black ink on the blocks and relief-printed onto rice paper. Finally, the books were bound with thread and needles.

Figure 11: Above: frame exported from Sketchup; Below: rendering by pix2pixHD

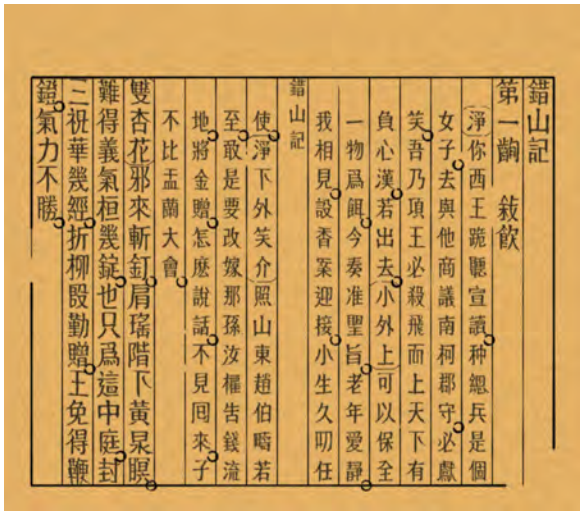


Figure 12: Generated rendering of a page from the script to be sent to laser-cuter

Result

This project has presented in two different forms of art. First as a eight-minute-long video accompanied by sound and as eight printed books of the opera script.

At the beginning of the video, the camera slowly moves through the interior of a tea house while introductory texts are superimposed on the image (figure 13). The camera eventually stops at a chair facing the stage, where the performance begins. Actors enter the stage in turns and sing with synthesized voices and dance to the generated music. Donning various costumes, the 5 of them perform dialog as well as monologue during different points of the performance. (figure 14 and figure 15)

Figure 13: Tea House

Figure 14: Still from performance

Figure 15: Another still from performance

The books are printed using laser-cut woodblocks on rice paper, and bound together using thread and needles by hand. Each of the books contain the first chapter of the script, and are typeset in the style of traditional Chinese prints. (figure 16)

Conclusion

This paper presents our techniques in generating Chinese Opera using machine learning methods. The project was presented at the *Art + Machine Learning* exhibition in Pittsburgh on May 1st, 2018. The printed and hand-bound books were offered to the audience for viewing at the show as further en-

Figure 16: Book

hancement of their experiences.

In order for people not familiar with the Chinese language to enjoy our piece, we translated the lyrics and added them as subtitles to the video. Accompanied by rich audio and visuals, the somewhat nonsensical dialogs provided much room for viewer's own interpretation. We've heard people describe it as a love story, while others thought it was more about intrigues.

Our approach can be generalized to other art forms such as western theatre, the cinema, or moving images in general. One could very well train our system against screenplays and coresponding movies, to produce avant-garde experimental films.

For future work, we plan to study Chinese literature theory in depth, taking tones of the Chinese characters into consideration while generating music and lyrics. The music theory would be introduced to make the outputs more realistic as well. Also, we would like to apply *vid2vid* [11] to reduce flicker between adjacent frames and dig into pitch shift technique to generate more convincing vocals. The dance video generation project *Everybody Dance Now* [3] published three months after the exhibition of our project have presented a promising adversarial network for the improvement on generation of human figures in our project. Finally, future work also includes the improvement of thematic correlation between script and music. We look forward to build in the future an autonomous and self-consistent machine that churns out of massive Chinese operas on its own.

References

[1] 2018. Kunquwang. http://www.52Kunqu.com.

[2] Canny, J. 1986. A computational approach to edge detection. *IEEE Trans. Pattern Anal. Mach. Intell.* 8(6):679–698.

[3] Chan, C.; Ginosar, S.; Zhou, T.; and Efros, A. A. 2018. Everybody dance now. *CoRR* abs/1808.07371.

[4] Gers, F. A., and Schmidhuber, J. 2000. Recurrent nets that time and count. In *Proceedings of the IEEE-INNS-ENNS International Joint Conference on Neural Networks. IJCNN 2000. Neural Computing: New Challenges and Perspectives for the New Millennium*, volume 3, 189–194. IEEE.

[5] Girshick, R.; Radosavovic, I.; Gkioxari, G.; Dollár, P.; and He, K. 2018. Detectron. https://github.com/facebookresearch/detectron.

[6] Hochreiter, S., and Schmidhuber, J. 1997. Long short-term memory. *Neural computation* 9(8):1735–1780.

[7] Isola, P.; Zhu, J.-Y.; Zhou, T.; and Efros, A. A. 2016. Image-to-image translation with conditional adversarial networks. *arxiv*.

[8] Karpathy, A. 2015. Char-rnn.

[9] Kazemi, V., and Sullivan, J. 2014. One millisecond face alignment with an ensemble of regression trees. In *Proceedings of the IEEE conference on computer vision and pattern recognition*, 1867–1874.

[10] Sturm, B. L.; Santos, J. F.; Ben-Tal, O.; and Korshunova, I. 2016. Music transcription modelling and composition using deep learning. *arXiv preprint arXiv:1604.08723*.

[11] Ting-Chun Wang, Ming-Yu Liu, J.-Y. Z. G. L. A. T. J. K. B. C. 2018. Video-to-video synthesis. *arxiv*.

[12] Trahndorff, K. F. E. 1827. Ästhetik oder lehre von weltanschauung und kunst.

[13] Wang, T.-C.; Liu, M.-Y.; Zhu, J.-Y.; Tao, A.; Kautz, J.; and Catanzaro, B. 2017. High-resolution image synthesis and semantic manipulation with conditional gans. *arXiv preprint arXiv:1711.11585*.

Authors Biographies

Lingdong Huang is an artist and creative coder pursuing his undergraduate degree in Computer Science and Art at Carnegie Mellon University.

Zheng Jiang is a musician and computer scientist pursuing his master's degree in Music and Technology at Carnegie Mellon University.

Syuan-Cheng Sun is a theater artist and interaction designer pursuing his master degree in Video and Media Design at Carnegie Mellon University.

Tong Bai is a computer vision engineer who recently graduated from Carnegie Mellon University and started her career at cognition group in Microsoft.

Dr. Eunsu Kang is a Korean media artist who creates interactive audiovisual installations and AI artworks. Her current research is focused on creative AI and artistic expressions generated by Machine Learning algorithms. Creating interdisciplinary projects, her signature has been seamless integration of art disciplines and innovative techniques. Her work has been invited to numerous places around the world including Korea, Japan, China, Switzerland, Sweden, France, Germany, and the US. All ten of her solo shows, consisting of individual or collaborative projects, were invited or awarded. She has won the Korean National Grant for Arts three times. Her researches have been presented at prestigious conferences including ACM, ICMC, ISEA, and

NeurIPS. Kang earned her Ph.D. in Digital Arts and Experimental Media from DXARTS at the University of Washington. She received an MA in Media Arts and Technology from UCSB and an MFA from the Ewha Womans University. She had been a tenured art professor at the University of Akron for nine years and is currently a Visiting Professor with emphasis on Art and Machine Learning at the School of Computer Science, Carnegie Mellon University.

Dr. Barnabás Póczos is an associate professor in the Machine Learning Department at the School of Computer Science, Carnegie Mellon University. His research interests lie in the theoretical questions of statistics and their applications to machine learning. Currently he is developing machine learning methods for advancing automated discovery and efficient data processing in applied sciences including health-sciences, neuroscience, bioinformatics, cosmology, agriculture, robotics, civil engineering, and material sciences. His results have been published in top machine learning journals and conference proceedings, and he is the co-author of 100+ peer reviewed papers. He has been a PI or co-Investigator on 15+ federal and non-federal grants. Dr. Poczos is a member of the Auton Lab in the School of Computer Science. He is a recipient of the Yahoo! ACE award. In 2001 he earned his M.Sc. in applied mathematics at Eotvos Lorand University in Budapest, Hungary. In 2007 he obtained his Ph.D. in computer science from the same university. From 2007-2010 he was a postdoctoral fellow in the RLAI group at University of Alberta, then he moved to Pittsburgh where he was a postdoctoral fellow in the Auton Lab at Carnegie Mellon from 2010-2012.

Volumetric Light Sculptures: Occupying the space between the apparatus and the image

Brendan Harwood
Affiliation (s): RMIT University
Location, Country: Melbourne, Australia
Contact: Brendan.harwood@rmit.edu.au

ABSTRACT

This paper aims to formalise a subset of technologies which possess the ability to produce different forms of volumetric light, a fundamental consideration of artists where light is the primordial medium within their practice. Volumetric light may occur when light is focused by an optical lens or emitted from a light producing apparatus, this light then made visible by obstructive, semi-opaque or translucent materials and surfaces. The light can form intangible, three dimensional, volumetric sculptures that redefine temporal spatial relationships. The subset within my classification of light producing apparatuses are all driven by a signal control, often a computer system, classified as *digital light* [1]. These forms of light may be used to define the space or exist within the space. This paper will look at LED arrays, Lasers/Searchlights, and Video Projectors. As this connects with my own practice, it is important to better understand the taxonomy of these devices to anticipate what paths they may forge in the development of new imaging systems.

KEYWORDS

Light, Sculpture, Projections, Lasers, Volumetric Light, Darkness, Apparatus, Form.

INTRODUCTION

It would be during the Bauhaus movement that Lazlo Maholoy-Nagy alongside Nathan Lerner, as leaders in this then-new wave of seeing, would coin the term 'to paint with light' [2]. From them, ushered a consideration to think of light in terms of its own plasticity, its own qualities, as if it were a material of its own, a material that could be harboured with a gusto as a whole new means of imaging. Light was not just auxiliary in the illumination of an image or space, but light (and shadow) would *become* the image. Light and the shadows it cast were embraced as the subject of work and this saw practitioners within and beyond the Bauhaus movement explore ways light could be sculptured and represented.

The three classes of apparatuses that I will delineate in their contribution to the creation of different forms of light sculptures will be as; LED (Light Emitting Diodes) arrays - strip and screen, lasers and searchlights, and video projections – both film and digital. Each are assembled and function in a manner slightly different to each other, some produce light in a way where the light and/or image are attached to the apparatus - *bound light*, bound light may be considered as monitors, screens or arrays, in this case the LED arrays. Other forms of technology emit light that is concentrated through optical lenses to be shaped and cast from the apparatus - *cast light*, cast light to be considered as light and/or an image that is cast away from the apparatus. This magnification and casting of light/image possesses the ability to highlight or digitise the appearance of another surface or space separate from the device itself.

The three types of apparatuses that have been chosen all share one thing in common, beyond just being producers of light, all are able to be controlled by a signal that may influence the intensity, direction or colour, this signalling generally controlled by a computer system. Both LEDs and video projectors rely on this computer-controlled system to produce and display digital images, as can lasers/beamers – considered to be producing an image of a single 1x1 sample. In the case of all three, they produce light and colour in an additive system [3] where the primary colours of red, green and blue are used in combination to generate and emit light. When all three are combined together of equal intensities they produce a transparent white.

Here, I will firstly provide a brief overview of light and ways in which it has been and can be considered. I will briefly detail how different contemporary technologies have been used to construct volumetric light sculptures, highlighting practicing artists who have been using these respective technologies, as exemplary means to better understand how it has been utilised. Concluding with a commentary on how the functions of these technologies have influenced my practice and propose ways in which these considerations of light might progress with the development of future technologies, predominantly – holograms, where space and material may no longer be required in the construction of detailed, volumetric, intangible images.

This paper does not seek to qualify the image that is produced by these respective apparatuses or the surface(s) which they may illuminate. Each three of the technologies are capable of producing and displaying digital images, from the single-sample point laser/beamer to the highly detailed LEDS and projectors. There are interactions and implications that light can have with the materiality and perception of a space beyond just its volumetric quality, but the focus more on the quality of light in relation to the technological means of production.

LIGHT

While there are theorist and philosophers who have dedicate lifetimes to trying to understand what light is and how it functions - from Descartes to Newton to Goethe, right up to contemporaries as Zajonc and Cubitt, we are still yet to decide exactly what light is. There are so many attempted reasonings from multiple sources that interweave, compliment and sometimes contradict each other. The two *popular* reasonings for the material property of light is that it can be of either a wave or a particle. Both theories successfully start and finish at a point of truth to how they believe light can be deconstructed, but take very different paths of reasoning to arrive at a justification of theory. I will try to avoid the care for scientific proof [4] and rather focus on the implications of the technology that is being implemented in installation work where light it considered the primary, if not only, medium in an artwork. Science has proven that light can be considered as a particle, also that light is a waveform. Be it a particle or a waveform - light is still light and there ain't nothing more to it, yet. Were there further interrogation into this proposed taxonomy then the research might arrive at a level that requires not only a delineation of machine-apparatus but also further application to the how the material properties of the light they admit can be manipulated. In both cases, each theorem requires for this material to (however it be considered) travel from source, through space, to object. This *space between* the source and object is central to this current stage of research

Though popular opinions and moral associations with light have changed through time, as had the methods and mechanics of its production, the substance of light in its material / immaterial quality has not. The ideas of sight and visions that were long held for some 1500 years are to be attributed to Plato's developments on vision beyond the work of Pythagoras, his predecessor. In Plato's tradition, the light of the eye played fully as important a role as the light of the sun [5][6]. Plato's vision was that there was not only outer light - a source of light that was external to the body; be it the sun or a flame, but we possessed something called inner light. Inner light was the fire of the eye that would coalesce with the outer light to mediate the experience of man in an otherwise dark, cavernous external world. This idea of man's inner light continues on to this day, often associated with one's morals on conscience. Light was the representation and figure of the divine, of an idol. In fact, the term enlightenment has always carried with it an association of progressive and moral desire that can be achieved through the banishing of darkness [7].

Light is not something we can see, it is only that which it illuminates makes the experience of light a visual experience. When considering the sense of sight - the eye requires more than just a functional system of biomechanics, it requires light too, as aforementioned by Plato. For one to navigate a space they require more than just what the organ can function as, where as other means of navigating a space can be assisted through touch; also sound, taste and smell as other secondary locative senses. Without light, the eye serves very little, if any, function.

It is difficult to imagine pervasive darkness. It can be difficult to imagine a prolonged period of time where there was no light nor a potential source of light, other than constructed sight-sensory deprivation experience. We live in a time where it is impossible to deactivate the presence of electronic illumination that perpetuates through the full cycle of a day. I attribute this to a contributing factor that has seen many arts practitioners beginning to work with light in a way that provides the audience with an experience of light that isn't akin to the mundane, domesticised way we are more commonly use to experiencing it.

A couple of thousand years ago we come across, and what might be the first, a consideration of the volumetric quality of light from Aristotle as he deduced our inability to see in the dark being due to the air around us developing an opaqueness [8] that would increase in density during moments of partial or complete deficiencies of light - darkness. Only in introducing light would it cut through the air to eradicate this ever-passive thick smog.

From this, we now have a number of contemporary artists who are practicing with light as their focus medium, who are trying to make light visible and bringing forth how it might be represented volumetrically in pure darkness, working with the materiality of space and often allowing the light to propel through volumes of smog (or forms of; haze, smoke, mist, water etc.) which would 'catch' the light, allowing it to be made visible. The catching of the light is currently the most important and required role for us to experience it in a dimensional and volumetric quality.

LED Arrays

Light Emitting Diodes can be assembled in linear or rectilinear array that may appear as strips or screens. The light and image that these arrays are willed to produced is often bound to the apparatus itself. The bound nature of this light poses a difficulty to work with where constructions of these arrays are often limited to what the rigid nature of the apparatus allows. In many forms of the structuring of these arrays we see the light be able to do little beyond how the apparatuses are assembled, often resulting in structures and displays that appear quite geometric of flat in the form or edges they define. The benefit to this style or apparatus is it possesses a great potential for incredibly high intensity light with little residual heat as a biproduct. This high intensity – low heat trade off allows for these constructions of these array to be concealed, sheathed or supported by other material forms and structures.

One practitioner who has, since the development and accessibility of this technology, incorporated it into his arts practice is James Turrell. Throughout Turrell's 50-year career he has word with augmenting one's perception of space through the use of light and how this can be imposed back into different physical environments, where installations allow this augmentation to be held in contrast to wider spaces that are impervious to this light (often an outdoor setting),

and other series' of installation that focus so elicit a ganzfeld effect [9]. Ganzfeld is to induce a sense of partial of complete loss of depth perception through illuminating entire enclosed space in a slowly changing single hue (see Figure 1.)

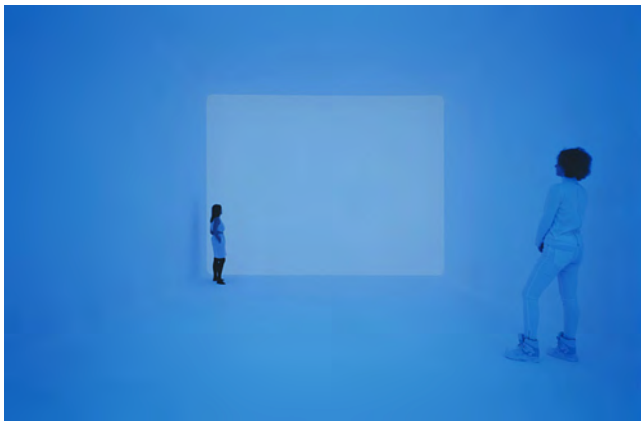


Figure 1. James Turrell, *Sight Unseen.* 2013 ©James Turrell photography © Florian Holzherr

Turrell would make use of the durability of this LED technology, hiding the apparatus itself in shallow reliefs or cervices and having the computer system controlling this light completely out of view. The single hue of colour would permeate and otherwise-white space, changing in colour ever so slowly, over extended cycles, indistinguishable in the incremental shifts between polar colours. Access to this functionality of a light/image producing apparatus was only introduced into his work when the granularity between soft changes in colour was achievable, previous to this Turrell worked with predominantly cathode tubes. When occupying the space for long enough the eye would lose ability to perceive depth. These spaces are design for the audience to feel the weight and the presence of light, to make believe that in a room of colour, there was a volumetric quality to how the visually intoxicating light could be.

Another artist working LEDs utilising another quality of this technology, empowering the rigid panel-like assembly as an advantage in the presentation of its light is Kit Webster. Webster embraces the geometric form of LED screens to erect monolithic monuments where the LED panels are arranges in a three-dimensional way as archway-like structures, inviting audiences to occupy the same space as the panels as geometric animations play out on the panels as in Figure 2.

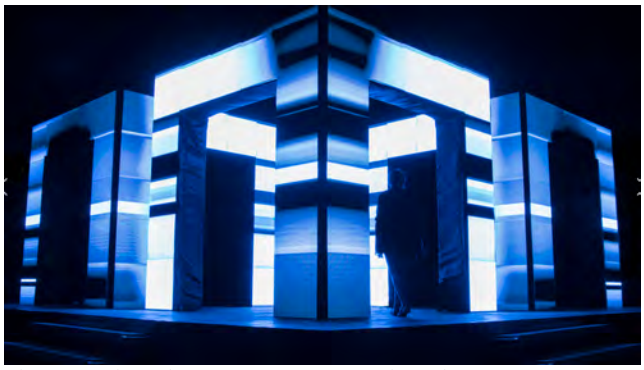


Figure 2. Kit Webster, *Axiom.* 2017 ©Kit Webster

In *Axiom* the panels make up a proscenium that not only house the experience of audience becomes a part of the work, but they allow Webster to control how the light is distributed through this navigable space. The stiffness of the panels becomes the works greatest strength, and intentionally distributed in the series of repeated right angle. Both Turrell and Webster work with the limitations of this apparatus and utilise it to produce work that is empowered by what might otherwise be considered as a limitation.

Lasers / Searchlights

Here I consider laser and the searchlight to be in a similar category with very little that differentiates the two, other than intensity of concentrated light and ability to display and interchange a spectrum of colour. Searchlights are to be considered as any device that produces a concentrated beam (sometimes colloquially referred to as moving heads, beamers or sharpys) often seen in stage lighting. They produce light in a very similar effect as lasers. There is a devastating accuracy to laser lights that can be achieved with some of the most highly concentrated forms of light. One may, if pressed, treat the product of this light as a single sample of a 1 x1 image that can be reared and controlled at the base of the apparatus to be cast around an space. The laser may appear to 'draw' images through our persistence of vision, when it is still locating its single point a series of predetermined locations faster than what our eye can track - it is still but a single image smeared around a space in our field of vision that otherwise appears to use as a whole image. The space that these lasers and searchlights occupy with such accuracy is made furthermore distinguished by the negative space around the beam due to the high lux concentration in this persistent parallel stream. Without much of a potential to produce a single line or 'fan' of lines, the laser light is often isolated by a vast amount of space around it, this surrounding space tends to intensify the path of light by stark contrast.

Figure 3. Matthew Schrieber, *Leviathan.* 2018 ©Matthew Schrieber

Artists such as Matthew Schrieber work with that intensified contrast of the exacting light path and the space around it, forming intricate, interwoven light sculptures with the often repeated and re-angled strokes. Often, if not always static, these threads of concentrated pure light would form tapestries of large geometric sculptural forms. As seen in Figure 3. Schrieber allow for the dimensional quality of his work to appear at change by allowing audiences to navigate the space and partially, momentarily obstruct the beams along their trajectory, giving life to an otherwise rigid intangible structure. While the light from these lasers (and moving heads) can be impressive, even when activated in a modular and 'moving' way, a single one alone is often not enough to establish a noteworthy presence in the construction of light sculpture (notwithstanding Yoko Ono's *Imagine Peace Tower* [10]). These modules and apparatuses work best when choreographed and sequenced together in a unison that braids together, contributing to a tapestry of beams of light.

Video Projectors

While the video projector can function with a similar mannerism to laser lights, it is not able to achieve the intensity of concentrate light that the laser may. The advantage of the Digital Video Projector, and where it benefits as a system for display, is that it can produce an image far exceeding the size of the apparatus itself and not constrained by the limitations of what an LED screen or monitor display may [11]. This means the area they are able to cover and the volume they are able to cast can be direct by broad. Video projectors possess the potential to produce very fine and meticulously detailed images in rectilinear order that is extruded from the lens of the apparatus to the eventual surface that lies opposing the projector, intended or incidental, the image may change in the size of each sample/pixel value along the (x, y) plane but remains consistent along the z-plane. The further from the apparatus the light is intercepted then the larger the image it is willed to produce will appear extruding from the apparatus in a conical way. This manner of presenting large scale images projected onto surfaces within which or those that define a space may be referred to as situated animation [12] or in a broader sense - situated imagery, this combination of digital video projectors and situated imagery within a space result in an often-practiced means of Spatial Augmented Reality [13] where situated imagery is used to augment the visual appearance of a space, also associated with *projection mapping*. In the case of this paper, not concerned with the final image, there is still an ability to achieve augmentation within the space between the projector and the image. This augmentation occurs, much like with the other two forms of technology – within the space between. The image can still be designed with the intention of being extruded from the lens of the apparatus without ever needed to be qualified on an opposing surface.

In 1973, Anthony McCall would exhibit his short film Line Describing a Cone for the first time (see Figure 4). McCall placed equal amounts of importance on the line that was to appear on the screen and that way in which it moved, in a slow and minimalist style of animation, as he was the space between the apparatus (at the time of original exhibit, McCall used a film projector). This space between would resemble, as the line suggests, a cone that extruded and enlarged into the space. This would be the conceptual weight that underpinned his subsequent work - how may the space be reformed through projecting these ribbons of light into a space and how may we allow them to materialise in a volumetric form. McCall would often use originally allow this performance of light to me caught by cigarette smoke and dust, only to be replaced with streamlined emissions from haze machines when picked up and presented in more formal gallery settings (in departure from his studio) [14]

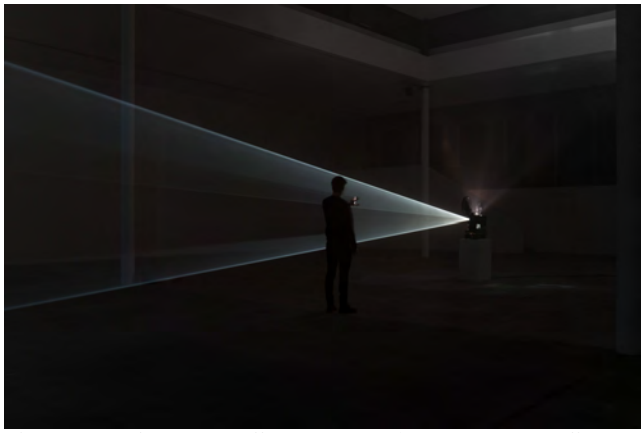


Figure 4. Anthony McCall, *Line Describing a Cone.* ©Julia Stoschek Foundation

McCall would continue his practice working with projected white lines in both a horizonal and eventually vertical format. His main separating factor between these two cast volumes were his horizontal pieces were considered more cinematic with allowing for interception, interaction and causational change in the final image as influences by the audience's displacement in the space, where his vertical works were seen as more sculptural pieces, as these chamber-like membranes that could engulf the audience [15]. McCall would encourage, much like all of the other works mentioned, the audience to participate in the space that the light was cast into. Temporal and unpredictable audience interventions of the McCall's work would bring a constant sense

of change in how the caught light and the space related from one person to another and how they were displaced in relation to his work. McCall would go on to work with other light apparatuses yet still preserve his interest in making durational, participatory and ephemeral work.

Breaking the Convention

Sometimes it takes getting everything in the same room to realise the similarities and differences between different apparatuses and technologies that all work towards the production of a similar ornament. Better understanding what is individual and possible, not to mention limited, by these different technologies only provide a clearer path to how they might be better utilised or employed to facilitate a specific intention. In my own practice, I worked recently with a large light sculpture that allowed for audience participation and intervention with a multi-projector set up covering a single scrim.

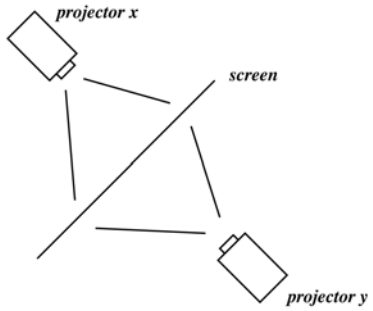


Figure 5. Plot - *Lightwall* ©Brendan Harwood

If we look at Figure 5 we have a simple set up of two projectors and a single semitransparent screen. The screen is suspended in between *projector x* and *projector y*. The images that *projector x* and *projector y* produce will intersect on the screen, superimposed onto one another. In this circumstance the two imaged will combine additive way. If *projector x* were projecting a solid red colour and *projector y* were projecting solid blue, then the screen would appear purple.

If something obstructed (partially or fully) *projector y* then what we would have on the screen would be the isolated visual information from *projector x* in the silhouette of the obstructing object and the surround negative space as still the visual information from both *x* and *y* in its default additive state.

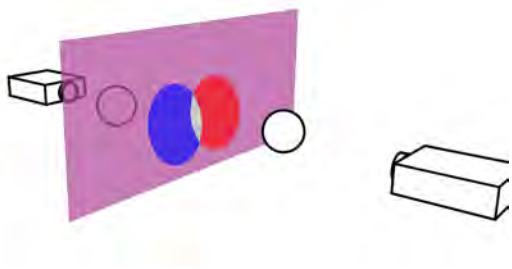


Figure 6. Previsualisation – *Lightwall* ©Brendan Harwood

Following on, in the case of Figure 6 we have introduced an obstructive sphere in between *projector y* and the screen as well. A majority of the screen remains the additive product of the red and blue light, and the silhouette of the obstruction appears as the red light from *projector x*. Then if you were to introduce a second sphere obstructing partial amount of the colour between *projector x* and the screen then in that silhouette appear as the information from projector y. When both silhouettes overlap, and a partial amount of the screen is block from either side – it remains blank as the natural colour and look of the material. This theory was installed as a large-scale work that allowed for the audience members to be the obstructions in between the apparatus and the image and interact with the shadows of other members on the opposing side to them.

It took an otherwise-negative, to obstruct and image, and turned it into the focal point of the piece, while occupying the space between within the volume of haze.

Putting this theory into practice - this concept was exhibited as commission for the Nura Headphone product launch, as an installation to act as a visual spectacle to view as the attendee's attempted the headphones during a demonstration, but also directed traffic to and from the demonstration area, see Figure 7. When ever one walked either side along the 20 meter freestanding wall, they would inevitably obstruct partial amounts of the projected colour field, where their silhouette was visually articulated by the projected colour from the other side of the screen. When this was experienced with people on a single side – you had an engaging 'recolouring' of the otherwise shadowed impression of the audience member. When there were audience members on both sides there arose an almost 'Peter Pan effect' where one's own silhouette would appear on the same surface as another's but not necessarily from an audience on the same side. What happened from here was watching people on each side puppet the impressions they left on the screen to interact with each other and encourage that the obstruction of the projected fields of colour revealed more about these overlays of images than if it were to be preserved and left uninterrupted.

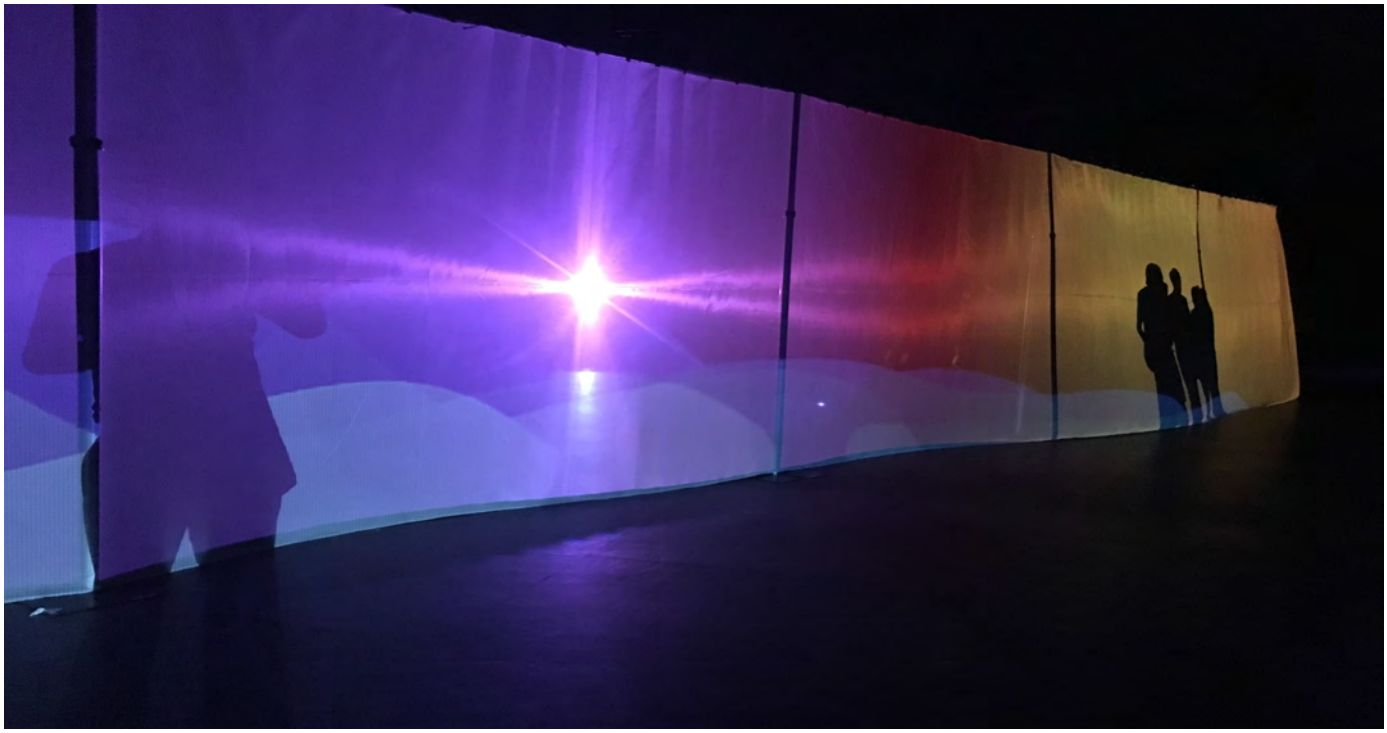


Figure 7. Installation – *Lightwall* ©Brendan Harwood

Conclusion

Through defining a taxonomy of computer-controlled light/image producing apparatuses that function in the production of light sculptures, we have a foundation for where forthcoming technology may be placed within. Each technology has its advantages and disadvantages – LEDs can produce light at a great intensity but are often restricted to the rigid body of the apparatus, Lasers/Searchlights can direct highly concentrated amounts of light but are often *alone* if not in unison with others, Video Projectors can extrude images through space with a shear increase in size but often rely on heavy amounts of haze or material for this light to appear on. Understanding where the projected image sits within this techne-cosmos has deepened my understanding of this form and how it works, enabling me to produce further work. As the eye relies on a source of light to activate the function of sight, the light sculpture relies on a density, an opaque moment in space for it to materialise. Here is a way to classify the different technologies and how the arts practitioners have utilised the idiosyncrasies of each. These leaves us with an understanding of how rules can be adhered to or how they may be defied – and in doing so, inspiring new ways that this technology can be utilised.

Soon will come a time when holographic technology will be readily available and we will require less for a three-dimensional, volumetric image to be 'caught' with. This could lead to a complete lack of need for considering the materiality of space for light to be articulated by, which will change the whole way in which light is treated and spaces are designed.

References

[1] Stephen Jones, "What is Digital Light?" in Nathaniel Tkacz, Sean Cubitt, and Daniel Palmer. *Digital Light* (Open Humanities Press, 2015), 98.

[2] László Moholy-Nagy and Daphne M. Hoffmann, *The New Vision and = Abstract of an Artist* (New York: Wittenborn, Schultz, 1947), 86.

[3] Carolyn Kane. *Chromatic Algorithms: Synthetic Color, Computer Art and Aesthetics After Code.* (Chicago: University of Chicago Press, 2014), 27.

[4] Abdelhamid I. Sabra, *Theories of Light: From Descartes to Newton*, (London: Oldbourne Book Co., 1967), 12.

[5] Arthur Zajonc. *Catching the Light: The Entwined History of Light and Mind*. (New York: New York: Oxford University Press, 1993), 21.

[6] Plato, M. S. Lane, and Henry Desmond Pritchard Lee. *The Republic.* Edited by M. S. Lane and Henry Desmond Pritchard (London: Penguin, 2007), 232.

[7] Tim Edensor. *From Light to Dark: Daylight, Illumination, and Gloom*. (Minneapolis: University of Minnesota Press, 2017), xiii.

[8] Arthur Zajonc. *Catching the Light : The Entwined History of Light and Mind*, 77.

[9] Cliff Lauson. *Light Show.* (London: Hayward Publishing, 2013), 160.

[10] Yoko Ono, “Imagine Peace Tower” Imagine Peace Tower, accessed December 15th, 2018, http://imaginepeacetower.com

[11] Oliver Bimber, Andreas Emmerling, and Thomas Klemmer. "Embedded Entertainment with Smart Projectors." *Computer* 38, (2005): 48.

[12] Dan Torre, “Animated Landscapes” in Chris Pallant. *Animated landscapes: history, form and function* (New York: Bloomsbury Academic, 2015), 199.

[13] Oliver Bimber and Ramesh Raskar, *Spatial augmented reality: merging real and virtual worlds* (Wellesley, Massachusetts: A K Peters, 2005), 7.

[14] Tyler Coburn, “Interview: Anthony McCall” *ArtReview* 47 (2011), 83.

[15] Anthony McCall, Serena Cattaneo Adorno, Tyler Coburn, Hangar Bicocca. *Anthony Mccall: Breath* (Mantova: M. Corraini, 2009), 19.

Bibliography

Gernot Böhme. *Atmospheric Architectures: The Aesthetics of Felt Spaces.* translator Engels-Schwarzpaul (London; New York, NY: Bloomsbury Academic, 2017).

Ulrich Bachmann. *Farben Zwischen Licht Und Dunkelheit = Colours between Light and Darkness*. (Zurich: Verlag Niggli, 2000).

Sean Cubitt. *The practice of light : a genealogy of visual technologies from prints to pixels.* (Cambridge, Massachusetts: The MIT Press, 2014).

James Cummings and Jeremy Bailenson. "How Immersive Is Enough? A Meta-Analysis of the Effect of Immersive Technology on User Presence." *Media Psychology* 19, (2016).

Wolfgang Schivelbusch. *Disenchanted Night: The Industrialization of Light in the Nineteenth Century* (Berkeley: University of California Press, 1988).

Junichirō Tanizaki. *In Praise of Shadows*. (London: Vintage, 2001).

Author Biography

Brendan Harwood is a PhD candidate in the School of Design at RMIT University Melbourne, Australia. His current research engages with the placemaking capabilities of light and how artists have manipulated light as the primary, intangible, medium in their practice. With a background and formal training in 2D animation, both hand drawn and motion graphics, he is now interested in non-screen based means of moving-image media presentation and how these methods of display, often incorporating projection mapping and/or spatial augmented reality, influence the design and production process of the media.

Conservation of Shadows: Shared Physicality Between Worlds

Haru (Hyunkyung) Ji[1] and Graham Wakefield[2]

[1]OCAD University, [2]York University
Toronto, Canada
hji@faculty.ocadu.ca, grrrwaaa@yorku.ca

Abstract

This article describes a site-specific interactive mixed reality installation artwork involving a network of over a hundred motor-actuated bells, projections upon a 4x6m bed of salt, and a dual motion tracked virtual reality perspective inhabited by artificial life and integrating real-time volume capture. This work responds to very specific history of the host venue as a former centre for disease control and reagent storage, through a central conception of shadows as shared physical images between visible and invisible worlds, carried through with dual emphasis on functional and contextual meaning in all components. Details of this context, as well as the technical realization, are followed by discussion of mixed reality art as a site-specific expression, and directions for future development.

Keywords

Art Installation, Artificial Life, Embodiment, Interactive Art, Mixed Reality, Physical Computing, Shadows, Site-Specific, Spatial Sound, Virtual Reality

Introduction: site-specific mixed reality

Virtual reality (VR) is appealing in its promise of infinite possibilities, and the sense of presence, or "being there". However this flexibility also puts it in a strange relationship with exhibition spaces. When VR can be viewed practically anywhere, and wherever it is, it can present being somewhere else, what ties a work to a place of an exhibition in particular, how can it avoid an inherent sense of disconnection? We are excited by the potential of Mixed Reality (MR) as a resolution that can bind virtual *spaces* to specific physical *places* in both functional and contextual ways. That is, rather than the virtuality presenting escapism to independent worlds, it may connect deeply to a particular place, ontologically rooted in site-specific grounds, perhaps revealing expansive possibilities within what is physically present. Not only in *being* there, but also in being *there*. This question was foremost in our conception and realization of the Conservation of Shadows artwork (Figure 1), installed at SeMA Chang-go, a recently acquired expansion of the Seoul Museum of Art within the former grounds of the Korea Centre for Disease Control.

Figure 1. The *Conservation of Shadows* installation.

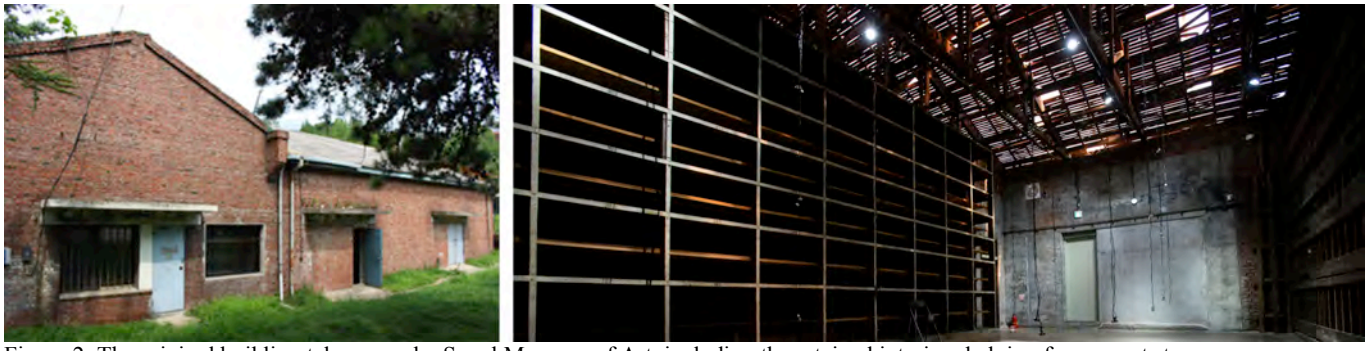


Figure 2. The original building taken over by Seoul Museum of Art, including the retained interior shelving for reagent storage.

Seoul City remodeled this site of medicinal warehouses, waste disposal facilities, animal testing labs, and reagent storage, into a new Innovation Park, including youth and community facilities as well as innovation hubs and the gallery itself (see Figure 2). The artwork formed part of an exhibition in late 2017 *(*"Requiem for Hybrid Life", organized by NMARA, a non-profit art-science association directed by Kenny Kyungmi Kim) that responded to the site's specific history while also reflecting on a future defined by biology and technology, in which distinctions between machines and living beings are becoming blurred.

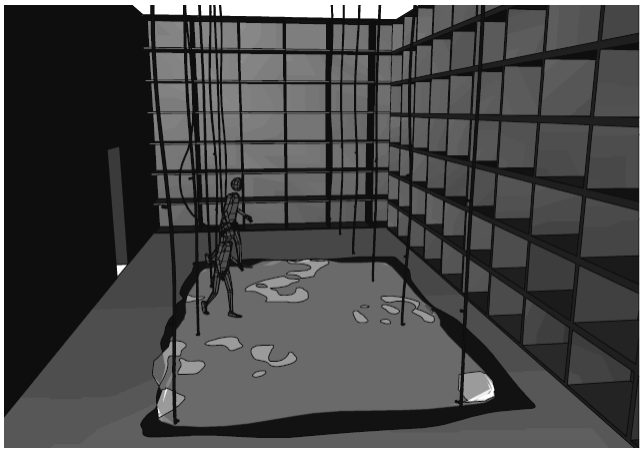


Figure 3. Pre-visualization of physical installation design.

Our first response to this site-specific condition responded to the building itself: a red brick masonry construction with wood truss ceiling dating from 1962. The installation space is large (6m by 12m) and barn-like with aged timber shelving and rafters (at 4-6m above the floor), through which one can see the sky during daylight hours. We felt that the space had a very charged atmosphere, not only through its history, but also in its textures of dappled light, quiet reverberation, temperature, humidity, and subtle odors. It made us imagine unknown beings growing fond of the wet texture of the old timber architecture, the fragrance of sunshine smeared between cracks, and the quietness of murmuring and whispering. To give life to them, we determined to extend senses and mix realities surrounded by softly ringing bells and the crunch of salt underfoot as shadows of the new beings pass by, along with a dual alternate perspective through head-mounted display in which we may instead become the shadows around which these beings play.

Our working method has always been to ensure all components of a work inter-relate, with both functional and contextual meaning [1]; what we achieved in this installation is the extension of the principle more fully into its physical realization. The floor of the room is laden with a carpet of 330 kg of salt, covering an approximately four by six meter area (the majority of the floor space), upon which light is projected from above (see Figure 4). Motor-actuated miniature bells surround the installation space, hanging down from the rafters at different locations and heights, varying in intensity and creating a variegated spatial sonic experience. A projector mounted centrally at around four meters above the ground casts a predominantly white image covering the bed of salt, fading away at the edges. Visitors walking on the salt thus inevitably cast shadows, which mingle with projected shadows of invisible creatures appearing as ghostly vortexes in the space. By donning a head-mounted display visitors take on an alternate perspective to witness another world co-existing in superposition with our own. What first appeared as flat shadows are unveiled to be the membranes of comprehensible beings moving around and through our now-shadowy bodies, and shaped by our movements and gestures.

The physical duality of shadows as a bridge between worlds

The heart of the piece is the character of shadows as a physical connection between realms, both revealing and concealing. Shadows are rich in functional and contextual roles, deeply rooted in human vision processes, psychological symbolism, and ancient myth. Yet, at the same time, as mathematically conducive optical and

geometric phenomena of linearity and functional transformations between spaces, they grounded some of the earliest science with chronological and cosmological tools.

Shadows are two-dimensional projections that speak of a three-dimensional reality, like the higher-dimensional beings that strangely fragment, coalesce, and pass through Flatland, incomprehensibly so to its occupants. [2, 3] As detached images of our outer form, our shadows impart less even than our reflections. Nevertheless they have recurrent mythical relation to spirit and loss. For example, the character Peter Schlemiel's life among people is undermined after a Faustian pact in which he sells his own shadow, and he retreats instead into a life of dedicated scientific naturalism [4]. Through shadows we can more readily join with others and become other in shadow play, puppetry, and theatre.

This spurred us to think of the physicality of shadows as a liminal bridge suspended between superposed physical and virtual space in both mathematical and mythological senses, continuing a thread of our prior work blending superposed physical and virtual space, perceptually and conceptually, through mixed reality artificial life [5].

In inspiration, it echoes the subtle physicality of the organisms moving from screen to body in Sugrue's Delicate Boundaries [6], the otherwise invisible inhabitation of site-specific locations imagined in Semiconductor's Mini Epochs [7], and the narratives of other "found" organisms occupying urban spaces in U-Ram's machinic sculptures [8]. We borrow the title of this work from Korean author Yoon-ha Lee's speculative fiction, which opens with this intriguing anti-proposition:

> "There is no such thing as conservation of shadows. When light destroys shadows, darkness does not gain in density elsewhere. When shadows steal over earth and across the sky, darkness is not diluted." [9]

Although the work does not refer directly to her reimagining of the Descent of Inanna with influences from the video game Portal [10], there is nevertheless a related sensibility of inter-spatial experience and the afterlife. Inanna is an ancient Sumerian goddess known for triggering Gilgamesh's grapple with mortality, and her descent into and return from the shadowy underworld *Kur*, where she is stripped of everything and passes through death itself.

Details of the realization

From the first designs to the realization of the installation, in both physical and virtual components, we focused on maintaining a duality of functional and contextual meaning.

Bed of Salt The choice of salt as material serves several functional purposes. The near-white colour responds to projection well, but more importantly the granular texture does not take the projection coldly as an impassive screen. The translucent granules diffuse the light, imparting a material sense of depth and quenching pixelation. The salt is heavy enough, and laid thickly enough, to take footprints without dispersing too much or exposing the underlying floor. Visitors nevertheless feel the grains shifting and audibly crunching underfoot with each step as they progress further into the environment.

This brings attention to the ground, literally the media under our standing, and the shadows upon it, while also subtly undermining sure footing. As a material, salt carries meaning as a natural antibacterial/antiseptic preservative. Within Korean shamanistic traditions salt also carries a kind of enchantment. It is regarded as precious for its ability purify space, purging or expelling unfaithful forces and bad spirits.

Figure 4. (Above) Visitors' shadows on the salt blend with those of the otherwise invisible creatures surrounding them. (Below) Close-up detail of projected shadows upon salt.

Bell-motor assembly network Functionally bells are well suited for spatial sound, as they are rich in spectrum and transients. Moreover the bells are not perfectly manufactured, each with distinct imperfections. Together this makes them very easy to localize, even when filled out significantly through the warmly resonant reverberation of the timber framework of the room.

Bells also have specific roles in Korean shamanism as sounds that bridge between the living and dead, a way of communication between the visible and invisible. Shaking and rattling bells often accompany shamanist ceremonies in Korea. Of the three kinds of shaman, the third kind is one that is visited and becomes inhabited by small gods, and who will no longer be subjects of their own lives. After the ceremony of accepting a small god, such shamans have the ability to help people. The first sign of this visitation is that you hear bells ringing when nobody else does. In the exhibition the bells do not jingle in a rhythmic or celebratory way, but continually tremble and jostle against each other, sometimes very softly, sometimes much more insistently. Several visitors described it as "haunting".

The bells are activated by a network of 12 microcontroller boards arranged in a 2x6 grid above the exhibition space. The microcontroller boards[1] are customized Arduino Unos with a smaller form-factor and built-in networking, designed to be used in large addressable sensor network arrays. The entire network including the motors are supplied power by PoE, and the network is addressed from the installation PC by an FTDI USB to serial ethernet converter. Each microcontroller board provides six 5V analog outputs, each of which is connected to an individual motor-bell assembly by 22AWG cable. Each assembly is two miniature bells and a small 11000 RM 5VDC vibration motor, the same kind that makes a cell phone vibrate, in direct contact (see Figure 5). Motor-bell assemblies were positioned in pairs for redundancy/robustness, with each microcontroller effectively controlling three independent quadruplets of bells that hung at heights of approximately 0.5m, 1.5m, and 2.5m above the floor (over 150m of cable in total). Thus although the installation utilized 144 individual bells on 72 channels, with pairing and redundancy there were effectively 36 independent 3D sound locations around the installation space.

Varying the motor signal resulted in perceptually smooth transitions between the gentlest sporadic tinkles to continuous ringing to rather loud frenetic rattling. Thus, rather than using a discrete event model of ringing bells when virtual creatures intersect with them (collision-based), we adjusted motor activation levels continuously depending on a mapping of the distance and density of living matter near to the location of the bell. These motor intensity updates were updated in the simulation and distributed to all nodes in the microcontroller network at rate of 60Hz.

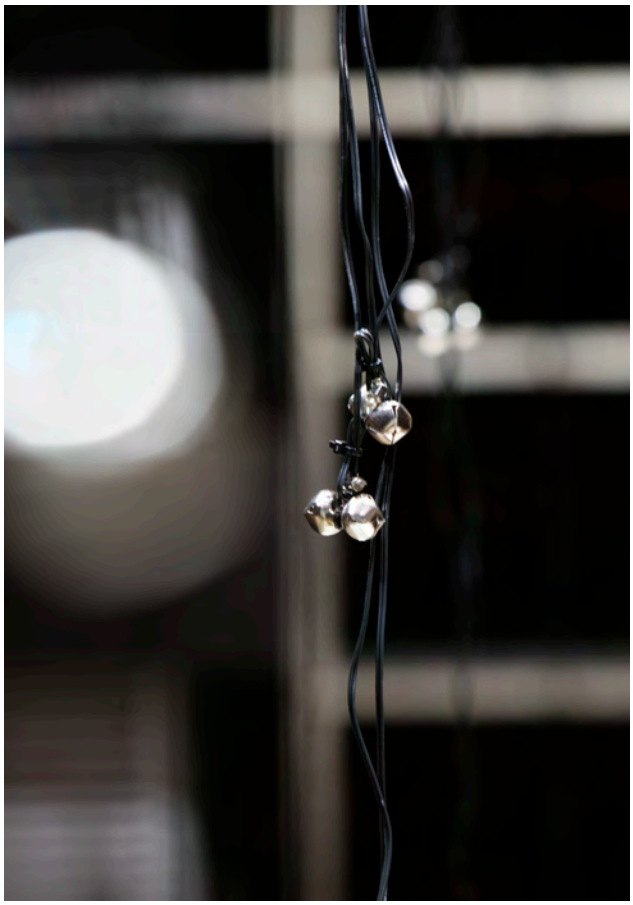


Figure 5. Close-up photograph of a motor-bell assembly hung in the installation space.

Simulation and Rendering The majority of the software was authored in C++ and OpenGL/GLSL, running on a small form factor Intel I7 PC with an Nvidia GTX 1080 Ti GPU. The software renders two graphical views of the same world: one shadow-render at 30 frames per second, 1920x1080 resolution, for the ceiling-mounted projector, and one first-person view at 90 frames per second at 4096x4096 resolution per eye for the VR head mounted display (HMD).

The projected image renders silhouettes of creatures against a white background to simulate the shadows in the installation. This is achieved by a shadow-render pass over a frustum from the gallery floor plane to the projector location above, with distance-dependent intensity and sharpness. That is, creatures' shadows are darker, crisper, and scale-consistent when close to the ground, but much larger, paler, and with softer penumbra when closer to the projector above. With sunlight filtering through the rafters by day, the shadows of the beings become more pronounced by night (see Figure 6).

[1]Using nD::Nodes with support from Professor Mark-David Hosale, from the nD::StudioLab, York University. www.ndstudiolab.com.

Figure 6. Visitors exploring the installation during the daytime (above) and after sunset (below).

The virtual living beings form a multi-agent system of up to four thousand members at a time, with awareness of their environment implemented using vector density fields and hashspace-encoded neighbour queries. These beings, of around 25cm individual length, have varying preferences for joining into multi-cellular superorganisms that take on globular or snake-like undulating forms, sometimes spanning many meters in size; recognizable as living but not in a familiar way. Their behavioural and structural preferences diffuse gradually through populations as morphogens, sometimes differentiating, and sometimes responding to the presence of the human visitors around whom they dance.

VR Perspective For the VR HMD we used an HTC Vive, expanding the effective tracking area to almost the entire room using extension cables and a sync cable between the Vive beacons. In literal contrast to the salt-projection, from the HMD the world appears predominantly black. Creatures are translucent, showing only surface reflections from a virtual light source positioned in the same world-location as the projector (Figures 7 & 9).

Figure 7. Superposed photograph and virtual world. Photograph taken with motion-tracked camera, and virtual image rendered simultaneously from camera's perspective and location, to align the physical and virtual spaces accurately. Although this "mixed" view is never part of the installation experience itself, it may help convey to the reader the nature of the system.

Before installation we performed a photogrammetric capture of the room, registering & fusing a sequence of RGBD captures into a 360-degree spatial cloud (see Figure 8). This cloud forms a barely-visible backdrop to the VR experience, providing a subtle echo to root the virtual space back to the physical. Some additional particles would drift slowly upward, like bubbles, aligned with the locations of dangling bells.

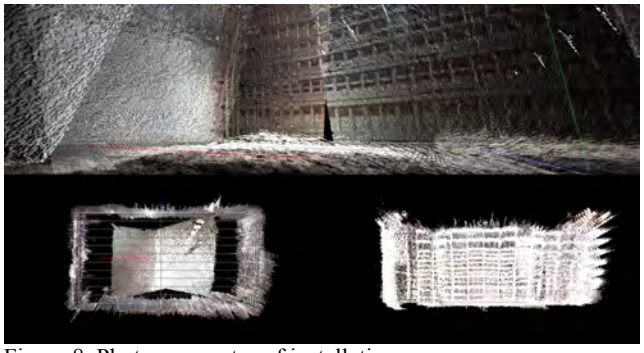


Figure 8. Photogrammetry of installation space.

Shadow-Volumes More importantly, all visitors to the installation also appear in the virtual space, but as solid, opaque shadow-volumes of a pure black void. These shadow-volumes are effectively height maps derived from the depth images captured by two RGB-D cameras mounted above the installation space. The RGB-D cameras were also mounted centrally, very close to the projector, such that the shadow-volumes that visitors cast in the virtual space appear cone-like and aligned to the same location as the projector/light-source.

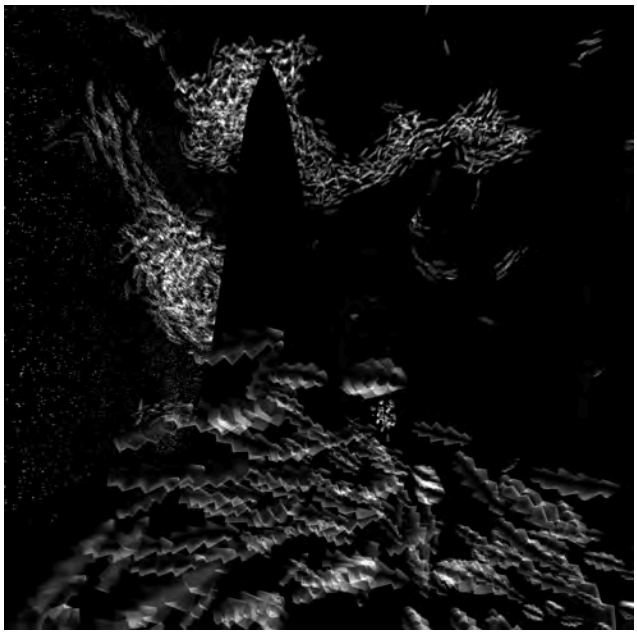


Figure 9. Screen capture of the VR perspective, with a shadow-volume of another visitor occluding some of the undulating aggregates of artificial life beings.

Figure 10. Visitor discovering the virtual shadow-volumes of their own hands.

As shadows, visitors become stripped of all texture and feature, existing only as moving presences whose forms negate vision. That is, the shadow-volumes are rendered black against a black background, and thus primarily perceived by how they occlude the creatures inhabiting the space (see Figure 9), and how they affect the creatures' movements. The visitor wearing the headset thus discovers their own body and hands (see Figure 10), but also discovers the presence of other humans around them. This presence is nevertheless paired with a somewhat eerie sensation of absence; perhaps inversely akin to the feeling of knowing when somebody else is with you in a dark room, one that is simultaneously inhabited by others.

Figure 11. Visitors sharing physical and virtual space.

Discussion and future directions

Throughout this work we were conscious of mixed reality technologies (VR, motion tracking, RGB-D, projection) as *site-specific* methodologies. One of the comments most frequently expressed by visitors concerned how well the installation fit the space, sonically, visually, and thematically. We also noted that although the VR headset was in frequent use, it did not dominate visits to the artwork, with no queues for it even during busy periods.

The artwork follows in an extended research-creation project and series of interactive art installations by the authors, surrounding humans with biologically-inspired complex systems experienced in immersive mixed reality, under the title "Artificial Nature" [11]. The invitation is to become part of an world in superposition to ours that is rich in living feedback networks, but not as its the central subject. The host exhibition concerned itself with a living environment that is increasingly saturated with computational agency, that is also becoming more visually and spatially aware, and in which there is no longer as clear a divide between the perceptions of the body and those of the spirit. Our natural response is an urge to give *life* to mixed reality; to explore how we may coexist with others in ways that are mutually more abundantly curious, playful, and meaningfully rewarding.

The artwork has since been invited to several venues for international exhibition in 2019. For these exhibitions we are deepening this responsive/interactive relationship between the human and the other beings in the space. In

particular we want to bridge the sense of cohabitation with digital beings. We are exploring structural neuroevolution for agents, and aim to combine this with curiosity-driven behaviour through predictive/compression based reward functions. The aim is toward experiences in which visitors sense how they are perceived and related-to by other beings that are clearly and playfully aware of them. In this way we hope to challenge preconceptions that computational systems are in opposition to human and natural systems, while also conceiving how non-anthropocentric and decentralized artificial ecosystems can become more empathetic and conducive to sharing the world.

Acknowledgements

With special thanks to Mark-David Hosale and students of the Digital Media program at York University (Adiola Palmer, Amir Bahador Rostami, Filiz Eryilmaz, and Nicholas Abbruzzese) for invaluable help putting together the microcontroller network and motor-bell assemblies. This research was undertaken as part of the Vision: Science to Applications program, thanks in part to funding from the Canada First Research Excellence Fund.

References

[1] Ji, Haru and Wakefield, Graham. "Endogenous Biologically Inspired Art of Complex Systems." Computer Graphics and Applications 36, no. 1 (January, 2016): 16-21. IEEE Computer Society.
[2] Abbott, Edwin A. Flatland: A romance of many dimensions. OUP Oxford, 2006. (First published 1884).
[3] Sousanis, Nick. Unflattening. Harvard University Press, 2015.
[4] von Chamisso, Adelbert. Peter Schlemihl's Miraculous Story. Camden House, 1993 (First published 1814).
[5] Wakefield, Graham and Ji, Haru. "Becoming-There: Natural Presence in an Art of Artificial Ecologies." In International Symposium on Ubiquitous Virtual Reality (Daejeon, Republic of Korea), 11-14. IEEE Computer Society, July, 2013.
[6] Sugrue, Chris, “Delicate Boundaries (2007)”, Personal website, accessed November 15 2018, http://csugrue.com/delicateboundaries.
[7] Jarman, Ruth and Gerhardt, Joe, “Mini-Epoch Series (2003)”, Semiconductor website, accessed November 15, 2018, http://semiconductorfilms.com/art/mini-epoch-series
[8] U-Ram, Choe. Artist’s website, accessed November 15, 2018, http://www.uram.net
[9] Lee, Yoon Ha. Conservation of Shadows. Gaithersburg, MD: Prime Books, 2013.
[10] Lee, Yoon Ha. Personal website, accessed November 15, 2018, https://www.yoonhalee.com/?p=304
[11] Ji, Haru and Wakefield, Graham. "Biotopes Computationnels (Computational Biotopes)" In Stream 04: Les Paradoxes du vivant (The Paradoxes of the Living), pp. 304-316 Philippe Chiambaretta Architecte, Paris, November 2017.

Author Biographies

Artificial Nature is a research-creation project co-founded by Haru Ji and Graham Wakefield in 2007. **Haru Ji** is a media artist exploring the subject of life in art through artificial life worldmaking. She holds a Ph.D. in Media Arts and Technology from UCSB and is an assistant professor in DPXA & the Digital Futures programs at OCAD University in Toronto, Canada. **Graham Wakefield** is an artist-researcher and software developer exploring the liveness of computational media. As Assistant Professor in Computational Arts and Canada Research Chair in Interactive Visualization he directs the Alice Lab at York University. **Artificial Nature** installations have counted over forty exhibits across nine countries, including festivals such as SIGGRAPH, Microwave Hong Kong, and Digital Art Festival Taipei, conferences such as ISEA, EvoWorkshops, and IEEE VIS, venues including La Gaite Lyrique, ZKM, CAFA Beijing, Seoul City Hall, MOXI and the AlloSphere Santa Barbara, long with selection in the VIDA Art & Artificial Life competition (2015) and the Kaleidoscope Virtual Reality showcase (2017).

Memex in the Mirror

Using Social Media to Visualize Collective Thought in Real-time

Ian Willcock
University of Hertfordshire
Hatfield, United Kingdom
i.willcock@herts.ac.uk

Abstract

The paper discusses the 'What We Think About When We Think About…" project which uses real-time searches of large data sets produced by social media systems to permit the visualization of collective thought in real-time. It begins by briefly exploring the relationship between technology and those who make and use it and suggests that digital technology affects the ways modern humans think, thought-patterns which the examination of social media data can reveal. The operation of the project software is examined in some detail and two areas of application in augmented and virtual realities are discussed.

Keywords

Collective Consciousness
Social Media
Augmented Reality
Big Data
Knowledge systems and thought
Generative Digital Art
Digital Narratives

Introduction

Thoughts, unless communicated, are secret things; private responses to both a 'public' physical world and the people that populate it, and our individual, interior private representations of ourselves and our contexts. The long history of public fascination with 'mind reading'[1] and the many current research efforts in the fields of Neuroscience and Psychology (e.g. Shen et al 2018, Nemrodov et al 2018) which seek to make an individual's thoughts accessible to others are evidence of the cultural importance placed on this interior, mental activity. [1][2] In contrast, the "What We Think About When We Think About…" project takes a different approach, one that is rooted in big data and in real-time analytics to attempt to visualize not the contents of a single individual's thoughts, but rather what we, the summed mass of connected humanity, are thinking.

The 'What We Think About When We Think About…" series is a long-term project which aims to produce public art works which reveal collective thought in real-time in order to enrich audiences' experiences. Strands of aggregated consciousness are displayed on screens or projected onto the world in order to enrich viewers' experiences of their world, to provide a sense of community and shared context for the essentially individual operation of thought. The hidden virtual world of thought is projected into and onto the physical world, augmenting its fabric with echoes of cognitive responses to the world.

The design of the software underpinning each of the installations takes as its starting premise a reversal of the core concept of user-centered design; instead of (digital) systems being crafted to accommodate and support the needs and habits of the user, the project suggests that we can legitimately claim to be able to discover things about users (and especially the mass of users represented through accumulated big data) by interrogating the tools and systems they use and then present those findings to audiences.

The project achieves this by performing multiple searches of mass social media systems to reveal statistically frequent habits of thought and, from this data, constructs branching, expanding narratives; streams of (mass) consciousness that unfold in real-time revealing the banality, fragility and poetry of contemporary human thought. At the same time, the transient, repetitive (even obsessive) concentration on the topic that forms the theme of a given instantiation of the project also reveal something about the ways collective thought and, by implication, our individual patterns of cognition, are shaped by the technology we use.

[1] Indeed it has been suggested (e.g. Goldman 2006, Young 2011) that being able to represent the mental state of others ('Mentalizing'), is a key reason for our brains being the size they are and an essential differentiation between humans and other animals. [3][4]

Technology and its Users

From the first emergence(s) of tool making, there has been a recognition that there is a relationship between, on the one hand, the form and processes of production and use and, on the other, the materiality of the (evolving) human body and the patterns and extent of human thought (Ambrose 2001, Isaac 1986). [5][6] Further, there is acceptance that this relationship operates in both directions; the form and features of tools and technology are influenced by the bodily characteristics and culture which produces them, while simultaneously their users (and the communities made up of those users) are altered through that use. In the past, this effect has typically been subtle, operating in a feedback loop mediated by evolution which has meant that changes in technology (e.g. the use of fire for cooking, the herding of milk-producing animals etc.) were inscribed on the human form through selective processes operating on DNA. In more recent times, the pace of technological development has meant that the effects may be expressed more in terms of culture, behavior or habits of cognition than in changes to the body. Whatever the differences in the specific expressions of alteration, Boulter maintains that,

> "Each technology, if not each single invention, remakes the men who invent or possess it by altering their most elemental capacity – that of surviving in the world…" [7]

If the fact of an effect of technology on humanity is accepted, the overall benefits of these changes are increasingly contested. Whilst the current paper cannot explore this opposition in detail, its essence can be summarized by looking at the views of key theorists from both sides. Marshall McLuhan followed an essentially modernist tradition, conceiving technology as an essentially enabling, even liberating, extension of the human body which has been continually and incrementally improved over time in a grand narrative of progress:

> "Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, …we approach the final phase of the extensions of man - the technological simulation of consciousness, when the creative process will be collectively and corporately extended to the whole of human society" [8]

However, there is another view that cannot be ignored when exploring the contexts of a body of work which has technology at its core. For Foucault, technology was not a neutral tool providing opportunities for artists, but a system for exercising power and control; a set of constraints which necessarily encoded ways of thinking and acting congruent with the controlling power. As Behernt summarizes in 'Foucault and Technology',

> "…technology is the essence of power in its most insidious forms – discipline as that which not only regiments and normalizes the body, pervading it so deeply that it creates, as an instrument of its power, the very facet of ourselves that we are inclined to consider most our own and the least tainted by domination – our self." [9]

The design of technological systems is necessarily influenced by the patterns of activity and capability of the human organism, the physical and mental modes of activity and operation with which we sense and affect the world[2]. Taking this premise as a starting point, the 'What We Think about When We Think About…' project seeks to reverse this relationship and, by examining the products of mass, digital activity, to discover something about the thinking of mass human community about a specific subject area. This approach is not novel, talking about the emergence of modern humans and early stone cutting tools, Issacs offers the insight that, "…we have been using archaeology and early evidence as a mirror by which to obtain more or less familiar visions of ourselves." [10]

Digital Media and Mass Thought

Media technology has been explicitly related to human thought processes since before media became digital. Vanavar Bush proposed the *Memex*, an associative connection aid for stored knowledge designed to enhance human thought in 1945. [11] Alan Turing in his 1950 paper, Computing Machinery and Intelligence, explored the nature of, and differences between, the algorithmic processes underlying computer operation and those of human cognition. [12] In the paper, he postulated that the two might become increasingly difficult to tell apart, presenting the well-known Turing Test as a way to distinguish the human from the computer. Both of these core texts are joined by much subsequent work in assuming (often implicitly) that there is an underlying structural relationship between the operation of digital computation and human thought; one could characterize continuing debates as being between views of this relationship as being one of prosthetic accommodation or (increasingly close) mimicry.

Human thought processes are (obviously) highly complex and have been represented in a large number of often complex models based on a range of approaches (e.g. stimulus-response, connectionist, multiple faculty-based, social agent-based etc.). [13][14][15] Two features however are very widely shared between accounts of human cognition; a mechanism to deal with decoding and responding appropriately to external stimuli, and a way for experience of the world to be collected and related to previous experiences

[2] This relationship between the human the machine persists whether one takes a McLuhanesque view of the potential effects of technology on humanity or the darker vision of Foucault. The adaption of technology to 'fit' is necessary for either liberation or control.

(learnt) to form a dynamic associative model. Since digital tools can be seen to have a relationship to the human thought processes providing their inputs and informing their structures, the current work seeks to make the two essential features of human thought, responses to stimuli and associative connections, visible through operations on the mass of real-time data produced by social media and search systems.

Responses and associations in social media data

Two separate sets of data are used in the current project to obtain dynamic material reflecting the two key aspects of human cognition. Each data set is continually updated by the organization which supplies the systems which generate the data; Twitter and Google. The interrogation of these datasets is in real-time via publicly available network APIs (Application Programming Interfaces), an approach to using data in creative AR activity which has become increasingly significant in recent years. [16] This approach provides the project with two appropriate data sets; the Twitter search provides a sample of the most recent responses to a stimulus while the Google continuations data set provides access to summed human cognitive activity focusing on associative connections between items.

Real-time stimulus-response data is obtained using the online Twitter search API through a keyword search operating on recent tweets[3] to find text fragments incorporating a given term (Fig. 1).

Figure 1 Twitter Search component based on 'goodness'

The search term used in a particular project instantiation is chosen to reflect the context or theme of the event (see below). During testing, seed search terms have included, 'goodness', 'freedom', and 'open'; results seem to be best (which here means richer and more varied) when a conceptually powerful phrase is used rather than something specific. The current implementation requests the ten most recent tweets and then randomly selects one of these to form the seed phrase to initiate the generation of the proliferating tree structure which is the visualization of summed associative processes.

Once a seed phrase has been selected from the results of the twitter search, the installation begins to iteratively build and display stands of summed thoughts. It does this by using Google's (unofficial) search auto-complete API to obtain the currently most popular associative continuations for a short text fragment (Fig. 2). [17]

[3] The Twitter search API has a limit of 7 days; only tweets within this period are available for searching. See: https://dev.twitter.com/rest/reference/get/search/tweets for details.

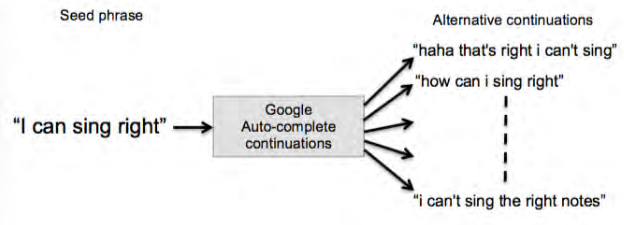


Figure 2 – Google auto-complete continuation component

The results from each call are filtered to remove obvious media requests such as 'DVD', 'jpg', 'mp3' etc. and to remove word duplications. Results are then weighted in favor of multiple word extensions (so that the resultant strands of visualized thought avoid, as far as possible, becoming a string of single words).

Visualization – Narratives of Thought

The Twitter search and auto-complete continuation components are incorporated in an iterative generative system which produces an emerging series of bifurcating text-based narratives which set out to reveal moment by moment, the changing dominant patterns of stimulus-response and conceptual connectivity of the digital collective (Fig. 3).

Figure 3 – Initial fragment of collective thought visualization (Image - the author)

Figure 4 – Collective thought visualization showing branching structure (Image - the author)

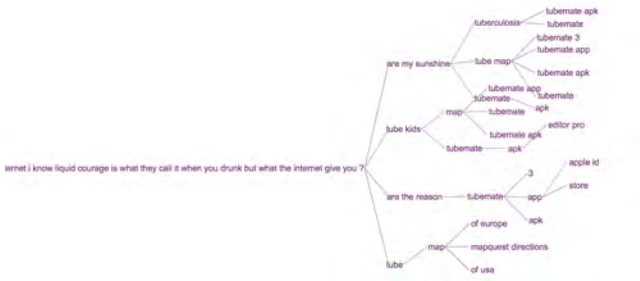


Figure 5 – Collective thought visualization with multiple branch points (Image - the author)

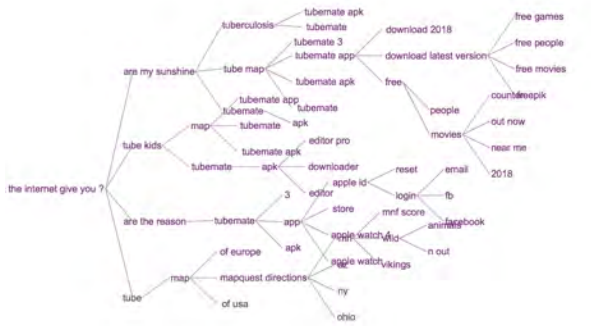


Figure 6 – Collective thought visualization with multiple branch points producing a dense narrative structure. The whole structure is scrolling left so that new branchpoints are visible. (Image - the author)

The overall management of the visualizations (see Figs. 4, 5 and 6) attempts to mirror the pattern of human thinking – particularly that associated with dwelling or focusing on a subject is a slightly obsessive way. The project runs for a while following 'thoughts' from the initial twitter phrase, allowing them to proliferate, associate and expand; streams of collective consciousness. The visualization then restarts, based on a new twitter search from the same key word. Filtering and branch-culling functions maintain basic sense (although at the expense of richness, see below) and a manageable number of alternative parallel strands although the density of results changes rapidly; a seed phrase may result in a long-lived, highly extensible and dense structure at one time and then produce a feeble set of results which rapidly dwindle at a later point. The advantage of the 'train of thought' mode is that the project produces a set of narrative threads with the viewer being shown the developing fringes of the thought construct. The disadvantage however, is that the visual display loses the sense of accretion, of a construct which continually references its own growing complexity and density. To counter this, an alternative, 'end-on' view is possible; a collection where the evolving parallel stands of thought emerge towards the viewer with their preceding elements gradually receding, yet still providing a visualization of the complexity and range of the cluster of thoughts. The advantage of this approach are both the sharply increased level of detail and the demonstration of the non-linear aspects of thought processes through the presentation and superimposition of results that are increasingly divergent from the initial starting point.

To ensure interest for viewers, the system monitors the overall level of activity, ensures the active region of the narrative tree is visible and restarts the visualization process if all branches have finished propagating or if a significant amount of time has elapsed (when continuations can become repetitive).

Application: Augmenting Reality

The initial creative challenge posed is how can one approach the model of operation of more conventional augmented reality systems and overlay or integrate with the physical world employing a real-time visualization of the world of thought? If a walk through a city can be made more vivid and satisfying by adding information about the buildings and locations one encounters, how can an awareness of how the wider digital community is thinking be made to improve engagement with, and understanding of, the physical reality we inhabit?

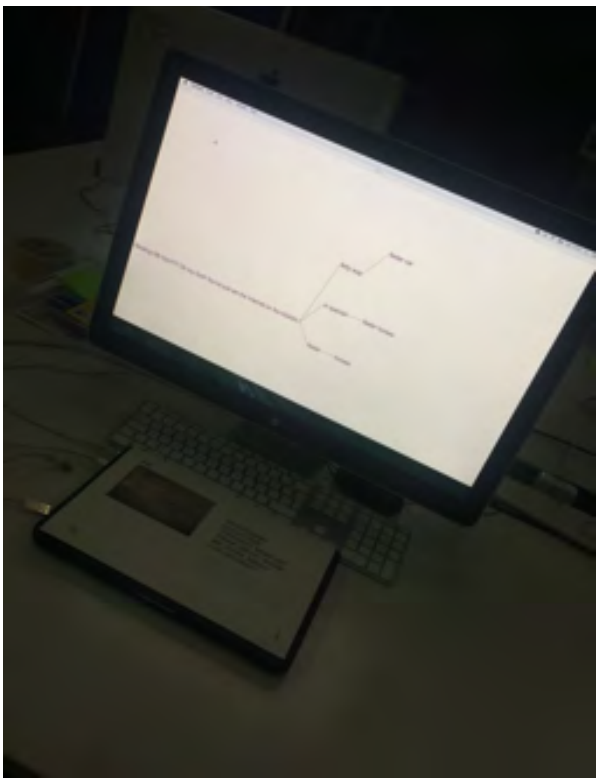


Figure 7 – Installation of project at Mozfest 2016, London (Image - the author)

The first full instantiation of the project was in MozEx, a featured exhibition space at MozFest 2016 in London on October 28th, 2016. [18] The exhibition was a collaboration between Mozilla Festival, Tate Exchange and the V&A and

was curated by Luca Damiani and Irini Papadimitriou. Set within "The world's leading festival for the open internet" movement", the project was presented as a stand-alone, screen-based installation (Fig. 7).
The intention was to provide a real-time collective commentary on the surrounding (mainly practical) internet-centered activity.

At Mozfest in October 2016, the project was titled "What We Think About When We Think About the Internet' and the twitter search term, used to initiate the seeding searches, was 'internet'. This was a useful term as it produced a satisfyingly wide range of responses from the utilitarian and prosaic through to wry musings on the cultural value and social purpose of networked media (see Fig. 8).

How To Back Up And Sync Your Mobile Phone Data On Internet
Broke the internet???? There are twitter accounts that are literally pictures of dogs wearing glasses with more
When even your app's UI depends on an Internet connection
This is the true purpose of the internet

Figure 8 - A sample of found Twitter phrases based on a search for 'internet'

In future iterations of the project, the plan is to integrate the display of information with the material world on a much larger scale so that instead of being screen-based, the strands of visualized collective thought will be projected upon artefacts, spaces and buildings, particularly those associated with knowledge – maps, libraries and lecture halls. The scale of this approach has the added advantage that the nature of the experience of the project changes from the essentially individual one of encounters with screen-based work to something that is more collective, a mode that is perhaps a more appropriate context for exploring what is a collective phenomenon.

Application: Real in Virtual

Initial realizations of the project concentrated on augmentation of the physical world through overlaid or adjacent cognitive information, but the latest strand of the project has switched this relationship around to begin to explore the injection of real-time tracings of collective consciousness into virtual worlds. One of the key characteristics of most current immersive VR experiences is their (currently) separation from the real world. [19] This is partly the highly intrusive and isolating nature of the physical hardware required (wrap-around headset, headphones, perhaps a tether to a host computer) and also perhaps a recognition that the medium's affordances for transcendence, for placing the user in settings which are *not* those of everyday lived reality, are too powerful and tempting for most creatives not to explore[4]. This removal of social context has its dangers however, it can limit the capacity for such works to be meaningful, to have resonances for the user that persist and transfer from the immediate 'in world' encounter to wider experiences of the world. While not all experiences and not all art has to be meaningful, it would be a significant loss if creatives were unable to share Jesse Schell's related ambition for games - 'The Lens of Resonance'. [21] One way to supply reference or connection to the external world might be to reproduce the themed streams of mass consciousness 'in world', to provide an augmentation of virtual objects within a virtual experience using real-time cognitive data. The software underpinning the project is currently being rewritten in C# to provide this functionality.

Conclusion

On one level, the 'What We Think About When We Think About…' project simply uses an algorithmic iterative cycle to reveal the current characteristics of an averaged set of thought patterns (adopting a superficially similar methodology to that used to create averaged visual portraits and other median characteristics from large sets of image material[5]). However, because the data is semantic and the summing operations are non-destructive ('visualization without reduction' in Manovitch's phrase), both the overall patterns and individual cognitive components can be seen and interrogated – one can discern both the pattern and the detail in a way that is not possible with visual (or audio) averaging. [21] Further, those problems of significance (what does it *mean* that selfie images from a certain geographical area tend to adopt a given pose) are largely avoided because both the patterns of consciousness and the individual thought-items from which they are constructed refer (at least partly) to external objects; this is 'thinking about' rather than just thinking. [22] It is also not Lévy's 'Collective Intelligence', a meta-cognitive construct of potential which through connectivity and community surpasses the limitations of individual capacities (and hence empowering all), or a Jungian collective unconscious where symbolism and meaning are resolved down to a shared set of significations, but is a statistically generated reflection of collective thought activity; the ways humans are thinking about a given theme at any given instant. [23] Because of the ways the data is visualized and presented and the deliberate association of given instantiations of the project with specific themes (for example, the Internet at MozFest), it manages to convey, not just some of the patterns of mass human cognitive behavior (the obsessive returning to starting points, the distractions of associations nudging focus away from initial ideas) but also, through the rich comingling of the prosaic and the anxiety-revealing within activity that is essentially complex and dynamic, something about the conflicted emotional state(s) of connected humanity as we stare together into the uncertain future.

[4] This is not to say that such work as not been done at all, or that it is unsuccessful, combinations of AR and VR such as *Whist* (2017) show satisfying approaches to producing hybrid experiences. [20]

[5] For example the recent work of Lev Manovitch and his team – see http://selfiecity.net/

References

[1] Shen, G., Dwivedi, K., Majima, K., Horikawa, T. & Kamitani, Y. (2018) *End-to-End Deep Image Reconstruction from Human Brain Activity*. bioRxiv, February, 272518.
[2] Nemrodov, D., Niemeier, M., Patel, A. & Nestor, A. (2018) *The Neural Dynamics of Facial Identity Processing: Insights from EEG-Based Pattern Analysis and Image Reconstruction*. eNeuro, January, ENEURO.0358-17.2018.
[3] Goldman, A. I. (2006) *Simulating Minds: The Philosophy, Psychology, and Neuroscience of Mindreading*. Oxford University Press, USA.
[4] Young, A. (2011) "Self, Brain, Microbe, and the Vanishing Commissar". *Science, Technology, & Human Values*, 36 (5) September, pp. 638–661.
[5] S. H. Ambrose, (2001) 'Paleolithic Technology and Human Evolution'. *Science,* 291 (5509) March, pp. 1748–1753.
[6] G. Isaac, 'Foundation Stones: Early Artefacts as Indicators of Activities and Abilities'. In *Stone Age Prehistory: Studies in Memory of Charles McBurney*, (Cambridge: Cambridge University Press, 1986). 221–42.
[7] J.David Bolter. *Turing's Man: Western Culture in the Computer Age.* (The University of North Carolina Press, 1984). 211
[8] Marshall McLuhan. *Understanding Media: The Extensions of Man*. New edition. (Cambridge, Mass: MIT Press, 1994). 19
[9] Michael C. Behrent, 'Foucault and Technology'. *History and Technology* 29, no. 1 (1 March 2013): 87. doi:10.1080/07341512.2013.780351.
[10] G. Isaac, 'Foundation Stones: Early Artefacts as Indicators of Activities and Abilities' 237
[11] Vannevar. Bush 1945. 'As We May Think'. *The Atlantic Monthly*, July.
[12] Alan Turing. 1950. 'Computing Machinery and Intelligence'. *Mind* 49 (236): 433–60.
[13] John R Anderson,. *The Architecture of Cognition*. Psychology Press, 1983.
[14] Noam Chomsky. *Rules and Representations*: Columbia Classics Edition. Columbia University Press, 1980.
[15] Leonides A. A Doumas and John E. Hummel. 'Approaches to Modeling Human Mental Representations: What Works, What Doesn't, and Why'. In *The Cambridge Handbook of Thinking and Reasoning*. (New York: Cambridge University Press 2005). 73-94
[16] Conor McGarrigle. 'Augmented Resistance: The Possibilities for AR and Data Driven Art + Interview, Statement, Artwork'. *Leonardo Electronic Almanac* 19, no. 1 (15 January 2013). http://ojs.gold.ac.uk/index.php/lea/article/view/113.
[17] Shreyas Chand. 'Google Autocomplete "API"', 3 January 2013. Website last accessed 18/12/19. https://shreyaschand.com/blog/2013/01/03/google-autocomplete-api/.
[18] 'Mozilla Festival'. Accessed 30 January 2017. https://mozillafestival.org.
[19] Helena Van Kerrebroeck, , Malaika Brengman, and Kim Willems. 'Escaping the Crowd: An Experimental Study on the Impact of a Virtual Reality Experience in a Shopping Mall'. *Computers in Human Behavior* 77 (1 December 2017): 437–50. https://doi.org/10.1016/j.chb.2017.07.019.
[20] *Whist.* AΦE. (Performance/Exhibition 2017) see http://www.aoiesteban.com/home/.
[21] Jesse Schell,. The Art of Game Design: A Book of Lenses: Second Edition. (Boca Ration: CRC Press, 2015). 66
[22] Manovich, Lev. 'What Is Visualisation?' Visual Studies 26, no. 1 (15 March 2011): 41 https://doi.org/10.1080/1472586X.2011.548488.
[23] Helen Caple. 'Analysing the Multimodal Text'. In *Corpus Approaches to Discourse: A Critical Review*. (New York: Routledge, 2018).
[24] Pierre Lévy. *Collective Intelligence. Mankind's Emerging World in Cyberspace*. (Cambridge, Massachusetts: Perseus books 1999).

Author Biography

Ian Willcock is a digital artist, researcher and lecturer in interactive media and live performance, and leads the taught postgraduate provision in the School of Creative Arts at the University of Hertfordshire.

His musical, multimedia and digital-performance pieces have been presented internationally and he has received many prizes and scholarships. Several of his pieces are published and his work is available on commercial recordings. He has collaborated on a number of large-scale digital performance and mixed-media installation projects and in 2012, completed his doctorate in Multimedia and Live Performance at De Montfort University. His research interests include immersive experience design, contemporary creative digital practice and media production methodologies.

Mediating Exhibitions via Audience Participation on Social Media: Collectivist and Individualist Curatorial Approaches in One World Exposition 2 Exhibitions

Kyle Chung
School of Creative Media, City University of Hong Kong
Hong Kong, China
kyle.chung@my.cityu.edu.hk

Abstract

The integration of social media into daily life is one of the most distinct demographic features of younger generations, especially among Generation Z (born between 1996 and 2015). For museums and other cultural institutions to engage with this audience group efficiently, their exhibitions have to take social media into the consideration of mediating strategies. This study aims to address the challenges and opportunities of such practice, by analysing and assessing the effectiveness of two different curatorial approaches to mediate exhibition context via audience participation on social media, namely the Collectivist and Individualist approaches. Purposefully curated in the respective curatorial approaches, two major media art exhibitions in the series *One World Exposition 2* in Hong Kong (2017-18) were analysed using the Engagement Process identified by E. A. Edmonds, L. Muller and M. Connell [3] with stages including Attractor, Sustainer and Relator. Through observation, focus group and data extracted on social media, the effort of the Collectivist curatorial strategies to intentionally manipulate audience behaviour showed generally better result in activating audience participation on social media. While recognising its limitations including the different institutions' positions and motivation towards social media, this study raises critical implications such as the influence of social media celebrities, social media posts as audience's interpretations and the concern of curatorial strategies overshadowing the artwork.

Keywords

Curatorship, Social Media, Generation Z, Media Art, Audience Participation, Engagement, Museum Studies, Arts Management, Audience Behaviour

Introduction

Since the early 20th century, reaching a wider audience has been one of the core missions for most major museums. With the rise of Generation Z (born between 1996 and 2015) [5] [6] and their unprecedented dependence on social media since childhood [6] [13], the curatorial strategies to mediate exhibition context require significant changes to accommodate younger generations. To address the generational shifts, this study analyses the effectiveness of the curatorial approaches to mediate exhibition context via audience participation on social media, in two exhibitions in the series *One World Exposition 2* in Hong Kong (2017-18).

One World Exposition 2 (OWE2) is a two-part exhibition series, organised by Videotage, a non-profit media art organisation in Hong Kong, co-curated by Isaac Leung (Chairman, Videotage) and Kyle Chung (Curator, Videotage). The exhibitions showcased media art by Hong Kong and Mainland Chinese artists born after 1980, featuring Chen Tianzhuo (CN), Chen Wei (CN), Double Fly Art Center (CN), Hu Weiyi (CN), Lu Yang (CN), Sun Xun (CN), Carla Chan (HK), Chris Cheung (h0nh1m)/XCEED (HK), Tang Kwok Hin (HK) and Morgan Wong (HK). With the same selection of artists, the first exhibition in 2017 comprised all existing artworks responding to 'social media culture' as the unifying theme; the second exhibition in 2018 showcased all newly commissioned artworks by individual artists/ artist group based on the reflection of their own artistic practice since the first exhibition. In response to the setup of the series, the two exhibitions were curated in two distinct curatorial approaches, the Collectivist approach and the Individualist approach. This study describes and analyses the mediating processes of both exhibitions in the respective approaches, using the Engagement Process identified by E. A. Edmonds, L. Muller and M. Connell [3] with stages including Attractor, Sustainer and Relator. The effectiveness of each approach to mediate exhibition context via audience participation on social media is assessed through on-site observation, focus group as well as social media posts and statistics, such as tags, geotags, etc. Discussing the success and limitations of both curatorial approaches, this study demonstrates the power structure of social media in relation to audience participation in physical exhibitions, the depth of engagement and other contributing factors among the exhibitions' stakeholders, such as artist's interpretation and institution's intention towards social media.

Methods

Given the aforementioned setup of the OWE2 exhibition series, two exhibitions were curated in the Collectivist and Individualist approaches respectively, in order to test their effectiveness in mediating exhibition context via audience participation on social media. The Collectivist curatorial approach, as concluded by M. Lind [12], "was inspired by the Russian Revolution and by Einstein's theory of

relativity. It encouraged a varied and active experience through dynamic exhibition design, where things looked different from different angles, while simultaneously emphasizing the totality of the installation." (Ibid, p.87) Aiming to deliver a shared experience in the exhibition, the Collectivist curatorial approach focuses on the collective encounters with art. This is notably different from the Individualist curatorial approach, instigated by Alfred Barr, Founding Director of Museum of Modern Art in New York in 1930s. With paintings hung low on the white walls, Barr's formalist view of art encourages personal relationship with the artwork, by refining the audience's artistic awareness [8]. Along with this heightened sense of individuality, this curatorial approach promotes integrated didacticism in display strategies, focusing on the artwork itself to deliver exhibition context based on the visual entity and spatial sensibility rather than discursive subject matter [12].

The effectiveness of the curatorial approaches is described and analysed using the Engagement Process identified by E. A. Edmonds, L. Muller and M. Connell [3]. Based on the study on visitor behavior and usage models within the museum space by A. Bollo and L. Dal Pozzolo [1], this Engagement Process includes three stages. The first one is Attractors, which are attributes that encourage the audience to start the experience. They possess, as Bollo and Pozzolo call it, "attraction power", aiming to grab people's attention among other distractions in a public space (Ibid). The second stage in this Engagement Process is Sustainers. They are features that hold the audience engaged throughout the process [3]. They carry "holding power" to sustain the audience's interest, generating exhibition hotspots where the audience stays and interacts with the exhibition [1]. The last one is Relaters, which are factors that extend the growth of relationship between the exhibition and the audience to after the experience. They aid a continuing experience as long-term audience engagement [3].

To assess the effectiveness of the curatorial approaches in mediating exhibition context via audience participation on social media, three methods were used for evaluation, including observation, focus group and social media posts and statistics. Extensively used by museologists such as E. S. Robinson on museum visitor behaviour [16] and B. I. Gilman on "museum fatigue" [4], observation as a research method was used to collect qualitative data, where the researcher does not appear to be an observer from the audience's perspective [23]. While acknowledging the potential bias, emotions and thoughts the researcher might experience that could influence the results, qualitative data from on-site observation was recorded through descriptive field notes, reflective memos and detailed journaling [20] [23]. This is particularly useful for empirical studies on museum audience behaviour and interactions between the audience and the exhibition, since valuable insights into the on-site experience can be generated as the researcher puts themselves in the same time and space (Ibid). Also, focus group was conducted to cross-reference the interpretations and analysis of the facts and observational data. After the exhibition experience, six visitors were invited to participate in semi-structured focus group discussions, as a comprehensive way of learning the audience experience and analysing the resulting implications [1] [23]. In addition to observations and focus group, the primary materials to evaluate the Relator stage in the Engagement Process [3] are the social media posts and statistics. The audience response to the exhibitions on social media directly reflects the level of effectiveness of mediating exhibition context via audience participation on social media. Trends and patterns were analysed and identified, in order to draw implications on the factors that trigger audience's input on social media, as well as the ways in which the audience interprets and displays exhibition context via social media.

Analysis and Results

First Exhibition - One World Exposition 2.1: #like4like

The exhibition curated in the Collectivist approach was *One World Exposition 2.1: #like4like*, co-organised by Videotage and K11 Hong Kong, in chi K11 art space (21 March – 21 May 2017) (Fig. 1).

Fig. 1 One World Exposition 2.1: #like4like

As an Attractor element in the Collectivist approach, this exhibition was designed to present the vision of being an attention-seeking entity. Instead of a conventional white cube display environment, the exhibition design was heavily decorated with bold, sharp, fluorescent colours in order to deliver a controlled environment, which aimed to be a captivating psychedelic experience (Fig. 2).

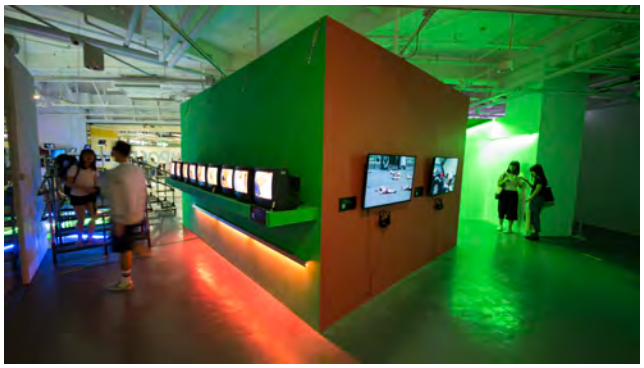


Fig. 2 Dynamic exhibition design in One World Exposition 2.1: #like4like

Another Attractor element was the strategic positioning of the eye-catching artworks. For instance, the fluorescent green neon light artwork *Unprecedented Freedom* (2016) by Chen Wei was positioned in front of the big windows facing one of the busiest subway stations in Hong Kong (Fig. 3), as a tactic of "street marketing" to draw attention from general public [11]. Also, the platform and the windows create a distance from the artwork (Fig. 3 & 4), suggesting a different perspective and experience than just looking from outside, as another way to drive people into the exhibition.

Fig. 3 Unprecedented Freedom (2016) by Chen Wei

Fig. 4 Platforms integrated in exhibition design for the sculpture; YOGAMAYA (2016) by Chen Tianzhuo

As an Attractor element specifically targeting to encourage photo taking as an interactive experience, the exhibition was branded as a selfie-friendly social environment. There were "selfie point" signage throughout the exhibition to encourage the audience to take selfies (Fig. 5). This selfie-taking behaviour yielded a by-product of the exhibition, the photo image, that served as triggering materials for potential online distribution on social media (Fig. 6) [2] [7] [10] [21].

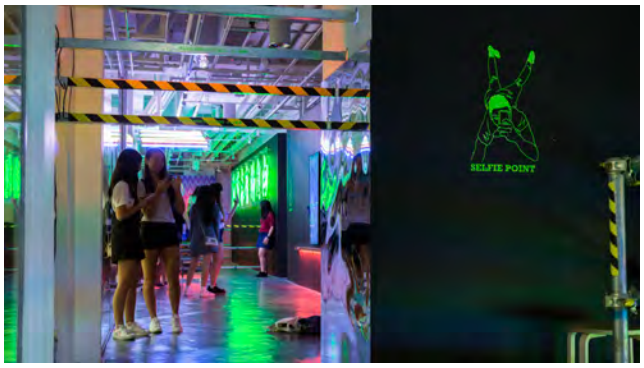


Fig. 5 Selfie point signage

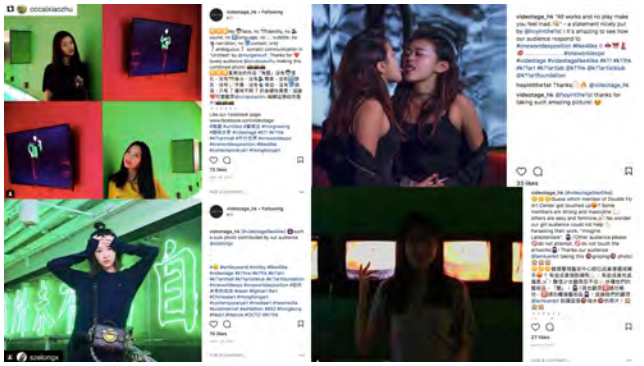


Fig. 6 Instagram posts about OWE2.1 [2] [7] [10] [21]

At the Sustainer stage, the primary effort was made through the exhibited artworks. To easily sustain the audience's interests, especially for the non-exhibition goers, one of the criteria for artwork selection was bold, edgy visual and artistic context. The video work *PICNIC* (2014) by Chen Tianzhou was an obvious choice, which depicts the worship dance for a fictional androgynous god (Fig. 7). Another example was the 5-channel video work, *One day perhaps there's discovery of that unbeauty* (2013) by Tang Kwok Hin (Fig. 8). It was an artwork based on the artist's intimate self-reflection on time and boredom, with video content such as melting wax on a palm, self-harm to bleed, vomiting, etc. Existing in this collection of artworks, the exhibition adds another layer of context to the artwork that portrays the sinister aspects of the visual. These worked in line with the curatorial vision to present the exhibition itself as an "attention-seeking" entity, and strengthened the totality of the exhibition experience in the Collectivist approach as a Sustainer element.

Fig. 7 *PICNIC* (2014) by Chen Tianzhuo, screenshot (image courtesy of the artist)

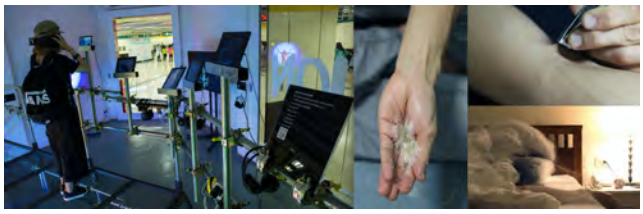


Fig. 8 *One day perhaps there's discovery of that unbeauty* (2014) by Tang Kwok Hin, installation shot (left), screenshots (right) (image courtesy of the artist)

Fig. 9 Peephole installation (outside)

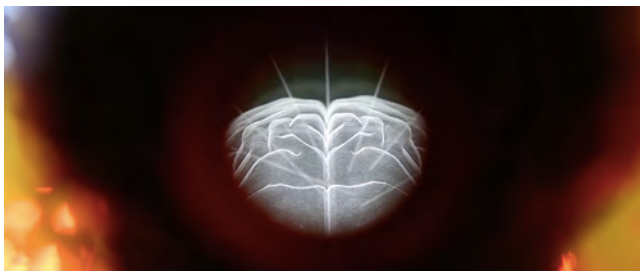


Fig. 10 Peephole installation (inside)

Also, a peephole installation was created for the crystal sculptures *Hearse Delusional Mandala* (2015) by Lu Yang to seduce the audience to walk up for a look (Fig. 9 & 10). This not only aimed to sustain the audience's interest by enabling the interaction performed by the audience to discover the artworks in the mysterious boxes. This also streamlined the audience's visual perspective towards the artworks, creating the active but shared collective encounters with the artworks.

As another Sustainer element, the exhibition route was restricted into a single path, along with strategic positioning of artworks, to guide the audience through as a controlled mechanism (Fig. 11). Particularly so, a long corridor was created from one end of the exhibition space to another, in order to showcase artworks that were in linear form in a linear space. One instance was the 9 metre long neon light artwork *Unprecedented Freedom* (2016) by Chen Wei, hung higher up on the wall for the audience to view when they had to make the effort to walk up and along the platform (Fig. 3) Another instance was the 5-channel video installation *The Melting Black* (2016) by Carla Chan (Fig. 12), displaying a large-scaled synced video of a digitally manipulated and distorted scenery of sea waves across the corridor.

Fig. 12 *The Melting Black* (2016) by Carla Chan

At the Relator stage, the exhibition reviews after the exhibition experience indicated sufficient engagement to catch media attention, especially among art professionals, such as The Standard [24], Art Radar [22], etc. However, these types of response were the work of the art scene's insiders. Specifically in relation to the conscious effort in

Fig. 11 Long corridor across the exhibition space. *Unprecedented Freedom* (2016) by Chen Wei (left), *The Melting Black* (2016) by Carla Chan (right)

the Collectivist curatorial strategies to guide the controlled manner of engagement, social media entries by the general public played a major role in the Engagement process [3]. For instance, during the 8 week exhibition period, there were over 5,000 posts on Instagram by the audience with geotags and hashtags generated for this exhibition (Fig. 13) [14]. Also, it's worth noting the variety of social media entries. The audience reacted differently to different artworks via social media posts, for instance there were serious images with the video work *Delusional Mandala, Delusional Crime and Punishment* (2015) by Lu Yang (Fig. 14) [18] and humorous images with the sculpture *YOGAMAYA* (2016) by Chen Tianzhuo (Fig. 15) [17]. Other than the images, the text captions on social media can be considered as content production and interpretation activated and driven by the context of the artworks, regardless of the original interpretations by the artists and curators. Some of the social media posts by the audience attached paragraphs of captions, for instance the Instagram post shown in Fig. 16 [9] responded to the artwork *Unprecedented Freedom* (2016) by Chen Wei with 483 Chinese words of caption about the ephemeral aspect of love and relationships, while Chen Wei's interpretation focuses on the embedded political implications of the artwork he recreated from the same neon light sign in a dance club in China; and, the curators' interpretation is to put the artist's original idea forward and ask what "unprecedented freedom" means to Hong Kong in the postcolonial context.

Fig. 13 Instagram posts tagged for the exhibition [14]

Fig. 14 Serious Instagram post [18]

Fig. 15 Humorous Instagram post [17]

Fig. 16 Instagram post with a caption about reflective interpretation towards an artwork [9]

Second Exhibition - One World Exposition 2.2: #YOU #ME #ourSELFIES

The exhibition curated in the Individualist approach was *One World Exposition 2.2: #YOU #ME #ourSELFIES*, co-organised by Videotage and Hong Kong Visual Arts Centre (vA!), Leisure and Cultural Services Department, Hong Kong Government. It was hosted in vA! (7 – 22 January 2018) (Fig. 17).

Fig. 17 One World Exposition 2.2: #YOU #ME #ourSELFIES (Entrance)

At the Attractor stage in the Engagement process [3], the OWE2.2 exhibition took Alfred Barr's view in advocating for personal relationship with the artworks [8], encouraging more democratic perspectives towards the artworks from the audience. The overall exhibition design provides the audience a white-cube environment (Fig. 18). Also, the exhibition route was open-ended with the artworks scattered throughout the Visual Arts Centre, within and outside of the exhibition space. The audience was free to view the artworks in any particular order. For instance, consisting of a three-channel video installation and an on-going live contemporary dance performance, *Our Feet Are Always Younger Than Our Heads* (2018) by Morgan Wong was located in the lecture theatre in the Visual Arts Centre (Fig. 19), fully utilising the stage as well as the seating area to accommodate different components of the artwork. Another example was that the 3D stop motion animation video work *Time Spy* (2016) by Sun Xun, was positioned outside of the building as an outdoor screening projection installation (Fig. 20).

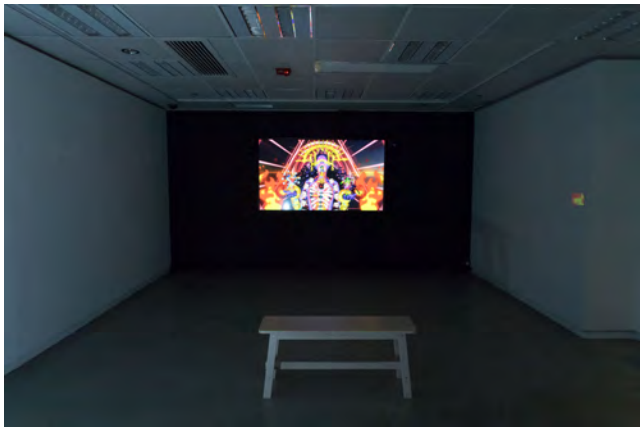


Fig. 18 White cube environment. *Electromagnetic Brainology* (2017) by Lu Yang

Fig. 19 *Our Feet Are Always Younger Than Our Heads* (2018) by Morgan Wong

Fig. 20 *Time Spy* (2016) by Sun Xun

As another Attractor element, the video work with large scale LED light panel, *Trouble (New World)* (2018) by Chen Wei, was positioned at the entrance of the Visual Arts Centre (Fig. 21), since it was an eye-catching artwork to draw attention from general public. More importantly, the context of the artwork, which mimicked an advertisement of an immigration consultant agency in response to the immigration issue from Mainland China to Hong Kong, acted as a welcome address to the audience at the beginning of the exhibition experience.

Fig. 21 *Trouble (New World)* (2018) by Chen Wei

At the Sustainer stage, the OWE2.2 exhibition in the Individualist approach also relied on strategic positioning of the artworks themselves to sustain the audience's interests. The audience was primarily guided through the exhibition by the artworks themselves. For instance, immediately after pushing through the door into the exhibition space, the audience would see an almost naked body strapped in a wheelchair as in the artwork, *The Raver* (2018) by Hu Weiyi (Fig. 22). Reflecting on the notion of surveillance with technology in daily life, this work gave a surprise factor to the audience by situating an actor in a wheelchair with surveillance cameras mounted all over the (temporarily) tattooed body, then live-feeding the close-up videos on the monitor for the surveillee to watch.

Fig. 22 *The Raver* (2018) by Hu Weiyi

By using the artworks themselves to assemble the exhibition experience based on the visual and spatial relations [12], the Individualist approach also informed another Sustainer element that the journey through the OWE2.2 exhibition was guided by the dynamics between the artworks. One prominent instance was the two distinct spatial experiences in Carla Chan's and Chris Cheung's installations on two sides of a long corridor. On the one hand, *A Blacker Cloud* (2018) by Carla Chan was a smoke installation (Fig. 23), where the subtle prints of digital landscape rendered with a random noise algorithm are quickly obscured and then slowly revealed by smoke as a physical material in its random form. It delivered to the audience an experience of observing the interplay between the digital and physical forms of randomness within the confined spaces. On the contrary, on the other side of the corridor, *CarbonScape* (2018) by Chris Cheung was a kinetic sound installation that situated the audience into a space of audiovisual performance (Fig. 24). It immersed the audience among the flying spheres purposefully manipulated to visualise the 18 audio tracks inspired by global carbon emission data.


Fig. 23 *A Blacker Cloud* (2018) by Carla Chan


Fig. 24 *CarbonScape* (2018) by Chris Cheung

At the Relator stage, the OWE2.2 exhibition was well received in continuing the engagement among media and art professionals through responding in news articles and reviews after the exhibition experience. However, the audience input on social media about the exhibition as post-interaction engagement was significantly less in comparison to that in OWE2.1. For instance, none of the official hashtags was used substantially during the 3-week exhibition period. This limited engagement on social media reflects the conscious effort in the Individualist approach to avoid guiding the on-site audience experience towards social media behaviour such as photo and selfie taking.

Discussion and Conclusion

The overall Collectivist and Individualist curatorial approaches to mediate exhibition context via audience participation on social media in the *One World Exposition 2* exhibition series yielded distinctive results. The Collectivist strategies of purposefully guiding audience behaviour was generally better in activating audience engagement on social media, as opposed to the Individualist strategies of democratic encounters within the exhibition space. Also, the higher attendance of the exhibition reflected the more social media attention, which suggested that the Attractor and Sustainer stages in the respective curatorial approaches resulted consistently in the Relator stage throughout the Engagement processes [3]. For instance, the exhibition *OWE2.1: #like4like* had the highest attendance for Chi K11 Art Space in 2017, with approximately 2,500 visitors per week and over 5,000 geotags and hashtags on Instagram within the exhibition period. On the other hand, The attendance of *OWE2.2: #YOU #ME #ourSELFIES* was approximately 1,500 visitors per week, while the official hashtags of OWE2.2 were rarely used by the general public on Instagram, and mostly used by staff from the co-organisers vA! and Videotage. Despite the consistent results, this study recognizes its limitations, such as the institution's position as a variable. Since OWE2.1 was in collaboration with Chi K11 Art Space which is both organisationally and physically within the K11 shopping mall, the profit motif as well as their corporate position in presenting a young trendy branding understandably fueled

their financial support for the curatorial angle to expand audience base in the exhibition and social media presence. On the contrary, OWE2.2 was in collaboration with the Hong Kong Government. While attendance and impact on social media were part of the objectives, profit motif had no influence on the decisions made regarding curatorial strategies.

Another implication noted from the social media presence of the two exhibitions is that social media celebrities are a significant stakeholder in this mode of engagement. They play a major role in distributing information on social media. For instance, Poortravellers, an Instagram "influencer" with 314,000 followers, posted an image about the OWE2.1 exhibition which gathered over 9000 likes within 24 hours [15]. As a result, the exhibition in the following weekend had over a thousand visitors each day. This also indicates that the post-experience engagement on social media in the Relator stage can act as an Attractor element, creating a potential cycle to encourage more people on social media to attend the exhibition.

In addition to the different results from the audience, the artists in the exhibition series had concerns over the Collectivist curatorial strategies overshadowing the content and context of their artworks. Although all curatorial decisions were agreed upon between the artists and curators, and no parties involved were offended ethically and legally, it took significantly more time and effort to negotiate with the artists on exhibition design in OWE2.1 than that in OWE2.2. For instance, in the OWE2.1 exhibition, the artist of *The Melting Black* (2016), Carla Chan, originally disapproved of the red light track under her 5-channel video installation (Fig. 12), suggesting the dynamic exhibition design to be a distraction. The artist eventually understood and was happy about the exhibition design as a linking device to achieve a cohesive, shared audience experience. On the contrary, in the OWE2.2 exhibition, when the white-cube environment was proposed to encourage a more varied, democratic form of engagement, all of the artists accepted it with ease, indicating that most artists in this exhibition series felt more comfortable with the Individualist curatorial approach.

This study analyses the different curatorial approaches to activate the potential of social media as a form of engagement for exhibition context mediation. Future research can focus on the depth of this mode of engagement and how it can be best used to serve the various objectives of different institutions. As theorists D. J. Sherman and I. Rogoff [19] pointed out that all exhibition display strategies involve assumptions about the audience an institution aims to address, and those assumptions carry inherent contradictions about the institution's objectives, such as the delivery of education and pleasure. Since social media is becoming an inseparable part of life for younger generations [13], it is necessary to rethink and further understand the impact of social media towards the existing models of audience engagement and curatorial strategies.

Acknowledgements

The exhibition series *One World Exposition 2* was organized by Videotage, co-curated by Kyle Chung (Curator, Videotage) and Isaac Leung (Chairman, Videotage), supported by Hong Kong Arts Development Council. *One World Exposition 2.1: #like4like* was co-organised with Chi K11 Art Space. *One World Exposition 2.2: #YOU #ME #ourSELFIES* was co-organised with Hong Kong Visual Arts Centre (vA!), Leisure and Cultural Services Department, Hong Kong Government, co-curated with Ivy Lin (Curator, vA!). Lenders acknowledgement: Beijing Commune, Long March Space, Space Station, ShanghART Gallery.

References

[1] Bollo, Alessandro, and Luca Dal Pozzolo. *Analysis of Visitor Behaviour inside the Museum: An Empirical Study*, 2005.

[2] cccaixiaozhu. "Videotage On Instagram: '[#videotagelike4like] No Face, No Identity, No Sound, No Language, No Subtitle, No Narration, No Context, Only Ambiguous….'" Instagram, May 18, 2017. https://www.instagram.com/p/BUO-7nlB61D/.

[3] Edmonds, Ernest, Lizzie Muller, and Matthew Connell. "On Creative Engagement," Visual Communication 5, 5, no. 3 (2006): 307–22.

[4] Gilman, Benjamin Ives. "Museum Fatigue," The Scientific Monthly 2, 2, no. 1 (1916): 62–74. http://www.jstor.org/stable/6127.

[5] Goh, Edmund, and Cindy Lee. "A Workforce to Be Reckoned with: The Emerging Pivotal Generation Z Hospitality Workforce," International Journal of Hospitality Management 73, 73 (2018): 20–28.

[6] Hallam, Jed. *The Social Media Manifesto*. London; Basingstoke: London : Palgrave Macmillan UK : Imprint: Palgrave Macmillan, 2012.

[7] hoyintthe1st. "Videotage On Instagram: '"All Works and No Play Make You Feel Mad." - a Statement Nicely Put by @hoyintthe1st ! It's Amazing to See How Our Audience Respond To….'" Instagram, April 19, 2017. https://www.instagram.com/p/BTEJ--lh9NR/.

[8] Klonk, Charlotte. *Spaces of Experience: Art Gallery Interiors from 1800 to 2000*. New Haven: Yale University Press, 2009.

[9] lamfungfrances. "Videotage On Instagram: '[#videotagelike4like] An Extended Interpretation of By Our Audience @lamfungfrances.'" Instagram, April 20, 2017. https://www.instagram.com/p/BTExUIfhOsh/.

[10] lamluenkit. "Videotage On Instagram: '[#videotagelike4like] Guess Which Member of Double Fly Art Center Got Touched up? Some Members Are Strong and Masculine; Others Are….'" Instagram, May 13, 2017. https://www.instagram.com/p/BUCcjI8BtN5/.

[11] Levinson, Jay Conrad. *Guerrilla Marketing : Secrets for Making Big Profits from Your Small Business*. Boston: Boston : Houghton Mifflin, 1998.

[12] Lind, Maria. *Why Mediate Art?* Edited by Jens Hoffmann. Ten Fundamental Questions of Curating. Mousse Publishing, 2013.
[13] Loader, Brian, Ariadne Vromen, and Michael Andrew Xenos. *The Networked Young Citizen : Social Media, Political Participation and Civic Engagement*. New York, NY: New York, NY : Routledge, 2014.
[14] petertamkt. "Peter Tam.K.T On Instagram: 'One World Exposition 2.1: #like4like Exhibition @ Chi K11 Art Space #petertamktstyle #K11HK #k11artistklub #K11Me'" Instagram, April 18, 2017. https://www.instagram.com/p/BTCE7BCFQz4/.
[15] poortravellers. "HK Foodies and Always More?? On Instagram: Selfie Point Like #like4like…." Instagram, April 18, 2017. https://www.instagram.com/p/BTBf7XZh4ws/.
[16] Robinson, E S, I C Sherman, L E Curry, and H H F Jayne. "The Behavior of the Museum Visitor," Publications of the American Association of Museums, 1928, 72.
[17] ronwandesign. "@ronwandesign on Instagram: ': Art Selfie , @asian_dope_boys @videotage_hk #chentianzhuo.'" Instagram, April 17, 2017. https://www.instagram.com/p/BS-VombBOwV/.
[18] sawjaiyam. "YAM ? On Instagram: '#hk #hongkong #hkig #hkiger #hkgirl #igers #igershk #nikon #nikond5300 #d5300 #instagood #instamood…." Instagram, April 15, 2017. https://www.instagram.com/p/BS32j7TBl_d/.
[19] Sherman, Daniel J, and Irit Rogoff. *Museum Culture : Histories, Discourses, Spectacles*. Minneapolis: Minneapolis : University of Minnesota Press, 1994.
[20] Spradley, James P. *Participant Observation*. New York: New York : Holt, Rinehart and Winston, 1980.
[21] szelongx. "Videotage On Instagram: '[#videotagelike4like] Such a Cute Photo Contributed by Our Audience @szelongx # #smileyworld #smiley #like4like #videotage #k11me…." Instagram, April 27, 2017. https://www.instagram.com/p/BTZMJPwBsyr/.
[22] Tong, Valencia. "Millennials and New Media Art in the Conceptual Age: Hong Kong's K11 and Videotage Co-Present 'One World Exposition 2.1: #like4like' | Art Radar." Art Radar, April 12, 2017. http://artradarjournal.com/2017/04/12/millennials-and-new-media-art-in-the-conceptual-age-hong-kongs-k11-and-videotage-co-present-one-world-exposition-2-1-like4like/.
[23] Watt, Diane. "On Becoming a Qualitative Researcher: The Value of Reflexivity," The Qualitative Report 12, 12, no. 1 (March 1, 2007): 82–101.
[24] Yeung, Trista. "Liking for a New Medium." The Standard, April 7, 2017. http://www.thestandard.com.hk/section-news.php?id=181615.

The *Gone Garden* VR Experience – An Impressionistic Representation as Virtual Heritage Reconstruction

Benjamin Seide, Ross Williams, Elke Reinhuber
School of Art, Design and Media / Nanyang Technological University
81 Nanyang Drive, Singapore
bseide@ntu.edu.sg, rawilliams@ntu.edu.sg, elke@ ntu.edu.sg

Abstract

In this paper, we outline how we have embraced the unique aesthetics of purposefully flawed photogrammetry and ambisonic sound to provide an impressionistic experience for a virtual heritage application.

Over the last decade, photogrammetry has become particularly useful for 3D reconstruction in the context of virtual heritage applications. Although even inexperienced users can achieve impressive results, flawed reconstructions still occur when, for example insufficient data is being provided. Also, the capture of non-static objects, such as plants, presents manifold challenges. Usually, one would discard such imperfect reconstruction, but arguably such glitches embody a certain aesthetic, by telling a different story.

Keywords

Virtual Reality experience, virtual heritage, photogrammetry, immersive media, digital heritage representation, glitch, ambisonic

Introduction

The initiative for this artistic research in progress derived from the announced refurbishment of a Chinese Garden in Singapore (Fig. 1 and 2).

Comparatively old for the 53-year-old city-state, the garden was built in 1955 as part of the back then Chinese University, affectionately known as 'Nantah'. According to old photographs from the time, it was rather a wide-open space but already contained significant elements such as pavilions, the gate, bridges, stones and a memorial (Pookong & Kwai Keong 2013). [1] In the process, our project generated extensive records involving documentation, preservation, representation and interpretation of the garden. These include photos, videos and circle-panoramic imagery, the 360° film "Secret Detours". The records also included, experiments with CG animation and visual effects as a form of visual interpretation, as well as a 3D reconstruction of the site as a Virtual Reality environment. During the production of the virtual environment, the redevelopment of the actual site began and confronted us with the disappearance of the garden as we knew it. As a group of researchers and artists who work in different fields of immersive media, we decided to explore possibilities of how to visualise the transience of the garden and its transformation from the beautiful arrangement of trees, flowers, pavilions and pathways to a deconstructed, semi-chaotic, broken state with piles of soil, tree trunks and wilderness taking over.

Figures 1 and 2. Yunnan Garden in Singapore, before the reconstruction. © Seide, Reinhuber, Williams. 2017

In the "Parragirls Past, Present" (2017) project, Kuchelmeister et al. explore visual abstraction of a heritage site through "point-cloud representations to simultaneously generate the perception of authenticity and scientific accuracy while presenting a fragmented and broken world". [2] In the "Handbook on the Economics of Cultural Heritage" (2013), Rizzo and Mignosa argue that narrative involvement is crucial for the success of Virtual Heritage applications: "The sense of presence in the virtual

environment is influenced not only by the degree of immersion but rather by the level of […] narrative involvement". [3] We argue that creating a visual narrative through an artistic interpretation of heritage may also successfully benefit the engagement and involvement of the audience. Our project "Gone Garden" explores the use of photogrammetry as a tool to create a non-realistic, impressionistic representation of the garden from data captured at the actual heritage site for the purpose of an emotional and aesthetic interpretation.

Visual Representation

Reconstruction and Approximate Recreation

Virtual Cultural Heritage explores techniques such as laser scanning, CGI animation, 360° imagery and photogrammetry aiming to create photorealistic and accurate representations of historic environments (Zara 2004). [4]

Developments over the last decade made photogrammetry tools accessible and particularly useful for the purpose of 3D reconstruction of heritage sites. For our project, we successfully used photogrammetry and tools such as *Agisoft Photoscan* to create 3D models of the park's monument and rock statues (Fig. 3). While the monument looks convincing from afar, the intensive smoothing of corners is clearly noticeable under closer inspection and required further manual adjustments.

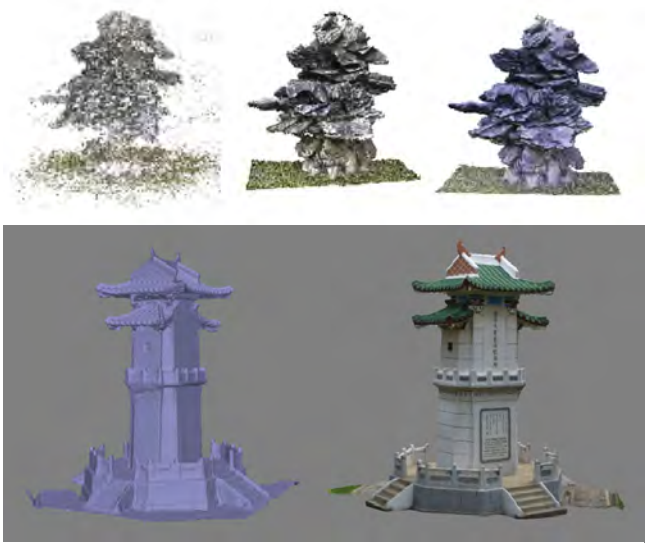


Figure 3. Digital reconstruction of rock and monument in Yunnan Garden, after photogrammetric capture. © Seide, Peixen, Reinhuber, Williams. 2017

Additional structures such as pathways, pavilions, the main gate and details such as benches, lamp posts and trash bins were modelled in *Autodesk Maya*. Achieving a high level of detail in modelling and texturing is crucial in the pursuit of achieving a realistic appearance.

As the garden is dominated by a huge palette of plants, from tropical palms to conifers, one of the main challenges was to recreate trees, bushes and flowers accordingly. While the process of photogrammetry is ideal for hard-surface static objects, it is unsuitable for small crisscrossing tree leaves, which produce an almost infinite-appearing number of occluded areas. Therefore, we decided to use digital plant assets, which are optimised for real-time projects. Even though these plants were carefully selected and matched according to plans and photos; replicating variety, position and size as close as possible, it means that ultimately the garden is not a true 3D reconstruction but an approximate recreation (Fig. 4). To get closer to a realistic representation, we intend to incorporate some of the CG assets with photogrammetry of existing tree trunks from the garden.

Combining all elements in a 3D environment with a realistic lighting setup has become very much easier over the last few years with software such as *Unity* and *Unreal*. A big challenge for a large environment with such a high volume of assets is the optimisation process required to run the application smoothly as a Virtual Reality experience.

Figure 4. Screenshot of the Yunnan Garden VR experience. © Seide, Reinhuber, Williams. 2018

Aerial Survey

In addition to the terrestrial data acquisition employed to create the 3D reconstructions of the stone rocks and the monument, an aerial survey was conducted.

A camera drone (*DJI Phantom 3*) was programmed to survey the garden from a height of 27m, just enough to avoid tall trees. The camera, while pointing straight downwards, took photos at a pre-programmed short time interval, resulting in 266 images. Processing these images with photogrammetry software produced a very precise orthophotograph of the garden (Fig. 5). An orthophotograph, or orthomosaic map, is a geometrically corrected aerial photograph which represents the Earth's surface accurately and can be used to measure true distances. We used orthophotography for our project as a reference for measurements, and manually positioned objects such as plants, trees, walkways and pavilions. So although it is not a 3D reconstruction, the positions of

objects in our virtual recreation of the garden represent the accurate locations in reference to the actual garden.

Figure 5. Orthophotograph of center of garden. © Seide, Reinhuber, Williams. 2018

Reconstruction with Insufficient Data

As the aerial survey was conducted to take photos pointing straight downwards only, the data set was vastly insufficient to generate a precise 3D reconstruction of the garden.

Processing the limited data set with photogrammetry resulted in a very low-resolution reconstruction, in which details such as trees are reduced to roundish blobs reassembling a rather abstract landscape (Fig. 6).

A Representation for a Disappearing Garden

While working to recreate an accurate and realistic representation as a VR experience, we revisited the actual garden. Even though we knew what would ultimately happen, it was depressing to be confronted with the construction site: a disassembled remembrance of what was once a green locale of recreation and enjoyment of nature.

Structures such as the pavilions, monument and gate were still intact but most of the flowers and many of the trees and shrubs had disappeared; the garden as we knew it was gone (Fig. 7).

Figure 6. 3D reconstruction from insufficient data. © Seide, Reinhuber, Williams. 2018

Figure 7. Yunnan Garden during refurbishment. © Seide, Reinhuber, Williams. 2018

Figure 8. Point cloud visualisation of garden. © Seide, Reinhuber, Williams. 2018

It became apparent to us that we needed a visual representation for this new reality: the transformed and fragmented version of the site. We started to experiment with point-cloud visualisation (Fig. 8), which provided aesthetic attributes to represent the aspect of the garden's fragmentation into small pieces, but eventually, we were not convinced by the high level of abstraction the point-cloud visualisation would produce.

The state of the garden at this time was that parts were still intact while others were gone. This grounded our decision to experiment with a combination of abstract and realistic elements, leading us to merge the low-resolution 3D reconstruction with our accurate recreation. This generated a roundish, almost abstract landscape, resulting in our VR experience "Gone Garden" (Fig. 9), a partially realistic representation, dissolving into an impressionistic dream-like memory of the garden.

Aural Representation

The importance of sound in immersive experiences in virtual reality is well acknowledged and high fidelity is considered essential (Serafin et al 2015). [5]

How the sound should or might relate to the visual world of Gone Garden and what those sounds should consist of, is an evolving process. Sound that occurred in the garden at the time of the acquisition of the visual data was not considered for use in any form of representation, as adjacent noise sources rendered useful recordings impossible [6]. The aural representation shares the same aesthetic of incomplete, fragmented and transformed data as the image. Distorted sound memories of imagined soundscapes and fragments of sonic recollection are the starting point, as if the user is experiencing the memory of another. Ambience recordings are transformed and distorted leaving hints of their origin in a way similar to the incomplete visual reconstruction based on photogrammetry. Audio processing that requires software to interpolate sound from "incomplete data" was explored, specifically the use of time expansion. With time expansion, the audio file is made longer in time, but the spectral content of the file maybe maintained. In simple terms, the audio file is made longer without changing its pitch. Audio processing algorithms create the required extra audio samples to achieve the increase in length. So, it is in this sense that the original data is "incomplete", and the audio processing "completes" it. When significant time expansion is employed, as was the case in the manipulation of the ambience recordings, audio artefacts (spectral content not present in the original recording) are usually generated, transforming, sometimes significantly, the original recording. Often considered undesirable by-products of this kind of audio processing, these artefacts or "errors" contribute to the otherworldly aesthetic and were applied to most sounds in the soundscape. As the user moves through the garden, the soundscape layers change and reflect the impressionistic nature of the virtual images. Some melodic elements are tied to specific objects and are only audible at close proximity, encouraging the user to approach. The soundscape of "Gone Garden" is an exploration of the use of sound in the impressionistic representation of virtual heritage.

Conclusion

As the garden site ceased to exist in its pre-2018 manifestation, our documentation in the form of photography, audio and video, 3D reconstruction and a VR experience offers a unique and comprehensive archive for future academic research and study.

Beyond the preservation aspect of the Yunnan Garden, the aim of the "Gone Garden" VR experience was to develop an interpretation of heritage with the aim of benefitting the audience's involvement. This challenged the project team to explore new visual and aural forms of representation. The foundation of our visual representation

Figure 9. Screenshots of the Gone Garden VR experience. © Seide, Reinhuber, Williams. 2018

is based on the data set of the garden itself, a technically imperfect reconstruction from insufficient data, which one would usually discard, but which can embody meaning to a recipient when put into context. Because we added trees and flowers that matched their appearance and position as accurately as possible, our visual representation constitutes a combination of a reconstruction and an artistic interpretation.

As the project is a work in progress, we, at the time of writing, invited the audience to explore two separate VR experiences, one being the realistic recreation of the garden, the other being the "Gone Garden" interpretation. A future plan for the project aims to create one united experience, in which the audience find themselves in a realistic replication of Yunnan garden which then over time transforms into an impressionistic fragmentation, allowing the viewer to experience and explore a culturally and historically significant place and an interpretation of its disappearance.

Acknowledgements

This research has been made possible through the kind support of an MOE grant in Singapore and ADM, School of Art, Design and Media, NTU Singapore. We also express our gratitude to HfG and ZKM Centre for Art and Media in Karlsruhe for the opportunity to present the work in progress.

References

[1] Poo Kong Kee and Kwai Keong Choi, *Nanyang Da Xue Li Shi Tu Pian Ji = A Pictorial History of Nantah*. (Singapore: Times Media Private Limited for the Chinese Heritage Centre, 2004).

[2] Volker Kuchelmeister, Lily Hibberd and Alex Davies. (2018). *Affect and Place Representation in Immersive Media: The Parragirls Past, Present project*. 71-78. 10.14236/ewic/EVA2018.14.

[3] Ilde Rizzo, Anna Mignosa, eds., *Handbook on the Economics of Cultural Heritage*. (Cheltenham: Edward Elgar Publishing (Elgar Original Reference), 2015).

[4] Zara Jiri, "Virtual reality and cultural heritage on the web." (2004) *7th International Conference on Computer Graphics and Artificial Intelligence*. 101–112.

[5] Stefania Serafin, et al. "Sonic Interaction in Virtual Environments." 2015 IEEE 2nd VR Workshop on Sonic Interactions for Virtual Environments (SIVE), doi:10.1109/sive.2015.7361283.

[6] Elke Reinhuber, Ross Williams, and Benjamin Seide, "The Scale of Immersion: Different Audio-Visual Experiences Exemplified by the 360° Video 'Secret Detours'." (2018) *EVA London 2018*. doi:10.14236/ewic/eva2018.45.

Bibliography

F. Bocci, M. E. Bonfigili, L. Calori, et al. "Virtual Reality and Cultural Heritage: some applications." Edited by Vito Cappellini and James Hemsley. *Atti della conferenza – Electronic Imaging and the Visual Arts Conference (EVA) 2000, Firenze: Il nuovo rinascimento; conference, training & workshops, 27-31 Marzo 2000, venu, Palazzo degli Affari.* (Bologna: Pitagora, 2000).

A. Bogdanovych, J. A. Rodriguez-Aguilar, S. Simoff, and A. Cohen. 2010. "Authentic Interactive Reenactment of Cultural Heritage with 3D Virtual Worlds and Artificial Intelligence." *Applied Artificial Intelligence* 24/6, (2010): 617-647.

Karen Collins et al., *The Oxford Handbook of Interactive Audio*. (Oxford: Oxford University Press, 2017).

Tom A. Garner and Mark Grimshaw, "Sonic Virtuality: Understanding Audio in a Virtual World" In *The Oxford Handbook of Virtuality*. (Oxford: Oxford University Press, 2014).

Mark Grimshaw (ed.), *The Oxford Handbook of Virtuality*. (Oxford: Oxford University Press, 2015).

Zara Jiri, "Virtual reality and cultural heritage on the web." (2004) *7th International Conference on Computer Graphics and Artificial Intelligence*. 101–112.

Poo Kong Kee and Kwai Keong Choi, *Nanyang Da Xue Li Shi Tu Pian Ji = A Pictorial History of Nantah*. (Singapore: Times Media Private Limited for the Chinese Heritage Centre, 2004).

Chairi Kiourt, George Pavlidis, Anestis Koutsoudis, and Dimitris Kalles, "Realistic Simulation Of Cultural Heritage." *International Journal of Computational Methods in Heritage Science* 1/1 (2017): 10-40.

Volker Kuchelmeister, Lily Hibberd, and Alex Davies, "Affect and Place Representation in Immersive Media: The Parragirls Past, Present Project." (2018) *EVA London 2018*. doi:10.14236/ewic/eva2018.14.

Nadia Magnenat-Thalmann, Georgios Papagiannakis, "Virtual Worlds and Augmented Reality in Cultural Heritage Applications" (2005) *Conference: Virtual Worlds and Augmented Reality in Cultural Heritage Applications* researchgate.net/publication/232613064_Virtual_Worlds_and_Augmented_Reality_in_Cultural_Heritage_Applications

Rolf Nordahl and Niels C. Nilsson, (2014) "The Sound of Being There: Presence and Interactive Audio in Immersive Virtual Reality". doi:10.1093/oxfordhb/9780199797226.013.013

Elke Reinhuber, Ross Williams, and Benjamin Seide, "The Scale of Immersion: Different Audio-Visual Experiences Exemplified by the 360° Video 'Secret Detours'." (2018) *EVA London 2018*. doi:10.14236/ewic/eva2018.45.

Ilde Rizzo and Anna Mignosa (eds.), *Handbook on the Economics of Cultural Heritage*. (Cheltenham: Edward Elgar Publishing (Elgar Original Reference), 2015).

Stefania Serafin et al., "Sonic Interaction in Virtual Environments." *2015 IEEE 2nd VR Workshop on Sonic Interactions for Virtual Environments (SIVE)*. doi:10.1109/sive.2015.7361283.

Authors Biographies

Benjamin Seide, Associate Professor – Nanyang Technological University (Singapore), educator, researcher and media artist, lives in Singapore and Berlin and researches in the field of animation and immersive media. In the 1990s, Seide shot his first interactive 360° film with a self-developed camera and explored representations in virtual space in his work "Paramatrix". His work as a visual effects artist from the 2000s contributed to Art House and Hollywood films, including Wim Wender's "Don't Come Knocking", Roman Polanski's "Oliver Twist" and Martin Scorsese's "Hugo". 2009–2013 Seide lived and worked in Shanghai and created the award-winning immersive experience of the General Motors World Expo pavilion.
Currently his projects investigate artistic interpretation of cultural and film heritage in immersive media, including the full-dome installation "Fellini: Circus of Light" and "The Spirit of Pontianak", a VR installation of the lost horror film "Pontianak" from 1958.

Ross Adrian Williams, Assistant Professor – Doctor of Musical Arts – Nanyang Technological University (Singapore). Australian composer/sound designer Ross Adrian Williams has

written music and designed sound across a range of styles for theatre, feature film, concert hall, dance, museum installation, VR and interactive media. His works have been performed internationally by groups such as the West Australian Youth and Symphony Orchestras and the Australian String Quartet, his music and sound design for award winning abstract, documentary and narrative films have been shown in festivals around the world. He holds a BMus (honours) from the University of Western Australia and a Masters and Doctorate in Musical Arts from Rice University, Texas.
As an Assistant Professor of Sound Design at the School of Art, Design and Media (NTU) his research interests range from implementation of audio stimuli to improve effectiveness of robotic motor training and improving the detection of volcanic events in infrasound to multichannel sound design for experimental film.

Elke Reinhuber, PhD, Assistant Professor – Nanyang Technological University (Singapore). The German media artist, researcher and educator teaches currently at the School of Art, Design and Media at NTU Singapore as Assistant Professor for Expanded Photography. She holds a PhD from COFA/UNSW, Sydney for her exploration on choice, decision making and counterfactual thinking in media arts.
Her interest in immersive representations of architectural cultural heritage via digital media started in the early days of laser scanning and panoramic imaging with QuickTime VR for web and interactive museum installations. Projects reaching from early Coptic to medieval and renaissance churches in Egypt, Germany or Mexico were a starting point for her artworks which add a narrative to historical or architecturally relevant sites. Her most recent pieces are closely connected to the rapidly changing city state of Singapore, where her award-winning stereoscopic video "Venomenon" was realized.
Her artistic research was presented internationally, at conferences, exhibitions, group shows, festivals and biennials.

Acting-Centred Definitions of Vactors, Synthespians, and Digital Doubles

Jason Kennedy
Auckland University of Technology
Auckland, New Zealand
jason.kennedy@aut.ac.nz

Abstract

This paper is an attempt to formalise definitions of different types of performance common to computer-generated (CG) characters in feature films, and to create a taxonomy of modes of performance among these characters. Terms such as a "virtual actors" (vactors), "synthespians", and "digital doubles" are frequently, but incorrectly, used interchangeably due to a lack of established definitions. What is the relationship of these terms to each other, and how should they be understood from both technological and performance-based perspectives? By articulating clear definitions for these terms, it is possible to theorise a variety of performance types specific to CG characters in feature films. These categories provide an expanded understanding of how performance is created among CG characters, and draws into question whether classic examples of synthespians are really synthespians at all.

Keywords

Synthespian, digital double, acting, performance, animation, motion capture, vactor

Introduction

In 1987, Jeff Kleiser and Diana Walczak coined the term "synthespian" to refer to several computer-generated (CG) characters their studio, the Kleiser-Walczak Construction Company, planned to produce: some of the first and arguably most realistic CG humans at that time. For instance, in the case of their first female synthespian, Dozo, who was the star of the 1989 music video "Don't Touch Me"[1], not only was the character a leap forward in terms of realistic 3D modelling, but her movements achieved a level of human fluidity that lent itself to greater performance believability than previously achieved by digital humans. [2] Kleiser and Walczak describe the term *synthespian* as "a portmanteau derived from [syn(thetic) + thespian] and meaning 'digital actor'". [3] It is important to recognise that acting is intrinsic to this definition, but what constitutes acting within the context of CG characters? A lack of clarity about this issue has led to a confusion in the distinction between synthespians and other types of digital characters. In her seminal article about cyberstars, Creed writes that

> Like the silvery, slippery, 'liquid metal' T-1000 robot in *Terminator 2: Judgement Day* […] or the crowd that fills the dock scene in the opening sequence of *Titanic* […], the computer-generated figures have no referent in the real world. These are not actors playing a part: rather they are what is known in the industry as 'synthespians', 'cyberstars', or 'vactors' (virtual actors) enacting the parts of extras historically played by real actors. [4]

In a little more than a decade following the establishment of the term *synthespian*, Creed equates it with cyberstars, virtual actors (vactors), and – most strikingly – digital doubles (in the form of the Titanic dock scene). Furthermore, Creed draws into question the nature – and possibly the significance – of *acting* to a definition of synthespians. Modern popular definitions for a synthespian include "a computer-generated three-dimensional character, either in a wholly animated film or in one that is a mixture of live action and computer animation" [5], and "a computer-generated image of a film actor, esp [sic] used in place of the real actor when shooting special effects or stunts". [6] The former definition relies solely on technical apparatus and pays no service to the role of acting, while the latter definition assumes that a synthespian character *must* be a digital manifestation of an existing actor.[1] As I shall explore in Section 2, the latter definition correlates the definition of a synthespian with that of a digital double, a recurring mistake since at least the time of Creed's article.

To date, academic discourse about synthespians primarily focuses on examples from only a handful of films, most of which were produced between 2000 and 2010. These

[1] A further distinction is that the former definition allows for characters in both animated and live-action films, whereas the latter definition is solely focused on live-action. In both definitions, the emphasis is placed on films, although synthespians exist across a range of moving image-based media.

films include *Final Fantasy: The Spirits Within* [7], *The Polar Express*, *King Kong* [8], *Beowulf* [9], *The Curious Case of Benjamin Button* [10], *Avatar* [11], and *Tron: Legacy* [12]. While these movies are worthy of the discussion they generate about acting within a virtual context, these movies do not fully represent the range of performance possibilities that virtual characters have achieved in the years since. As a result of this range of performance modes, in this paper I suggest it is necessary to articulate more precise definitions of terms common to this discourse, including "synthespian", "virtual actor", and "digital double".

This research was born from an ostensibly simple question: how many synthespians have been in feature films since Avatar? I estimated an answer of somewhere between 50-100 synthespian characters, but this research quickly revealed two things: 1) my estimate was far too low; and 2) a range of digital character performances exist in feature films, but not all of these should necessarily be classified as *synthespian performances*. However, it is important to document this full range of digital (or virtual) performances and apply meaningful definitions to each of the different performance types. This paper is an attempt to create a taxonomy of modes of performance among virtual characters within feature films.

I draw upon my combined experience as both an actor and an animator to identify and understand the different ways in which this wide range of characters perform within film. What constitutes a virtual actor and what modes of acting are encompassed by this definition? How are synthespians categorised in respect to virtual actors, and how do we identify synthespian performance within profilmic versus ex-filmic[2] contexts?

Contextual Review

Since 2010 (post-Avatar), there has been a steady increase in the number of virtual performances in feature films each year. This increase in the number of vactor roles is influenced by at least two factors:

- Advancements in computer hardware and software capabilities, especially in the areas of highly realistic modelling and texturing, as well as speed advancements for the playback of both keyframe and motion capture animation;
- An increase in the number of film directors and producers who are willing to invest the time, money, and faith to develop believable CG characters capable of performing these roles.

[2] I suggest the term ex-filmic as a counterpoint to "profilmic", and offer the following tentative definition: a reality or situation solely recorded through software-based cameras.

Personal Background

In order to piece together meaningful definitions for the virtual performance roles I have discussed so far, I believe it is important to share my background as an actor and animator. In my role as the Animation Pathway Leader at [REDACTED], I see myself foremost as a teacher of performance. In my case, performance takes the forms of acting and animation. I've taught animation at the tertiary level since 2006 and I have produced independent 3D animation work along the way. I've also studied acting and performed in theatre and film productions since 1999. My PhD investigates how we see the act of acting in the performance of animated characters. I see myself foremost as an actor-animator, whereby the emphasis is placed on me as an actor who primarily performs through my animations. My research sits in a multifaceted crossover between acting/animation and research/practice. The tacit knowledge gained through this creative nexus provides me with a means to identify both the nature of acting among virtual characters, as well as how the means of production affects the acting of those characters. I believe that my experience as both an actor and an animator enables me to bring a unifying awareness to animation performance, and in so doing provide a level of insight into all aspects of virtual performance that is otherwise unattainable.

Vactors, Synthespians, and Digital Doubles

Before proceeding further, it will be useful to define several terms that are often (mistakenly) used interchangeably. The terms "vactor", "synthespian", and "digital double" all bear a relationship as virtual performance terms, but require specialised definitions. No standard, agreed-upon definitions for these terms exists. As a result, it is important to define clear and separate meanings for these terms in order to encourage a standardised usage. The definitions I propose here are based more upon the nature of performance of a CG character than the technical means of its production.

Humans hold a privileged role in our conception of performance in general, and of acting specifically. Referencing Fiebach [13], King writes that "it remains an enduring premise of acting as professional practice that the human actor is central to the process of dramatic signification". [14] However, human characters are responsible for only a

portion of roles across the range of virtual performances. In reality, no virtual characters are truly human as they are all digital creations at some level; however, it should be suffi-cient to suggest that virtual performances by characters who bear a strong likeness to the physiology, emotional response, and movement of humans can be regarded as "human performances" in this regard. A range of digital non-human characters exist in feature films, as well, which calls into question the primacy of the human actor to dra-matic signification. As King elaborates: "But even allow-ing that the term *actor* is being used as a metonym for the collective contribution of human agency, the question of non-human performance and agency still remains." [15] By creating careful and distinct definitions for common virtual performance terms, it is possible to expand our understand-ing of how digital characters produce acting, as well as who – and *what* – can be considered an actor.

Prior to defining the virtual performance terms identi-fied above, it is important to lay a foundation of what is meant by both "performance" and "acting", both of which are slippery terms that obdurately resist fixed definitions. This paper is not concerned with uncovering all possible definitions for these terms, but rather in securing a set of definitions that will clarify and serve its purposes. Schechner aims wide when defining *performance* as "all the activity of a given participant on a given occasion which serves to influence in any way any of the other par-ticipants." [16] Performance can occur anywhere so long as a single condition is met: that the performed actions are "done *for* someone, even if that person is the performer him- or herself." [17] Digital technologies impact many modern forms of performance. Professor Steve Dixon, a leading researcher in the nexus between digital technolo-gies and the performing arts [18], defines *digital perfor-mance* as "all performance works where computer technol-ogies play a key role rather than a subsidiary one in con-tent, techniques, aesthetics, or delivery forms." [19] For the sake of this paper, we can equate the meaning of "virtual performance" with "digital performance".

Definitions of acting widely vary, especially between scholars of acting and practitioners of the craft. Acting coaches often describe acting in terms of concepts like "being", "reaction", "imagination", "empathy", "pretend-ing", "playing", and "mimesis". For Kirby, "[a]cting means to feign, to simulate, to represent, to impersonate." [20] He loosely defines *acting* as "something that is done by a performer rather than something that is done for or to him […]" [21]. He expands on this idea:

> If the performer does something to simulate, represent, impersonate and so forth, he is acting. It does not matter what style he uses […]. No emotion needs to be in-volved. The definition can depend solely on the charac-ter of what is done. […] Acting can be said to exist in the smallest and simplest action that involves pretence. [22]

Kirby identifies a continuum of acting, from not-acting through to complex acting (Figure 1). This continuum is not concerned with the style but rather the *amount* of act-ing. [23] For instance, "non-matrixed performing" takes place when the performer "is merely himself and is not imbedded […] in matrices of pretended or represented character, situation, place and time". [24] On the left end of the continuum, actors receive references of acting, as opposed to producing those references themselves. [25] As we move toward the right end of the continuum, the actor's role in producing references and representing a character increases. [26] "Received acting" occurs when a perform-er's participation in a story is implied more by strong and persistent matrices of representation surrounding the per-former rather than by the performer's actions. Kirby elabo-rates: "Extras, who do nothing but walk and stand in cos-tume, are seen as 'actors.' Anyone merely walking across a stage containing a realistic setting might come to represent a person in that place – and, perhaps, time – without doing anything we could distinguish as acting." [27]

Of concern to the discussion of synthespians are simple and complex amounts of acting. Kirby identifies simple acting as "that in which only one element or dimension of acting is used. [… Emotion] may be the only area in which pretence takes place […] or only an action such as putting on a jacket may be simulated." [28] Complex acting, by contrast, is multi-dimensional and involves simultaneously engaging in more than one area of pretence. [29] Hosea asserts that complex acting is commonly associated with "lifelikeness and authenticity in which the actors lose their own egos and become the characters that they portray." [30]

Rozik provides a more theoretical understanding of Kirby's

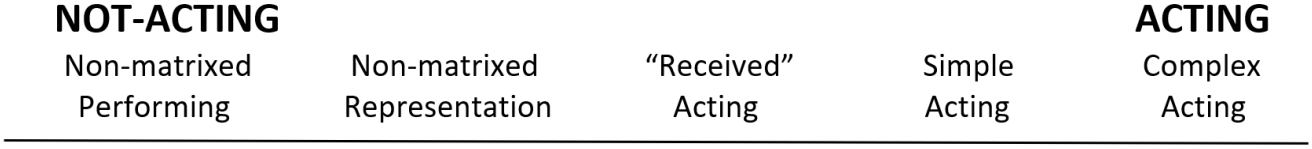


Figure 1. Kirby's continuum of acting. Reprinted from *On Acting and Not-Acting* (p. 8), by M. Kirby, 1972, *The Drama Review: TDR, 16*, no.1.

distinction of simple and complex acting, defining acting in this sense as "inscribing on matter a description of an entity in a world and deflection of reference to it". [31] That is, through acting, an actor attempts to hide any sense of him/herself while conveying a separate identity. While flesh and blood actors participate in a deflection of reference to themselves, a virtual performer never does so. The virtual performer never exists outside of the digital medium nor assumes a personality other than what is ascribed to it through its performance. As a result, the virtual performer never pretends to be anything other than what it is.

It is important to point out that not all virtual performances involve acting; that is, there are virtual characters that produce performances on screen that do not involve facets of acting such as empathy, simulation, impersonation, pretence, or even pseudo-deflection of reference. However, all virtual performances in feature films are a type of constructed performance, whereby more than one (living) person is responsible for the final product of the performance on screen. Motion capture, whereby an actor's live performance is digitised as data to be applied to and reconstructed through an animated character, is a common tool used to produce virtual performances, and can result in especially complex and nuanced constructed performances.

With a foundation laid, it is now possible to assign specific meaning to the three virtual performance terms identified so far. It is part of my argument that the term "virtual actor (vactor)" is an overarching category that contains both synthespian, digital doubles, and other categories of virtual performance (Figure 2). While the term "virtual performer" would be more consistent with the definitions above, *virtual actor* is an established term in the literature [32][33] and the neologism "vactor" can stand for both.

Vactor: a CG or digitally-augmented character capable of producing a screen-based performance.

Vactors do not need to produce a specific type or degree of performance, so long as they produce a performance of some kind. As a point of difference, synthespians and digital doubles are in part defined by the type of performances those characters produce.

Synthespian: a CG or digitally-augmented character that advances a screen-based story while producing acting that engages in at least one area of pretence.

Digital Double: a CG character whose participation in a screen-based story is implied more by its physiology, costume, and surroundings than by its actions.

The major point of distinction between synthespians and digital doubles is the capacity to produce acting. Synthespians occupy a space of performance that we generally associate with film acting, and we can reasonably compare synthespians to actors. On the other hand, digital doubles occupy a range of performance roles that are more akin to *received acting* than acting based on degrees of pretence. For instance, digital doubles are frequently used as stunt doubles during scenes in which it would be too dangerous or even impossible to film the real actor, as well as for scenes in which the character must embody "some property or ability that the actor it replaces does not have". [34] This is often the case for blockbuster visual effects – for example, some scenes in which Peter Parker in *The Amazing Spider-Man* [35] swings between buildings while holding tight onto threads of webbing. It is more likely that such a performance will be in the form of a digital double if the camera is located behind or far away from the character, thereby reducing visible sites of pretence. Digital doubles also often take the form of performance "extras", such as characters in a crowd. Again, significant distance from the camera plays a major role in whether a character in a crowd can be seen to visibly engage in pretence; examples include crowds of orcs, goblins, dwarves, and elves in *The Hobbit: Battle of the Five Armies* [36], and the tens of thousands of spectators who fill out the Oakland Coliseum in *Moneyball*. [37]

It should be pointed out that the term *digital double* is imperfect at best. A *double* implies that the digital character is indexical to a flesh-and-blood actor. The term *digital double* gained popularity during the 1990s as advancements in computer hardware and software made it more feasible to produce convincing CG doubles of actors. There were very few examples of actors whose movements were motion captured and translated onto CG characters that did *not* match their likeness, and therefore it was apt to consider this process a form of doubling. However, today there are hundreds of examples of actors whose motion capture performances are translated onto CG characters that bear no resemblance to them, as well as realistic CG characters whose performances are completely keyframe animated and which may share no index with a human performer. Despite its shortcomings, the term *digital double* is firmly established in the literature and legacy of computer graphics, visual effects, and animation. However, in order

to speak more clearly about the different roles that are encompassed by digital doubles, it is worth creating some subclassifications of the term.

There is precedent in literature from 2000-2010 to move toward the use of **digital doppelgänger** instead of "digital double". [38][39] The usage of "doppelgänger" is appropriate to CG characters that are exact digital recreations of the actors on which they are based. For digital doubles that do not resemble the actors on which they are based, I suggest the term **protean double**, which suggests a character that maintains a relationship to a flesh-and-blood actor while embodying dissimilar physiology. Finally, for CG characters that are solely keyframe animated and regardless of whether they bear a resemblance to a human actor in the same film, I suggest the term **digital fantoccini**. The Italian word "fantoccini" refers to puppet shows that featured jointed puppets manipulated by rods, strings, and mechanical devices. [40] Similar language is used to describe the process of animating characters using 3D software: a character's geometry is rigged to a series of joints that articulate its movement via mechanical (e.g.: digital) means. In this sense, we can imagine *fantoccini* as a precursor to contemporary CG animation practice. It is important to reassert that digital doppelgängers, protean doubles, and digital fantoccini all come under the umbrella of digital doubles, and are therefore subject to the constraints of received acting.

Cataloguing Vactor Performance

When I first started my investigation into how many synthespians have existed in feature films since 2010, I lacked a clarity of definitions for *vactor*, *synthespian*, and *digital double*. It was through the process of this research that a need to distinguish between these different types of performance became essential. In this section, I outline the process of my ongoing research into identifying vactors and the variety of performance types they participate in.

When exploring the range of vactors, I decided to limit my purview to feature films alone. Such a limitation still accesses what is arguably the largest population of digital performers, at least outside of video games. This study considers feature films from 2010-2018, but with some exceptions. Historically, the term "synthespian" was first used to describe CG characters that achieved a high degree of visual and performance realism in films such as *Final Fantasy: The Spirits Within* [41], *The Polar Express* [42], and *Beowulf* [43]. The term was later extended to CG characters in live-action films that achieved a degree of realism on par with their flesh-and-blood actor counterparts, such as in *The Curious Case of Benjamin Button* [44] and *Avatar*. [45]

In the examples above, a synthespian was defined by its performance ability as well as the degree of realism it achieved. While performance ability remains relatively

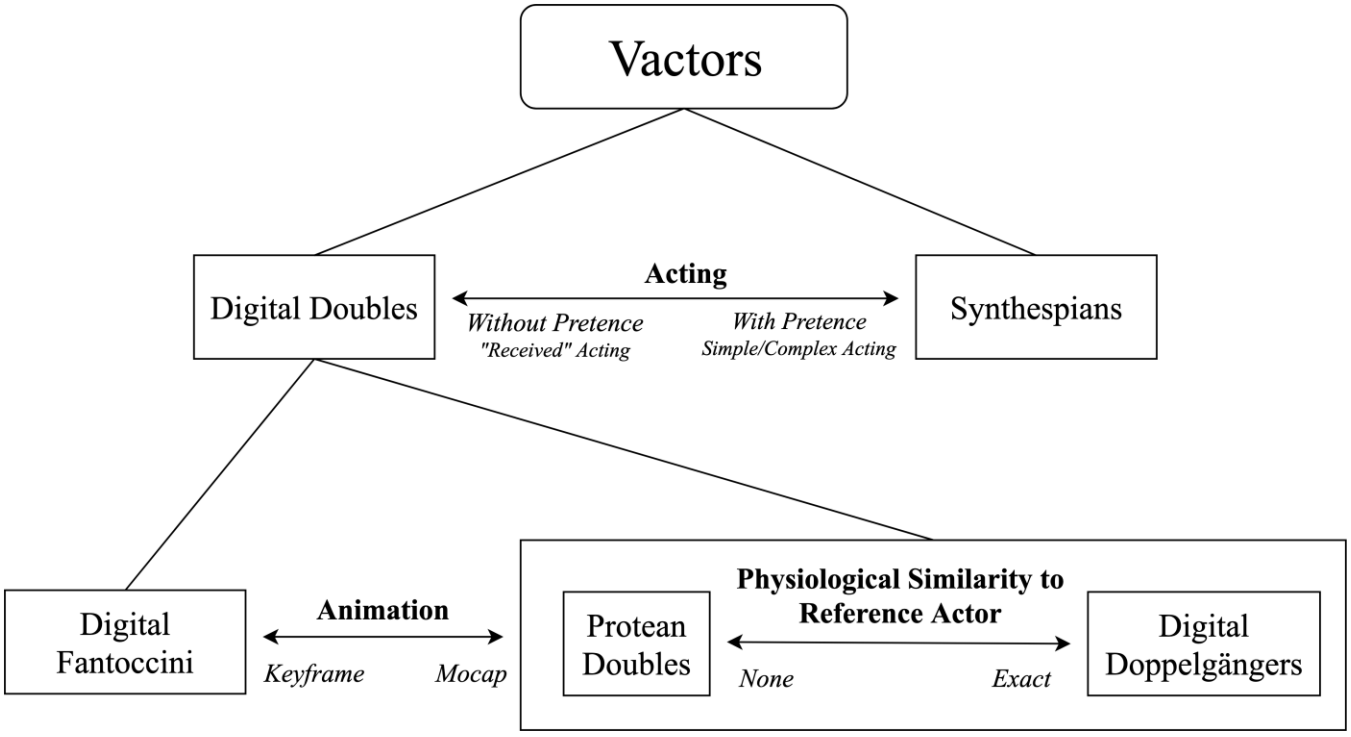


Figure 2. Diagram of virtual performance categories and relationships.

consistent after repeated viewings, it is common for a CG character that embodies the state-of-the-art visual accomplishment in one year to look far less convincing upon a repeated viewing several years later. This is due to the rapid acceleration of visual improvements regarding modelling, texturing, and rendering CG characters. With each of these improvements, viewer expectations about what is considered "realistic" shifts to the most recent visual marvel. It is therefore conceivable that after a certain amount of time, what was once considered realistic enough to qualify for synthespian status may suddenly fall below the same criteria. It is for this reason that I do not believe that synthespian status – nor vactor status – should be tied to visual accomplishment.

Instead, as discussed in the previous section, the definitions I suggest for all different types of vactors are based on the nature and degree of a CG character's performance. While it is tempting to include examples from 3D animated films, this still toys with distinguishing between degrees of visual accomplishment. For instance, it is unlikely that the characters in *Hoodwinked Too! Hood vs. Evil* [46] would be considered synthespians, whereas (as of this writing) I may be tempted to consider the characters in *Kingsglaive: Final Fantasy XV* [47] to live up to that mantle. However, it is unclear where to draw the line. Should we consider characters from *How to Train Your Dragon 2* [48] or *The Incredibles 2* [49], and if not, why *exactly* should they be excluded? As a result, I presently forgo animated films altogether and focus solely on vactors that are included within live-action films – that is, specifically within a profilmic space. I also exclude documentaries for the sake of maintaining a focus on narrative storytelling within a primarily fictional context.

Methods

This study features a survey of primarily Western films (American, Canadian, and Australian), with an attempt to pay service to Bollywood, Chinese, Korean, and European cinema. Some vactors are obviously present by their star role in a film, but many are obscured by lacking a speaking part or by being present for only a few frames within the entire film. I consider it untenable to watch every movie from between 2010-2018, so I developed a means by which to determine whether or not a movie likely contains vactors. The website "Wild About Movies" [50] provides a complete list of all Western feature films released each year, and I am able to begin winnowing out certain titles based on their trailers and posters alone. Admittedly, this is not a fool-proof process, so cross-examination with the "Internet Movie Database (IMDb)" [51] helps to reveal film budgets that are too low to support the expensive cost of producing vactors. For any movie that I suspect may potentially contain vactors, I search Google for relevant discussions about how the visual effects (VFX) for that movie were produced. Likewise, I reference *Cinefex*, a magazine about the major VFX film productions each year. Once I compile a list of every movie I suspect may contain vactors, I proceed to watch each film using MPC-HC media player for Windows. Using MPC-HC, I am able to advance ten seconds through the movie with each tap of the forward arrow key. This method allows me to move with relative speed through a film while managing to identify key moments that may contain vactors, at which point I play back the film at regular speed.

When I identify a vactor, I record it in a list of all other vactors from the same movie and year. Additionally, I have developed a list of acting categories for vactors based on the range of acting I've encountered so far in these films, and I add each vactor to the appropriate acting category or categories.

Categories of Acting Style

Verisimilar Realistic Acting: acting that highly approximates real-world performances

This acting style category features physical and performance believability closest to our expectation of human actors in feature films within the Western tradition of film acting (that is, as it relates to Konstantin Stanislavski and the directors who further developed and improved upon his lessons). Verisimilar realistic acting tries to simulate reality as closely as possible and often features synthespians that are meant to be indistinguishable from real-world actors. As a result, this style of acting further requires a high degree of realism in terms of character design in order to achieve the requisite performance results and audience suspension of disbelief. A few examples of characters within this style of acting include Clu from *Tron: Legacy* [52], Voldemort from *Harry Potter and the Deathly Hallows: Part 1* [53], and Stayne – Knave of Hearts from *Alice in Wonderland*. [54]

Stylised Realistic Acting: acting that goes beyond the normal confines of human experience, such as superpowers or cartoon designs

On one end of its spectrum, stylised realistic acting is

often similar to versimilar realistic acting in terms of a high degree of realism, but stylised realistic acting requires acting that relies on imagination that surpasses our normal human experience. On the opposite end of its spectrum, both character acting and character design may be highly stylised, resulting in performances of cartoon characters that believably interact with real-world counterparts. This is by far the most common vactor acting style category in feature films. A few examples include Tony Stark/Iron Man from *Iron Man 2* [55], Medusa from *Clash of the Titans* [56], and Yogi from *Yogi Bear*. [57]

Non-Realistic Acting: styles of acting that do not descend from the Stanislavski tradition

Non-realistic acting is a category meant to encompass a variety of performance modes outside of the Western tradition. Such modes are common to Bollywood and Chinese cinema, especially. It is important to point out that "non-realistic" is not a value judgment but rather a point of difference to the style of "realism" established in the West by Stanislavski. This is a less common category and I have identified only a single example from 2010: Chitti from the Bollywood film *Enthiran*. [58]

Anthropomorphised Acting: creatures acting with human-like intentions

Anthropomorphised creatures have been a hallmark of animation since its earliest days, and it is of little surprise that this is one of the most common vactor styles of acting. Anthropomorphised acting consists of creatures who are able to communicate a human-like range of empathy, emotion, and intention. Such characters include Aslan and Reepicheep from *The Chronicles of Narnia: Voyage of the Dawn Treader* [59], and the White Rabbit from *Alice in Wonderland*. [60]

Sentient Acting: sentient creatures performing according to their innate intentions

There are many intelligent creatures in film who, while unable to communicate directly with humans, are able to express clear intention, emotion, and thinking. Often these vactors take the form of fantastical or alien creatures whose lifestyles and manner become clear to us through their actions alone. Examples include the Death Eaters from *Harry Potter and the Deathly Hallows: Part 1* [61], the Homunculi from *Don't Be Afraid of the Dark* [62], and the Dragon Spirit from *The Last Airbender*. [63]

Complex Animal Performance: non-sentient creatures performing directed actions

If a CG creature lacks a clear reasoning ability, the performance it generates will likely be either basic or complex. In this case, complex refers to a type of performance that such a creature would not likely produce of its own accord, or would at least need to be trained to do so. This is sometimes a bit of an arbitrary distinction due to the fact that many of the creatures that fall into this category do not exist in the real world, and therefore it is debatable what behaviours we should normally expect of it. Examples include the Scorpiochs from *Clash of the Titans* [64], Nagini from *Harry Potter and the Deathly Hallows: Part 1* [65], and the Bandersnatch from *Alice in Wonderland*. [66]

Basic Animal Performance: non-sentient creatures performing their basic instincts

Basic animal performance is a type of action or performance we would normally expect from a given animal without training it to do so. The important distinction here is that the performance needs to be significant in that it advances the story in at least a small way. This is not a common category and there is only one example from 2010: the crows featured in *Jonah Hex*. [67]

Physical Acting: characters primarily performing a single type of action, such as fighting

Physical acting is one of the most common vactor categories of acting style. This is unsurprising in that physical acting carries on in the tradition of digital doppelgängers that are used as actor replacements for stuntwork. A significant point of difference is that characters in this category participate in at least one form of pretence, indicating that the character has visible sites of acting while engaging in this style. Examples include Tron/Rinzler from *Tron: Legacy* [68], Hans from *Trollhunter* [69], and Tony Stark/Iron Man from *Iron Man 2* [70] (as an example of how a character may participate in more than one style of acting).

Conclusion

This paper is an attempt to formalise definitions of different types of performance common to CG characters in feature films. Terms such as a virtual actors (vactors), syn-

thespians, and digital doubles are frequently (and incorrectly) used interchangeably due to a lack of established definitions. I suggest that "vactor" is an overarching category of CG characters capable of producing screen-based performances. Encompassed within this definition are synthespians and digital doubles. Synthespians are CG characters that engage in at least one area of pretence and thereby produce acting consistent with our "general understanding" of human acting in films. By comparison, digital doubles are CG characters that do not directly produce acting, but whose participation in the story is implied through external matrices of representation. The term "digital double" is itself misleading and I suggest that it should instead be understood through a series of separate subcategories, including digital doppelgängers, protean doubles, and digital fantoccini.

Vactors generally – and synthespians specifically – have been defined more by the means of their technological production than by their performance capability. Defining such CG characters based on how well they uphold a present standard of visual realism is a slippery slope into unresolvable subjectivity. Today's standard of realism may seem naïve and substandard after a few more years' worth of technical achievement. Likewise, there is no clear means to measure a "necessary" amount of visual realism in order to achieve synthespian status. Instead, I suggest shifting the discussion about vactors to a purely profilmic context, and producing performance-based definitions of these terms. A caveat to this approach is that it allows for highly stylised – or even cartoon-like – characters to be considered vactors so long as they exist within a profilmic space. At the same time, characters like Beowulf who exist within fully CG productions and who are considered classic examples of synthespians are no longer counted as such under this distinction. This research is still in an early stage of development and it is yet to be seen whether it is possible to develop a meaningful definition of vactors that embraces an ex-filmic context, as well.

References

[1] Jeff Kleiser, "Don't Touch Me (1989)," YouTube, accessed December 20, 2018, https://www.youtube.com/watch?v=8ovn8qRezPA

[2] Robert O'Neill, *Digital Character Development: Theory and Practice, 2nd ed.* (Boca Raton, FL: CRC Press, 2016), 26.

[3] Synthespian Studios, "About Synthespian Studios", accessed December 18, 2018, https://web.archive.org/web/20150201014739/http://www.synthespianstudios.net/about

[4] Barbara Creed, "The Cyberstar: Digital Pleasures and the End of the Unconscious," *Screen* 41, no. 1, (2000): 79.

[5] Oxford Living Dictionaries, "Definition of Synthespian (2018)", accessed December 18, 2018, https://en.oxforddictionaries.com/definition/synthespian

[6] Collins English Dictionary, "Definition of 'Synthespian' (2018)", accessed December 18, 2018, https://www.collinsdictionary.com/dictionary/english/synthespian

[7] Hironobu Sakaguchi, & Motonori Sakakibara. (2001). *Final Fantasy: The Spirits Within*. Film. Culver City, CA: Columbia Pictures.

[8] Robert Zemeckis. (2004). *The Polar Express.* Film. Burbank, CA: Warner Bros. Pictures.

[9] Robert Zemeckis. (2007). *Beowulf.* Film. Hollywood, CA: Paramount Pictures.

[10] David Fincher. (2008). *The Curious Case of Benjamin Button*. Film. Hollywood, CA: Paramount Pictures.

[11] James Cameron. (2009). *Avatar*. Film. Los Angeles, CA: 20th Century Fox.

[12] Joseph Kosinski. (2010). *Tron: Legacy*. Film. Burbank, CA: Walt Disney Studios Motion Pictures.

[13] Joachim Fiebach, "Theatricality: From Oral Traditions to Televised 'Realities'," *SubStance* 31, nos. 2&3, (2002).

[14] Barry King, "Articulating Digital Stardom," *Celebrity Studies* 2, no. 3, (2011): 248.

[15] ibid.

[16] Richard Schechner, *Performance Studies: An Introduction, 2nd ed.* (Abingdon, UK: Routledge, 2006): 29.

[17] Lori Landay, "The Mirror of Performance: Kinaesthetic, Subjectivity, and the Body in Film, Television, and Virtual Worlds," *Cinema Journal* 51, no. 3, (2012): 130.

[18] LASALLE College of the Arts, "Professor Steve Dixon (2016)", accessed October 3, 2017, http://www.lasalle.edu.sg/academics/professor-steve-dixon/

[19] Steve Dixon, *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* (Cambridge, MA: The MIT Press, 2008), 3.

[20] Michael Kirby, "On Acting and Not Acting," *The Drama Review: TDR* 16, no. 1, (1972): 3.

[21] ibid: 6.

[22] ibid.

[23] ibid: 3.

[24] ibid: 4.

[25] ibid: 5.

[26] ibid: 6.

[27] ibid: 5.

[28] ibid: 8.

[29] ibid: 9.

[30] Birgitta Hosea, "Substitutive Bodies and Constructed Actors: A Practice-Based Investigation of Animation as Performance," (Ph.D. diss., University of the Arts London, London, 2012.): 168.

[31] Eli Rozik. "Acting: The Quintessence of Theatricality," *SubStance* 31, nos. 2&3, (2002): 110.

[32] Barbara Creed, "The Cyberstar", 79.

[33] Barry King, "Articulating Digital Stardom", 252.

[34] Mark J.P. Wolf. "The Technological Construction of Performance," *Convergence: The International Journal of Research into New Media Technologies* 9, no. 4, (2003): 49.

[35] Marc Webb. (2012). *The Amazing Spider-Man*. Film. Culver City, CA: Columbia Pictures.
[36] Peter Jackson. (2014). *The Hobbit: The Battle of the Five Armies*. Film. Burbank, CA: Warner Bros. Pictures.
[37] Bennett Miller. (2011). *Moneyball*. Film. Culver City, CA: Columbia Pictures.
[38] D. Chimielewski, "Meet Sunny's digital doppelganger (January 5, 2005)", The Age, accessed December 20, 2018, http://www.theage.com.au/news/Film/Meet-Sunnys-digital-doppelganger/2005/01/04/1104601340883.html
[39] Lisa Bode, "Digital Doppelgängers," *M/C Journal*, Vol. 08, No. 03, accessed December 20, 2018, http://journal.media-culture.org.au/0507/07-bode.php
[40] World Encyclopedia of Puppetry Arts, "Fantoccini (2018)", accessed December 20, 2018, https://wepa.unima.org/en/fantoccini/
[41] Hironobu Sakaguchi, & Motonori Sakakibara. (2001). *Final Fantasy: The Spirits Within*.
[42] Robert Zemeckis. (2004). *The Polar Express.*
[43] Robert Zemeckis. (2007). *Beowulf*.
[44] David Fincher. (2008). *The Curious Case of Benjamin Button*.
[45] James Cameron. (2009). *Avatar*.
[46] Mike Disa. (2011). *Hoodwinked Too! Hood vs. Evil*. Film. New York: The Weinstein Company.
[47] Takeshi Nozue. (2016). *Kingsglaive: Final Fantasy XV*. Film. Culver City, CA: Sony Pictures Home Entertainment.
[48] Dean DeBois. (2014). *How to Train Your Dragon 2.* Film. Los Angeles: 20th Century Fox.
[49] Brad Bird. (2018) *The Incredibles 2*. Film. Burbank, CA: Walt Disney Studios Motion Pictures.
[50] Wild About Movies, "Wild About Movies," accessed December 20, 2018, https://www.wildaboutmovies.com/
[51] The Internet Movie Database, "IMDb," accessed December 20, 2018, https://www.imdb.com/
[52] Joseph Kosinski. (2010). *Tron: Legacy*.
[53] David Yaters. (2010). *Harry Potter and the Deathly Hallows: Part 1*. Film. Burbank, CA: Warner Bros. Pictures.
[54] Tim Burton. (2010). *Alice in Wonderland*. Film. Burbank, CA: Walt Disney Studios Motion Pictures.
[55] Jon Favreau. (2010). *Iron Man 2*. Film. Hollywood, CA: Paramount.
[56] Louis Letterier. (2010). *Clash of the Titans*. Film. Burbank, CA: Warner Bros. Pictures.
[57] Eric Brevig. (2010). *Yogi Bear*. Film. Burbank, CA: Warner Bros. Pictures.
[58] S. Shankar. (2010). *Enthiran*. Film. Chennai, India: Sun Pictures.
[59] Michael Apted. (2010). *The Chronicles of Narnia: Voyage of the Dawn Treader*. Film. Los Angeles: 20th Century Fox.
[60] Tim Burton. (2010). *Alice in Wonderland*.
[61] David Yaters. (2010). *Harry Potter and the Deathly Hallows: Part 1*.
[62] Troy Nixey. (2010). *Don't Be Afraid of the Dark*. Film. Los Angeles: Miramax Films.
[63] Tim Burton. (2010). *Alice in Wonderland*.
[64] Louis Letterier. (2010). *Clash of the Titans*.
[65] David Yaters. (2010). *Harry Potter and the Deathly Hallows: Part 1*.
[66] Tim Burton. (2010). *Alice in Wonderland*.
[67] Jimmy Hayward. (2010). *Jonah Hex*. Film. Burbank, CA: Warner Bros. Pictures.
[68] Joseph Kosinski. (2010). *Tron: Legacy*.
[69] André Øvredal. (2010). *Trollhunter*. Film. Norway: SF Norge.
[70] Jon Favreau. (2010). *Iron Man 2*.

Author Biography

Jason Kennedy is a senior lecturer and Animation Pathway Leader in the Digital Design department at Auckland University of Technology. He is a practicing artist with work in 3D animation, 3D Fine Art, video projection, and fine jewellery.

Jason is currently working on his PhD, which examines how our understanding of acting changes in light of modern animation and performance capture practices. In addition to being an animator, Jason is also an actor, and he draws on these two areas of experience to create his thesis.

Lifemirror: On the Circulation of Light in Networks

Oliver Case
Thanet
United Kingdom
ojcase@gmail.com

Abstract

This paper extends a theory of Lifemirror, a practice-based study on crowdsourced filmmaking first presented at ISEA2013. Inspired by the film *Life in a Day*, an online platform was developed to create and observe a crowdsourced film image by channeling video from smartphones directly into cinema spaces. The familiar film-event is replaced with a reflective film-process via networked camera gestures, a conceptual move which endeavours to maintain a flow of light as an extension of the environment. The consideration of such 'non-editing' systems is discussed in relation to the problem of energy and a spiritual dimension inherent in digital cinematic culture. After an introduction to the Deleuzian image, a theory is pursued through a trio of mini essays on the dominant themes, 'Time', 'Sense' and 'Other' where each is complimented by an original artwork from the surrounding practice.

Keywords

Cinema, Crowdsourcing, Deleuze, Post Internet, Mobile networks, Anthropocene, Practice as Research.

Introduction

Throughout cinema's short history, the exclusivity of the apparatus and its inherent power as a medium of mass communication has caused the machine to evolve a literary form that maintains a one-to-one/one-to-many relationship with the audience. This has caused a gravitational bias towards the director-as-author and an emergence of film theory centred on practices developed by a fortunate few. Today, smartphones are facilitating a freeform of cinematic expression within systems based on the author-centric model. These are perhaps exemplified by YouTube's infamous strapline, 'Broadcast Yourself'. Each day, millions of authored narratives vie for attention in a Darwinian model of media where hits and resolution determine survival. This study begins with the meeting of cinema, which first brought the moving image (and its viewer) under control, and the internet, which promises to free them.

Cinema immerses audiences in the place, time and action of others. 'Film-worlds', both fiction and documentary, form through myriad processes conspiring to connect viscerally with the audience. However, there is a fundamental distinction between the two genres. While both aim to create or recreate *worlds*, fiction tends towards illusion, and documentary, unless it has ulterior agendas, tends towards truth. As Hitchcock once quipped, 'In feature films the director is God; in documentary films God is the director' [1]. We might then ask where God resides in the crowdsourced docudrama *Life in a Day* [2] which credits 29 co-directors and contributions from countless others around the world? The film is constructed entirely from videos contributed by a global network of YouTube users who were asked to 'pick up a camera' and start filming within the 24hr period of a specific day. The resulting 93-minute sequence compresses 80,000 video contributions from 192 nations to 'tell a story', from sunrise to sunrise, of a single day on earth. It is truly an Internet-enabled film and the format has since inspired a plethora of country-specific versions [3].

To interrogate this emerging form, I developed Lifemirror [4, 5, 6], a platform for auto-generating crowdsourced film in cinemas. The system adopts simple rules that facilitate a movement of light uninterrupted by editorial intervention[1]. In this way, the Lifemirror 'machine' circulates images between cinema screens and a creator-audience through increasingly capable cameraphones. The traditional cinema experience of attending an authored *film-event* transforms into a generative *film-process* through contingent audience participation. As an example of Expanded Cinema [7], the machine subverts the traditional form by transforming the editorial cut from a control mechanism to a network sensitivity. Expanded Cinema's commitment to the art's relationship to consciousness takes on new meaning in the network. Where there is light, there is cinema – and this becomes a question of energy. To unpack these ideas further it is necessary to introduce a materialist perspective on cinema and media more generally.

Environment | Media

'Environments are media' [8] is arguably one of the most important statements from the emerging eco-media movement [9, 10, 11]. It affirms the balance which is key to human life and survival on this planet. The author of the statement John Durham Peters reminds us that all we have around us is in a very real way, 'the middle' of things and this provides a powerful reference point for exploring the networked moving image and its effects on society. Sean

[1] This was achieved by means of an iOS and Android app that could upload footage directly from cameras to user-named, perpetual counters on a server. Films generate from an accumulation of video clips continuously looping in time-sequential order and the content of the film is dependant on the audience watching.

Cubitt emphasizes the impact of human agency when he writes, 'media and mediation cannot be separated from their environmental impacts, but for that very reason they are privileged tools in creating a future other than our dark now' [12]. The climate crisis, as exemplar of this 'dark now', can therefore be positioned as a question of media. We might ask, what media conditions are necessary to communicate and perhaps realise what Bernard Stiegler terms 'neganthropy' [13] – a human-driven reversal of the overarching imbalance that is Anthropocentric climate change? And to what extent is cinema responsible when new media's most demanding energy requirement is the digital moving image? As a response to these pressing questions, Lifemirror is presented as a catalyst for theorising media sustainability based on the circulation of light in networks.

The Lifemirror machine subverts the control mechanism of film production by insisting on a continuous movement of images between cameras and screens. As light is a form of radiation, there is a corresponding change in film production as an energy system. What we physically see is a small slice of the electromagnetic spectrum which is arguably our closest scientific representation of eternal light, or Lux Aeterna. It is not an understatement to say that control of the spectrum has formed the foundation of the information age and our modern world [13], however it could be argued that such control reaches its nexus with the simultaneous advent of 8k video (pixel resolution at the limits of optical perception) and 5G networks (millimeter-waves at the limits human safety). Digital video already makes up for over 75% of all internet traffic and is in a constant upward trend [14]. During its ascendance, there has been an 80% increase in the energy needed to create, encode, store and transmit video due to the intermittent quadrupling of per-frame energy [15]. The usual response to this problem is to design more efficient compression, but now codecs cannot keep up and even with more energy efficient data-centres, streaming services need to store more versions of each file to meet different connection speeds [15].

In using ever higher frequencies, Professor Harald Haas postulates that lifi (wifi using visible light) is itself a 5G technology which puts us on the crest of a paradigm shift 'as significant as the analogue-digital transition' [16]. Demonstrated in 2011 at TED [17], lifi is 100 times quicker than information transmission over the radio band rendering the transfer of traditional films as instantaneous. While the air is encoded with data, oceans are lined with fibre-optic cables that make up the information infrastructure of global communications. The environment is media both on natural organic and human technical levels which suggests a growing need for society to sensitise to a vibrational reality. 'Impermanence' has long been a central teaching in Buddhism and may explain its growing popularity in the West as a tool for coping with an increasingly dense and accelerating infosphere. Sean Cubitt notes that it was the pursuit of coherent light in the late C19th that lead to the historical realization of Kantian freedom from the laws of nature, and that these methods are 'rigorously integrated into the hardwiring of contemporary global infrastructures' [19]. These 'ossified systems need a radically different understanding of light and its various functions and behaviors in digital culture. According to Cubitt,

> it will be one of the key challenges of the twenty-first century to invent new modes of working with light that involve not simply freeing it, as an entropic gesture, but finding new ways to create in partnership with light, rather than through its enslavement [19].

The advantage of framing the energy problem as a question of *light and time* is that there opens an opportunity for a cinematic response. For this, cinema must be taken at its roots.

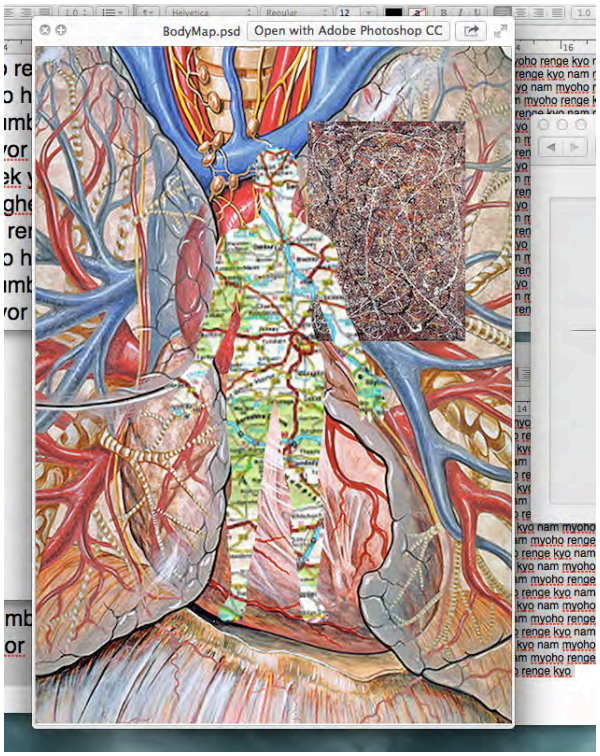


Figure 1. BodyMap #773110ZD1210. An image from my notes on the film Emptiness. In the background are various mantras the computer had been tasked with chanting. The image was constructed in reaction to the sound after attending a 10-day Vipassana course in the UK.

Deleuze | Image

Through his effort to form a 'logic' of cinema, Deleuze affords an ontological interpretation of how film might function in terms of light and time rather than authorship and story. Narrative in cinema is crafted through a complex array of image-making techniques that Deleuze argues are evolving proxies of the pre-technical functions of mind. Following Henri Bergson [20], the universe is but the interplay of images and the screen is their secondary mediator after the brain as a 'centre of indetermination'. Even before we

became moviegoers, the human mind worked cinematographically. We pan and tilt our heads, track with our bodies and focus with our eyes on the aspects of reality that most naturally coincide or agree with our evolving life narrative. The continuous interaction between ourselves and the movement of light continues in the cinema where the body-camera that allows us to live out our own story is surrendered to the techniques of directors (other humans and organising systems). Deleuze's book on cinema proposes a taxonomy of image-types that can be transposed to a perceptual reality on the 'brain screen' where we can recontextualise them for different requirements.

The tome is significantly divided up into two volumes: Cinema 1: The Movement image [21] and Cinema 2: The Time-image [22] where the caesura directly mirrors a break in human cinematographic perception. Cinema 1 at once develops and dissects the 'movement-image'. In short, this is a cinematic that conforms to the sensibility of the 'sensory-motor schema' which is the function of the brain that facilitates 'the common-sense temporal and spatial coordinates of our everyday world' [23]. The epitome of this image-type is found in Hollywood where we tend to follow narrative progressions relatable to our own experience of everyday reality. Cinema 2 hypothesises the breakdown of this function as reflected in a second cinematic, the 'time-image'. The time-image does not conform to our perceptions of the linear unfolding of reality but rather gives us an 'irrational cut', a movement outside perceived causality that brings the senses 'into direct relation with time and thought' [22]. It is a space-time where, in a literal sense, thought is forced to move differently. Deleuze argues that modern cinema was formed around this break in perceptual flow which only clearly reveals itself after World War 2. This was a time when cinematic narratives found themselves in a state of inoperability, a people-as-character unable to make sense of the devastation and non-sense of the event.

In her essay, Images of Thought and Acts of Creation, Amy Herzog concludes that 'the challenge is to see film not as a means of representation, but as an assemblage of images in flux with the world of images' [24]. The force of the hypothesis implies that cinema reflects transitory formations of consciousness itself, a working and re-working of the mind that takes place between actual and virtual screens. Jacques Rancière writes (on Deleuze's work):

> Along comes this book with its radical thesis. What constitutes the image is not the gaze, the imagination, or this art. In fact, the image need not be constituted at all. It exists in itself. It is not a mental representation, but matter-light in movement… Matter is the eye, the image is light, light is consciousness. [25]

This relationship of the recorded moving image to consciousness has deeper implications. Jonathan Beller argues that the cinematic mode of production results in an 'attention economy' [26] while Bernard Stiegler terms the widespread commercial engagement with visual media as a progressive 'industrialization of consciousness' [27]. If we extend the increasing cost of energy from the environmental to the mental, we may argue for an urgent call to interrogate the digital image and re-evaluate the practice and production of cinema in its networked form.

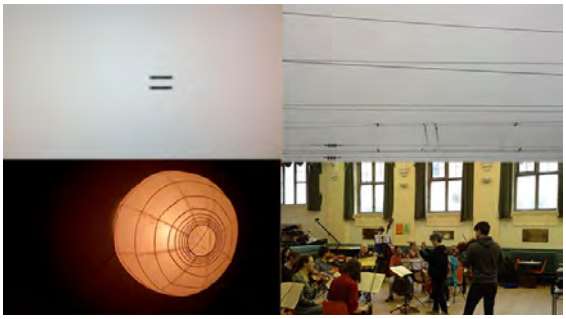


Figure 2. Maths and Equations. A film generated by Lifemirror in March 2013. The dynamic juxtapositioning of numbers, symbols, organisms and objects provided a useful boundary object for cinema focus groups. What happens at the limits of quantification in the biosphere?

Time

Where modern cinema evolved from the movement-image to the time-image, networked cinema begins with time-images that reform into an external arrangement of movement-image. The incommensurable leap of the time-image stems from the reorientation of the individual's preconception of the unity of space and finds correlation in the quantum or synaptic behavior in the brain. In a networked cinema, the sensory-motor familiarity of the movement-image retreats into the potentiality of pure time and exists in symbiosis with the mind where computational processes claim a stake in the continuation of the world-as-film. In other words, the connection to one's environment and familiar movements of reality begin to deterritorialise and the time-image becomes primary.

In his article, 'The Scattering of Time Crystals' [28] Michael Goddard reads Deleuze's crystalline account of the time-image in relation to Bergson's static and dynamic religions to endow cinema with the potential for mystical experience. Where static religion depends on a closed morality maintained though rigid organisation, dynamic religion is creative, vital and crystalline in that it is an 'open morality' sensitive to the spiritual currents that elude a probing intellect. Goddard relates this distinction to the time-image by suggesting that its very openness as a pure aesthetic that transcends the movement-image can be a tool for creating mystical experience. He argues that 'cinema, in its crystalline forms, can become a spiritual tool' capable of inducing ecstatic subjectivation as a 'pure optical and sound situation'. This renders cinematic experience as 'a scattering of time crystals that leads audiences beyond the boundaries of

their static selves and into profound contact with the outside [Ibid.].

The network-induced inversion of cinema from authored film-object to open stage of contingent contact forms a similar crystalline foundation for such experience. Where the organic regime 'is entirely reliant on sensory-motor schemata, which are habitual images that stand in for any direct experience of the spiritual' [Ibid.], a reterritorialisation of sense suggests a potential re-engagement of spirit through an evolved image of time. Goddard continues:

> Like an iceberg, the majority of which remains submerged beneath the surface of the ocean, mystical experience gives rise to a form of temporality that crystallises powerful virtual forces, beyond the power of an individual body or discourse to actualise: the body plunges into the virtual or spiritual depths which exceed it [Ibid.].

In a time-led cinema without an author, interconnected movements and virtual connections are submerged in the past and superpositioned onto the brain-screen[2] via the digital mediation of networked sense and contact. What is left are connection and delay points between actual and virtual times emerging through the human-machine process where, as opposed to a cinema manufacturing sense, instead complicates an emerging technological engagement with collective sense. This process resonates with Deleuze's earlier descriptions of the brain taken from Bergson:

> The brain does not manufacture representations, but only complicates the relationship between a received moment (excitation) and an executed moment (response). Between the two, it establishes an interval [30].

A meta-cinematic machine that has no production processes outside the community encounter makes way for an understanding of narrative and vitalising of myth through co-emergent 'films-to-come'. Understood as such, Lifemirror becomes an elongated community-made interval, or meta brain-screen.

To recapitulate, moments of 'sensed life' can filter through the network into the collective perceptual schemata of a networked audience. A contraction of temporal sensations offered by smartphones and connected devices reflect a community perspective (through the reciprocity of co-consciousness on screen) and so a creator-audience[3] form an image of time through collective participation. This contingent and evolving materialisation of time arrives through the Earth sensing itself through the collective cinematic evolution of consciousness. Earth realises her own time through sense mediated by us. In Hegelian terms, where humanity surges towards 'absolute knowledge' through the teleological sublation of opposing forces, the spiritual path for humanity reaches an essential collective image in order to make a vital sensory connection to the planet. Here, if only as a utopian ideal, the 'calling of cinema' may transcend relative experience and move on towards a collectively generated communication. We already see transformations of thought in media, in 'middle' or 'exterior' voices such as Malabou's 'voir venir' derived from a temporal reading of Hegel[4], or complete breaks from human-subject correlation as found in the radical contingency of speculative realism[5]. Earth's historical sense in the Anthropocene stems from recorded science reaching limits in both directions, from the infinitesimal 'God' particle, to the shape of universal light. Cinema and digital technology may then be seen as points of mass reflection in the evolution of consciousness where we experience contact (through separation) of minds.

If Lifemirror fractures the spectacle's illusion of completeness, it does so by using the contingent and continual fragmentation of the real against itself and without capital to create a diffractive mirror through which elements can pass and reform anew. Networked cameras, a web of sense, may offer humanity an entirely new perspective beyond the individual. It is worth noting Mark B. Hansen's concept of 'world sensibility' which acknowledges the importance of digital affect and its impact on the body and environment [31]. As we enter the proposed Anthropocene, a way of conceiving art without an author or reading stories without a hero (just as science now progresses in networks rather than the solitary mind) may help balance the film-earth relationship (the worlds and world we make) and further, help us define ourselves in the cloud consciousness we are making

Time | A Year in 5 Minutes

The theme of time is considered in the work *A Year in 5 Minutes*. Realised prior to Lifemirror, the film explores the structure of crowdsourced works such as Life in a Day. I condensed a year's worth of images on my cameraphone library into a 5-minute film. The rules set were, i) other than the intro and outro, images had to be placed chronologically in the timeline, ii) clips may be trimmed and retimed (but never re-ordered), and iii) music must take cues from the footage. The production was completed within a matter of

[2] Deleuze likened cinema to the functioning of the brain in interview using the infamous line 'The brain is the screen!' [29].

[3] Here, one may substitute Lifemirror, which was a relatively small intervention, with a global camera network formed by platforms such as Instagram in order to better visualise these behaviours of light.

[4] Where Derrida's project found in writing a way to navigate and bring to light the ever-present otherness in a text, Malabou finds in reading a neuro-plastic function that can fuel and disarm either side of a dialectic. In the act of reading, Malabou identifies the temporally plastic notion of 'voir venir', which can mean both to 'be sure of what is coming' and to 'not know what is coming'. For more detail see (Malabou, 2004).

[5] For more see (Meillassoux, 2008).

hours due to the fact that prioritising a linear temporality freed me up from the myriad creative decisions normally associated with editing. Works such as this led to reflections on a network responsive cinema. Figure 3 shows an augmented notebook page with an outdoor cinema feeding footage back to the audience through natural filters.

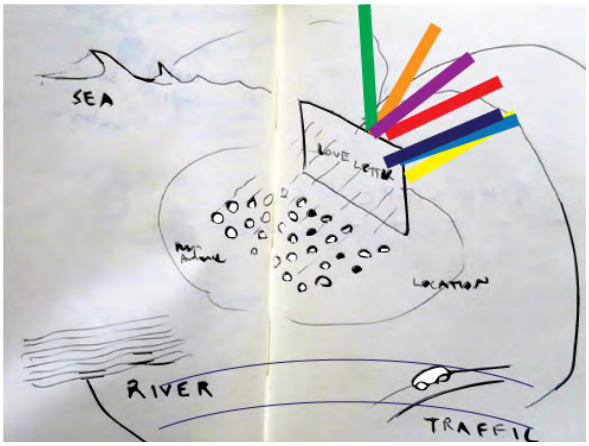


Figure 3. Cinema in my notebooks. Network images appear according to data incoming from sensors in the environment. Speculative films were suggested by audiences where natural elements dictate the flow of narrative. These ideas are currently igniting a film project on reincarnation.

Sense

The Lifemirror machine helps illuminate the fact that crowdsourced films like Life in a Day are not representational of community narrative by very fact of their construction. Helga Lenart-Cheng provides an important critical intervention in this area by discussing Life in a Day and similar crowdsourced film projects as legitimating a universalist view of global community. By analysing the editing techniques, she notes the inherent threat of undermining the very heterogeneity of time the films were meant to celebrate: 'By embracing this universal notion of simultaneity, Life in a Day purports to reconcile the relativity of our individual representations of time with the universality of our time sense' [32]. Cinematic machining a many-to-many production process then seems like a viable way to escape an author-community impasse in future hyper-connected media. The relativity of a transpolitical time-sense, between screen and audience, individual and machine, must then to be understood in relation to the work such that we may perceive its wider political implications.

Bergson's project offers a framework for sensitising to a universe of images that in turn allows Deleuze to theorise a molecular cinema that can illuminate and mobilise thought (a cinema of durations). In *Creative Evolution* [33], contra Darwin's model of 'survival of the fittest' (the Hollywood machine), Bergson reveals a sensitivity to the unfolding of perception by placing consciousness within life itself and establishing a concept of man who 'possesses a capacity for profound sympathy with everything that lives' [32]. As an audience sharing sense-experience, Lifemirror channels the image-as-connection (individually mediated encounters with the world) into a machinic processor of co-conscious awareness that is created individually and experienced together. It is a model that mimics the human perceptual function in linear sensation and irreversible time which may be able to process a 'deep-sense network' (as mobile sensors evolve and proliferate). Emergent network thinking has been progressed by Christopher Vitale whose work on 'Networkologies' provides a manifesto for sensitising to networked states. In his book of the same name, Networkologies was formed from an extensive online blogging project. In this, he writes:

> For now there is no need to imagine how mind arises from matter, since the ability to "feel" is likely part of all matter…this feeling begins to feed back onto itself, begins to feel itself feeling and to develop feelings about this. It is all networks and feedbacks between them at all levels of scale. [34].

As far as the eye is the most evolved of human senses, collective vision becomes a central, or rather primary question that may provide a 'sense of sense' for a connected community. As Jacques Derrida notes in his discussion of Deleuze and Guattari's hapticity of the eye, 'Intuitive vision does not just come into contact, it becomes contact, and this movement would pertain to its nature' [35]. Such an insight comes from a man who was all too aware of the interruption of film. In the documentary bearing his name, Derrida (2002), he quips to the film crew fumbling with equipment (that) 'the reflector interrupts the reflection'. An 'accidental' moment recorded extra-interview, his remark rather amusingly highlights the temporal separation and connection of recorded film hovering between production and reality, the very problematic set out in this project. Lifemirror communication, from the haptic perspective, may perhaps be thought of as non-produced and pre-linguistic, a film where the existing bonds that are human sensitivities remain contingent (with or without reflectors). In this way, a networked film is entirely separate from the film as territory.

David Hockney, aware of the 'time of art', once remarked that the splash of *A Bigger Splash* (1967) took seven days to complete and compared this to a 'weakness of photography for being snapped' [36]. Of course, it is not a weakness for the great flaneurs-turn-street photographers such as Bresson or Maier whose art was immanent with the camera as extension, but is there not a convergence of time in the body and of sense in the digital? In the film Hockney (2014), the painter insists (that) 'wider perspectives are needed now', and notably, much of his recent work plays with perspective, reversing depth to open out the world to confront the viewer (much like a cinema). Referencing the 1967 painting, the *A Bigger Picture* Exhibition (2012) adopts digital technology to navigate the material and immaterial space between

perception and nature. The video-based work is formed through a web of iPads simultaneously recording in order to create a fractal-like perspective on nature, and the paintings tower over the viewer after being recreated from works made by a digital tablet (iPad) in the field. More recently, Microsoft has produced an 'original Rembrandt' using machine learning [37]. Algorithms read the signs of Rembrandt's style and recreate an original image which is then 3D-printed into material form. We might then seek the aura of Rembrandt. Will it be felt when confronting the painting at its planned exhibition? Benjamin observes:

> What is aura, actually? A strange weave of space and time: the unique appearance of a distance, no matter how close it may be…to trace a range of mountains on the horizon, or a branch that throws its shadow on the observer, until the moment or the hour become part of their appearance— this is what it means to breathe the aura of those mountains, that branch. [38].

If it is a coincidence of space-time that gives rise to the aura, the digital event suggests an auratic opportunity precisely because it coincides the spatio-temporal relationship of human-earth media. Digital networks leave traces of both mind and matter in a high vibrational sphere, an aura as halo, a 'supplement added to perfection–something like the vibration of that which is perfect, the glow at its edges' [39]. As pharmakon[6], we are also negatively faced with a vulnerability that comes with speed of progress and ubiquitous integration – the capitalisation on the immateriality of money, trolling and neuro-advertising being examples. It is perhaps in understanding art as a practice of light [40], as an inclusive mediation of sense, that a network cinema may balance transitions and reimagine how collective memory can be structured. For if it were achievable, the 'impurity' of cinema [41] as the usurper of other arts and origin of digital media, might evolve into another calling in the hands of the creator-audience.

Sense | Points of Presence

The film *Points of Presence* (2017) is a collaboratively produced 20-minute film that submerges the audience in the socio-ecological tangles of internet materiality. It shows what can been seen and mediates the unseen of information. The video focuses not on the consumerism surrounding digital culture but rather on the symbiotic relationship between information infrastructure and the geographic, geologic, oceanographic, and atmospheric elements, immersing the audience in the textures, sounds, vertical vision, of the digital ecology of the North Atlantic. Tracing a network of undersea cables using drones reveals how the internet is a material political object intertwined with the natural environment, human labour, and mobility of data (Figure 4). The fibre-optic cables carry light in order to project light across billions of screens and the history of cinema embedded in the landscape. As the drone, we feel ourselves an immaterial presence within a digital-organic material landscape. Internet and drone share the same light-encoded information, 'a circulation of frequencies originating in the control of fire' [42].

Figure 4. Points of Presence. The drone observes humans burying the internet into a mountainside in Iceland. The fibre-optic cables extend to the sea in both directions where they continue around the globe.

Other

Much like cinema, people express 'possible worlds'. [43] The cinema of the network is not an enclosed world but rather the film-world turned inside-out through the proliferation of mobile recording technologies. The wandering camera-machine confronts a cinema leaking theatre. Films such as *Russian Ark* (1996) *Live Tape* (2009), and *Victoria* (2015), replace montage with single shot, camera-theatre performances. Lars Von Trier's *The Boss of it All* (2008) attempts an opposing strategy by self-referentially disrupting film with automated editing. To do this, the director developed a bespoke system called 'Automavision', a machine that limits human authorship by randomly adjusting the settings and positions of the camera. By disturbing the viewpoints, traditional cinema feels a tremor from the digital machine and the 'boss of it all', as an ironic reflection of the author, is called into question. The seventh art is indeed transforming into something entirely different when networked, something 'other'. Deleuze asserts that, 'the Other assures the margins and transitions in the world' [Ibid.]. He continues that others 'introduce the sign of the unseen in

[6] Pharmakon in Ancient Greek can mean both remedy and poison. In Phaedrus, Plato uses the term to reject writing in favour of thought-speech in dialogue with others (writing is seen as a poison that harms memory). Jacques Derrida uses the word in its split meaning to suggest that writing is both remedy and poison, thus making the term a deconstructive expression of indeterminacy. For a more detailed explanation of the term see (Deutscher, 2005: 8-10).

what I do see, making me grasp what I do not perceive as what is perceptible to an Other' [Ibid.]. This meditation on the Other is drawn from a reading of Michel Tournier's reworking of Robinson Crusoe. Without the Other, Robinson is confronted with the 'structure-other' where his given conceptions of reality break down to leave him in an elemental state. Rather than the ego, it is this structure 'which renders perception possible' [Ibid.] and leads the way for a reorganisation and comprehension through the Other, without whom there is nothing but elements [Ibid.].

Considering the Internet of Things[7] (IoT) as a 'temporally mediated Other' is an interesting idea in terms of perception and the construction of meaning. The world becomes uncommonly sensed together from that which we do not see or experience. What emerges in a networking cinema is an inverted author-vision so that only the exterior, through self and other, reveals itself in time. Thus, together we experience duration (as opposed to synchronized device-time). This experience of time through self and other in an elemental cinema then questions the essence of a temporal community. Deleuze elaborates:

> The Other thus assures the distinction of consciousness and its object as a temporal distinction. The first effect of its presence concerned space and the distribution of categories; but the second effect, which is perhaps the more profound, concerns time and the distribution of its dimensions - what comes before and after time [Ibid.].

In light of this, Lifemirror reflects a more general cinematic of 'being together' in a linear paratactic feedback. Digital networks allow the 'before and after' time of film to be represented through an extended sense of the creator-audience – Walter Benjamin's 'Messianic Time' seeping through crystalline smartphones.

To further explain this evolving cinematic, it is useful to consider Jean-Luc Nancy's observation that 'communication consists before all else in this sharing and in this co-appearance (com-parution) of finitude' [44]. In re-formulating Heidegger's notion of 'being-towards-death' with mitsein (being-with), rather than dasein (being-there), the philosopher proposes an idea of community based on shared finitude and an interruption of myth. This project may similarly be seen as an interruption of cinema (and cinematic thinking) as the emblematic tool for the subjective continuation of myth in collective memory. Nancy calls upon myth as a communication of the 'in-common' that spans our shared finitude in order to set in motion a political thought of community. Images made in the digital network also span our individual finitudes such that it is arguable that myth itself, like the notion of space, will be mediated under new terms. The involution of myth as 'nature communicating itself to man' [Ibid.] may be invoked by way of a movement of cinematics that continually defer to a middle voice and in the transmission of images between digital and organic planes. In discussing Nancy's conception of community in relation to myth, Ian James observes that the mythic narratives that form our sense of identity are themselves without foundation. Myth itself cannot account for the plurality of finite sense that forms experience, however this very plurality 'might then be organised into new mythic narratives which would displace the old' and where historical change can be seen in terms of 'a constant birth or becoming of singular-plural sense' that interrupts established foundational narratives and opens the way for future narratives to emerge [45].

Nancy's framework thus provides a powerful tool for critiquing the communitarian aspects of cinema and considering a cinematic network where myth continually interrupts and invents itself through the transformations of a people. In this new formulation, the seventh art in the cloud is a cinema-to-come where its elements are people who are, to some degree, artists 'with the task of answering to this world, or of answering for it' [46]. This calls for a transformation of the artist-philosopher in a world without others, into a participating channel with networked tools 'open to this fragmentation of sense that existence is' [Ibid]. Attending a networked cinema would signify a community distinct from society in that creation-attendance reforms community into 'an organic communion with its own essence' [44], a community without unity but in the interstitial spaces of cinematic thinking. Here, the intimate relationship of 'being together' and 'co-creating the world' may be considered through the 'gesture of video' as 'a new way of being-in-the-world' [47]. We would be elemental in this expanding cinema, as possible worlds communicating a possible world, obliterated and alone, but recreated in time.

Pre-empting Von Trier's comedy, The Boss of it All, Bergson suggested that laughter occurs when mechanism is injected into the human situation [48]. Through this lens, digital technology could be placing us at the margins of a divine comedy. We need new ways of thinking-doing art as a *way with* rather than as an aspiration or commodification – a making art sacred in all directions in time and so to open different doors to the future – digital or not. Those who are called artists have an ability to touch others through a medium, but the great circuit is in reality at every instant and every centre of indetermination. A Zen monk contemplates the universe on tilt as she pours the tea, so networked technology deserves a similar awareness for it forms a web that both surpasses and supports our own agency as a medium of nature. Humans are now responsible for connections between digital and organic networks where both may influence each other. Whatever they do to the web, they do to themselves. And as both audience and authors to the film flows of organic life. This paper suggests that this sensitising of the network may be explored through explorations of cinematic difference.

[7] The 'Internet of Things' proposes to interconnect everyday objects by allowing them to collect and exchange data and its advancement is rapidly reconfiguring the real and virtual

that is life, our performance now moves in two directions, touching two webs. So as theatre turns to meet our cameras, we might hear Deleuze urging both director and now meta-director to think again the problem of the stage, 'the problem of a movement which would directly touch the soul, which would be that of the soul' [49].

Other | Emptiness

Emptiness (2014-2019*)* [58] is an authored video installation. A computer voice beckons the audience into the dark room and hurries them to take their seats before a wall-sized screen. Made using Apple's text-to-speech software, the voice creates the illusion of a conscious cinema who laments the carelessness of humankind before reciting part Sanskrit–English translation of the Heart Sutra. The voice carries over the image of body meditating in a forest. The image slowly recedes and fades to white leaving heat lines in place of the trees (Figure 5). As an overarching reflection of the Lifemirror project, Emptiness embodies the concepts of time, sense and other through the idea of non-conception. Where Vipassana meditation, purportedly the Buddha's original discovered technique, allows sensation to rise and fall away in order to observe true reality, the platform simply observes the effects of sensory network. Emptiness contemplates the radical Other of the void and the light of cinema. One black screen then one white screen, now circulating outside the confines of tradition. Interestingly, in Taoist meditation, the internal process in the body is described as 'letting light move in a circle' which allows a negentropic force, or chi in the case of the body, to self-energise [50]. This secret to eternal life, Lux Aeterna, was known to the ancients and must perhaps be relearned by contemporary society (whose network now constitutes the global body) because when networked, we become the feedback the earth needs to support life.

Conclusion

As humans, we do not see the clamour of light around us, and even less how it responds to our individual actions. Imagined as a heat map, proliferating devices and their interaction with consciousness suggests a parallel climate change of the human environment. This global pulse may arguably be interpreted as cinema expanded, a human-created halo circulating through bodies and minds. This paper has offered an alternative perspective on the image in digital networks to help illuminate this nascent reality and has proposed an exploration of systems that offset the growing energy demands of a fully realised cinematic network built on industrial foundations. If rapid innovation is blind in its strides, we have never been closer to complete immersion in a dazzling Lux Aerterna, whether that be the death of the species, or a self-made paradise.

Figure 5. Emptiness. The camera slowly recedes from a human form meditating in a forest while text-to-speech software recites the Heart Sutra to the audience.

Acknowledgements

Lifemrror was funded by the EPSRC through the 'Telling Tales of Engagement' Competition and the 'Catalyst Citizens Transforming Society' Project. Sincere gratitude to Dr. Adam Fish and Dr. Bradley Garrett for bringing me onto the fascinating Points of Presence project and Ireti Olowe for her inspiring work on Emptiness.

References

[1] Wikipedia contributors, "Alfred Hitchcock - Quotes", Wikipedia, accessed April 14, 2019, https://m.imdb.com/name/nm0000033/quotes
[2] Kevin MacDonald, "Life in a Day (2011)", YouTube, accessed April 14, 2019, https://www.youtube.com/watch?v=JaFVr_cJJIY
[3] Wikipedia contributors, "Life in a Day" Wikipedia, accessed April 14, 2019, https://en.wikipedia.org/wiki/Life_in_a_Day_(2011_film)
[4] Oliver Case, "Lifemirror" (paper based on a talk presented at the International Symposium of Electronic Art. Sydney University, 2013)
[5] Oliver Case, "Lifemirror" (TVX2014 ACM International Conference on Online Experiences for Television and Online

Video, Newcastle, 2014)
[6] Oliver Case, "Lifemirror: A Reconsideration of Cinema as a Collective Process Between Digital and Organic Networks," (Ph.D. diss., HighWire Centre for Doctoral Training, Lancaster University, 2016.)
[7] Gene Youngblood, *Expanded Cinema* (London: Studio Vista Limited, 1970)
[8] John Durham Peters, *The Marvelous Clouds* (Chicago: University of Chicago Press, 2015)
[9] Jussi Parikka, *A Geology of Media* (Minneapolis: Minnesota Press, 2015)
[10] McKenzie Wark, *Theory for the Anthropocene* (London: Verso Books, 2015)
[11] Eugene Thacker, *In the Dust of This Planet* (Zero Books, 2012)
[12] Sean Cubitt, *Finite Media* (London, Duke Press, 2016)
[13] Bernard Stiegler, *The Neganthropocene* (London: Open Humanities Press, 2018)
[14] NASA, "Physicians for Safe Technology | *Glossary: Understanding Electromagnetic Radiation*, accessed April 14, 2019, https://mdsafetech.org/glossary-understanding-electromagnetic-radiation/
[15] CISCO, "Cisco Visual Networking Index: Forecast and Trends", 2017–2022, November 26, 2018.
[16] Rupert Howe, "Our 8K Future: Sadness, Happiness and Global Catastrophe," accessed 14 April 2019, https://www.linkedin.com/pulse/our-8k-future-sadness-happiness-global-catastrophe-rupert-howe/.
[17] Harald Haas, *LiFi Is a Paradigm-Shifting 5G Technology,* Reviews in Physics 3 (November 1, 2018): 26–31.
[18] Harald Haas, "Wireless Data From Every Light Bulb" accessed 12 April 2019, https://www.ted.com/talks/harald_haas_wireless_data_from_every_light_bulb
[19] Sean Cubitt, *Digital Light.* Ed. Sean Cubitt, Daniel Palmer, and Nathaniel Tkacz (London: Open Humanities Press, 2015)
[20] Henri Bergson, *Matter and Memory* (Edinburgh: Neill and Co. Ltd., 1962)
[21] Giles Deleuze, *Cinema 1: The Movement-Image* (Minneapolis: University of Minnesota Press, 1997)
[22] Giles Deleuze, *Cinema 2: The Time-Image* (Minneapolis: University of Minnesota Press, 1997)
[23] Ronald Bogue, *Deleuze on Cinema*. (London: Routledge, 2003)
[24] Amy Herzogz *Images of Thought* and Acts of Creation: Deleuze, Bergson, and the Question of Cinema (Invisible Culture, 2000)
[25] Jacques Rancière, *Film Fables* (New York: Berg Publishers, 2006)
[26] Jonathan Beller, *The Cinematic Mode of Production: attention economy and the society of the spectacle* (New England: Dartmouth College Press, 2006)
[27] Bernard Stiegler, *Technics and Time, 3: Cinematic Time and the Question of Malaise* (California: Stanford University Press, 2010)
[28] Micheal Goddard, "The scattering of time crystals: Deleuze, mysticism and cinema" in *Delezue and Religion,* ed. Mary Bryden (London: Routledge, 2001)
[29] Giles Deleuze "The Brain is the Screen: An interview with Giles Deleuze" in *The Brain is the Screen: Deleuze and the Philosophy of Cinema,* in ed. Gregory Flaxman (Minneapolis: Minnesota Press, 2000)
[30] Giles Deleuze, *Bergsonism* (New York: Zone Books, 1991)
[31] Mark G N Hansen, *Feed-Forward* (Chicago: University of Chicago Press, 2017)
[32] Helga Lenart-Cheng, "Concepts of Simultaneity and Community in the Crowd-Sourced Video Diary Life in a Day" (Cultural Politics vol. 10 (1) pp. 21-39.
[33] Henri Bergson, *Creative Evolution* (New York: Henry Holt and Company, 1911)
[34] Christopher Vitale, *Networkologies* (New York: Zero Books, 2014)
[35] Jacques Derrida, *On Touching, Jean-Luc Nancy* (Stanford University Press, 2004)
[36] *Hockney* (Directed by Randall Wright, BBC, 2014)
[37] Chris Baraniuk, "Computer paints 'new Rembrandt' after old works analysis", accessed 14 April 2019, https://www.bbc.co.uk/news/technology-35977315
[38] Walter Benjamin, *The Arcades Project* (London: Continuum 1999)
[39] Georgio Agamben, *The Coming Community*. Minneapolis: University of Minnesota Press, 1993)
[40] Sean Cubitt, *The Practice of Light*: *a Genealogy of Visual Technologies from Prints to Pixels* (Cambridge: MIT Press, 2014)
[41] Alain Badiou, *Cinema* (Cambridge: Polity Press, 2013)
[42] Oliver Case, Adam Fish and Bradley Garrett, "Drone Sense" UnMediated Journal 01 (2017): 73.
[43] Giles Deleuze, *The Logic of Sense* (London: Athlone Press, 1990)
[44] Jean-Luc Nancy, *The Inoperative Community* (London: University of Minnesota Press, 1991)
[45] Ian James, *The Fragmentary Demand: An Introduction to the Philosophy of Jean-Luc Nancy* (California: Stanford University Press, 2006)
[46] Jean-Luc Nancy, *The Sense of the World* (London: University of Minnesota Press, 1997)
[47] Vilém Flusser, *Gestures* (Minneapolis: University of Minnesota Press, 2014)
[48] P.A.Y. Gunter, "Bergson and the war against nature in ed. John Mullarkey *The New Bergson* (Manchester: Manchester University Press, 1999)
[49] Giles Deleuze, *Difference and Repetition* (London: Athlone Press, 1994)
[50] Anonymous, *Secret of the Golden Flower*, trans. Thomas Cleary (San Francisco: Harper Collins, 1991)

Author Biography

Oliver Case is a recent graduate of the HighWire Doctoral Training programme at Lancaster University. His practice-based research concerns the post-cinematic experience of time and environment where he uses contributory methods and post-disciplinary thinking to explore the moving image in networks. Current work focuses on fostering communication around sustainability and energy systems.
www.networkcinema.org

Art museums facing the light of reality: an approach to virtual reality inside museums

Pablo Gobira, Emanuelle de Oliveira Silva
Guignard School/State University of Minas Gerais (UEMG)
Belo Horizonte, Brazil
pablo.gobira@uemg.br, mrsmaahlem@gmail.com

Abstract

In this article we discuss on how museums, as a knowledge institution, can achieve the public using virtual reality as an instrument for exhibitions. Nowadays, most researches are about integrating Virtual Reality (VR) into the traditional frame of a museum in order to enable a deeper and more meaningful understanding of the displayed artworks. It happens due to a narrow view of the concept of "reality". In order to start this discussion we are going to broaden the concept of "reality", and go beyond the most commonly used terms of real and virtual. We will study some cases applications of virtual reality in museums and the way it is understood, to then bring about the amplitude of possibilities it has beyond the common use. We will work with the most widely accepted theories on museums and based on Roy Ascott's works we will bring a deeper discussion onto the matter of realities.

Keywords

Art museum; Virtual reality; Immersion; Digital arts; New media art

Introduction

The Franklin Institute, a center of science, education and development in Philadelphia (USA), has a page in their website to explain to prospect visitors about virtual and augmented reality. [1] With a permanent virtual reality (VR) room, and having developed a augmented reality (AR) application designed specifically for their Terracotta Warriors exhibition, the Institute dedicated this page to explain somewhat better what they describe as "one of the biggest technology trends of 2018". Unfortunately, their views of the uses for different types of reality, as a self claimed space for science, education and development, is not far off those in museums, that would be expected to take a more traditional approach to, so-called, new forms of technology.

In the first trimester of 2018, The New York Times published an article titled "European Museums Get Adventurous With Virtual Reality", which was inspired by the National Museum of Natural History in Paris that had just opened its permanent virtual reality installation that allows visitors to learn more about the evolution of the species, described how the european museus and curators have been positioning themselves in the face of these new "tools". [2] Unsurprisingly, from the very beginning it is shown their stance on VR and AR as a means to an end, a way to complement certain exhibitions where they deem that the traditional means wouldn't suffice.

It is not surprising for those who have been researching digital arts and its application on museums. Despite dating back to the 1950's, VR is still regarded as a new and experimental technology by the mainstream artistic circuit.During the past two decades, it has been most commonly used in archeological and cultural heritage, due to its 3D reconstruction characteristics, as a way of protecting the actual artifacts in their showcases, such as in 2015, when the British Museums had a Bronze Age artifacts displaying and utilised VR as a way to preserve better the actual artifacts and still transmit the information to the public. [3]

From this we intend to tackle the view not only on the way museums are using different realities, but to open a discussion based on what those realities are beyond the traditional view of AR and VR. We will also discuss how the usual singular physical placement differs when comparing museum institutions, since they are connected to one another due to the systems of realities. To do it, this work will be separated into two parts. the first one will be used to broaden the concepts of realities, showing differences, less referenced systems and a brief explanation on museums, how they were shaped and how they came to work this way. The second part will then discuss some realities and how they are used inside the museums, beyond the simple and common use of these systems as an assistant, a tool for traditional exhibitions. We will bring to light the different possibilities that exist

due to those systems of reality. In the end, we will also bring a question that is pertinent to the current art system.

Realities and Museums

"For us, it's about audience engagement, we don't want to be doing it for VR's sake. What we want to do is use VR where it can lend that extra context". [4] Hilary Knight, head of the press and marketing at the British Museum said back in 2015, when they were preparing to open the exhibition that would get the help from a VR system. Her words reflected well on the stance most institutions have on these systems. A means to an end instead of a whole question on its own. That line of thought is not something that developed on its own however. When looking at most of the studies done on this field in the last decade or so, there is a common concern in how to integrate virtual or augmented reality systems into traditional showings in museums.

It is a recurring theme when approaching the connection between different reality systems and museums to do it from a cultural heritage point of view, with the examples of Bruno *et al*. (2010); Tsichritzis and Gibbs (1991); Barceló, Forte and Sanders (2001), among others since the end of the 20th century. We are now however approaching the second decade of the 21st century, and the discourse shifted ever so slightly in a more broad approach, leaving the realm of archeology, and discussing the difficulties on how to apply VR and AR into the museums, as a way to "visualise and comprehend artistic, technical or biological collections displayed in museums", clarifying further informations on the artifacts to the viewer that would previously be hard to manage to pass on. [5][6][7] After more than 20 years, however, the discussions are still superficial, which goes against what, both the museums and the reality systems, are about in their core.

Between the 2 topics discussed here, the museum institutions are, without doubt, those more firmly rooted in our culture, due to the time it has been around and its worldwide presence, however when we take a step back and look at the duration of what is called art in human culture, the museums are just as much of a new development as the realities created with the help of technology. The museums, as we now know them, first appeared in the late 18th century, beginning of the 19th century, as an evolution from the *Wunderkammer*, the cabinets of curiosity, where people of high rank in society kept a personal collection of diversified objects. [8] Even who imagine the beginning of museum from the Uffizi Gallery would agree that it is not much time when compared to art existence. Much like the systems of reality, the museums are formed in a interdisciplinary way, where art is intertwined with science and other fields of knowledge.

The museums were then made to held these collections of objects that were considered culturally relevant, which main concerns were to document, organize and showcase the objects in a methodical way that allowed for future exhibitions. [9] Due to the industrial revolution, in the middle of the 19th century the museums started to modernise themselves, as a reflection of the changes happening in the cities as well as in the society. [10]

It was only in the middle of the 20th century that the "basic principles of contemporary museums" were more clearly defined. [11] Because of the modernist movement - and due to results of avant-garde groups and movements -, the museums started to be seen as a concept as well as an institution, a space and a system, or a network. [12] The new museums are then supposed to assist in a wider and more deep cultural experience as they transform themselves in order to become a "privileg tool for communication" with the "use of technologies and wide spectrum systems". [13] That is to say that the museums stop being simply the building that held the artworks back in the beginning of the 19th century and become a network of hyperlinked physical spaces through another dimension that goes beyond our physical reality. But then what is that other reality?

Or, others. The advent of technology helped in many ways to shed light into this matter. It was back in the 1950's that we had a first idea of technologically enhanced reality, with the creation of a flight simulator to train american pilots in the United States' Air Force. [14] Throughout the following decades, the technology was enhanced in many ways for other uses as well. [15] However, it was only in 1987 that Jaron Lanier, founder of VPL Research Inc., coined the term "Virtual Reality".[16]

The most common explanation for VR systems is: an interface that allows the user, through immersion, to navigate and control, with the help of haptics, a virtual world that shows informations regarding the real world. AR appears then around the end of the 1980's and the beginning of the 1990's as a category of VR. Augmented Reality is about "taking what is real and adding to it in

some way so that the user obtains more information from their environment", adding more to it than the necessity of full immersion that VR brings in order to work properly. [17] In the early years of the 1990's however it was still a bit confusing for researches when trying to categorize the multiple facets of VR and what they meant, so, in 1994, Milgram *et al*. creates the Reality-Virtuality (RV) Continuum.

Instead of "regarding the two concepts simply as antithesis" they decide to place the "real world", the world we live in and exist without the use of a machine being fundamental, and the virtual world on opposite ends of a continuum and call whatever is between those two, a mixed reality. [18] In this way, VR would be closest to the virtual world-end while AR would be placed in the middle.

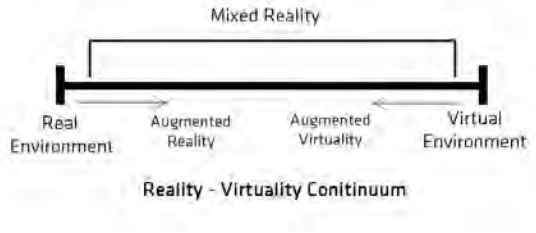


Figure 1: Scheme of the Reality-Virtuality Continuum. Created by the authors based on Milgram et al. [18]

Ever since this continuum was created, most, if not all, of the data collected, and papers that are written on the topic of different realities are based on the idea that whatever reality we are talking about has to fit inside of the continuum, which is why when approaching the topic of museums working with these other realities we are still approaching it through the lenses of integration, even though virtual reality is a part of our own reality, and why these discussions surrounding the topic also tend to ignore the different realities that are not encompassed by the Reality-Virtuality Continuum. For example, since AR is a facet of VR, we can say that VR then, when manifested as such, should be placed next to the Real end of the Continuum, rendering it impractical, or on the different moments where the 2 meet and coexist inside the Mixed Reality (MR) that makes this division nonsensical since in those situations there are not differences between one and the other. The museums, when in their social use, shows us that, even considering the VR inside the idea of Milgram *et al*'s Continuum, we are actually facing the reality, even if it happens through VR, AR or MR. This ends up raising the question of why we end up seeing VR as something besides reality. Maybe it is because VR presents to us, for instance, a game scenario. In whatever way we choose to see it, when it comes to museums, even if it is a museum dedicated to videogames, the VR is in service of a reality, which in the videogames museum case would be: videogames exist and we are proving that in here.

Reality beyond Immersion

After this realisation, we are probably left wondering what are, and how are, these realities that are not discussed. Despite this approach not being commonly taken, the discussion itself is as old as the creation of VR itself. In the 1980's, the researcher Roy Ascott was already saying that "the art of our time is one of system, process, behaviour, interaction" [19]. The use of realities inside the museums is a way to connect not only the viewers with the artwork, but also with each other, to serve as a communication device between all the museums that, when utilising this reality, end up in the same one.

This non-physical connectivity urges the matter of what he calls, Nature II, "[...] a reconfiguration of our world's molecular structures forming a new atomic basis of reality". [20] The telematic, an hyperlinked world, is expanding not only in terms of technology, but our cortex as well, which allow us to understand other realities, such as bioelectronics, a reality where these beings are able to exist, to be real like us, to live and reproduce, even with their lack of physicality. And it is our reality. It is now an expanded reality, thanks to the advent of VR (and other technologies), even if most of us believe it to be a different reality.

The global or the shared connectivity, this hyperlinked reality where we are able to share our thoughts (writing or talking or by anything else, is what Ascott calls Hypercortex. [21] He bases his theory on quantum physics and mechanic theories, for example, the microtubules theory, revisited by Stuart Hameroff and Sir Roger Penrose, that corroborates the idea of a universal consciousness. [22] This is a discussion of a post-human era, where we are active creators of the reality that we exist in not only by our actions, but with our state of being as a whole and our engagement with each other and with the constantly mutable telematics.

Our reality then is one of infinite possibilities. For instance, "Growing Things: The Cultures of NanoTech, Bio Tech, and Eco Tech Meat Art" is an event that happened at the beginning of the Millenium where art and science researchers alike gathered to discuss the possible outcomes of the conjoined forces of human and technologies when it came to the creation of beings. [23] Our culture is created by our reality that, in its turn, is created by our connection, therefore, the way we interact in our reality is what gives it meaning and that is shaping a global culture on the base of, VR intensified, telematics. This culture is ordinated and meaningful in a way that, accordingly to Ascott it makes that the aesthetics of assistance makes way for the aesthetics of appearances. [24]

In this context, the museums deal not only with reality, but they have a social function in this hyperlinked world, so why not deepen the conversation connecting VR, and its facets, to them? Why choose use VR, in majority, only as a mean to an end? It is probably because, when incorporating these realities, they did so because of VR becoming increasingly popular and the "hype around virtual reality in the 1990's" making it unlikely to reach all that it promised to make come true. [25]

The hype caused a influx of investment in the market for VR, but on a superficial, application level that only pursued few of the reality's possibilities. However when the research into it proved to be too expensive for uses outside of very specific niches, they were almost abruptly stopped. [26] That set a precedent for its use in museums. Since there was a shortage in resources for research and development, most of the works done with the use of VR couldn't reach their full potential, therefore we weren't able to see its full capacity which made so that the best use we saw of it being a means to an end, a tool to help our reality, in a way that we could not have expected the museums to give a step forward on this matter on its own. When looking into it, the use of VR in museums is a mirrored situation to that of the 1990's.

Not only the gadgets and haptics needed in the use of VR and its different systems are costly, the museums are traditional institutions dating back from even before the industrial revolution, making it so that their physical spaces need to be adjusted to receive works done with the use of VR. [27] The maintenance needed also elevates the expenses put into these kind of exhibition, making it even more difficult to to have a deeper, more meaningful work done with the VR.

Final Considerations

Tackling the subject of realities is not a easy thing to do, however it is proven time and again necessary in order to allow us a better understanding of our world, and even ourselves. As discussed in this article we are connected by our reality in a way that goes beyond the physical, actively reshaping the structure of things with the possibilities of our consciousness, and VR is the shaping tool for that to happen in a more easily understandable way so far. However, for a lack of proper research due to a shortage of investment, we are not utilising its full potential, barely scraping the surface of its different systems, not only on their use in museums, where they are time and again cited as a enhancement for previously existing exhibitions, but even on their research field, inside art, science and technology.

Our reality is a social construction, allowing therefore for the museums to make use of different realities as a part of ours, making it the object of our construction of knowledge. [28] There are long ways to go until the museums reach a production completely inside the multitude of possibilities of our reality, since only a few actually understand VR as our reality and not something else.

The use of Ascott's idea of perception enhancing are still not masterly done, even if the uses of AR, RV, and other realities, are in order to enhance the sensory and haptic human experience, such as optical, acoustic and physical systems, and that is because it is all in a superficial level.

In this article we don't have the intention of pointing out how or in which direction the researches inside VR or its application in museums should go, but we are bringing to light the fact that there should be an improvement of regarding the approach giving to the subject instead of simply insisting on diverse facets of the same line of thought. That also brings us to our most pertinent question: is the current use of VR inside the museums helping in improving its understanding or is it simply solidifying it merely as an assistant, entertaining device? While, yes, some improvements have been made in the idea of the clashing of this traditional institution and the, considered, new technology of virtual reality, in the last decade, and the fact that this improvement had helped the cementing of the idea of different realities into the general public, it has seemed to have stagnated in this place, and

the scientific and academic community, until this point in time, have not tried to take use of this newly discovered public interest in virtual reality to further the researches in the field in a way that is beneficial in a multidisciplinary field. As previously discussed on this paper, the possibilities inside virtual realities and other realities are vast and should be deeply explored so to achieve its maximum potential, and while it is important that the public have a more practical access as a way to understand the discussions happening and that its presence is current and of easy access, the stagnation as it is becomes detrimental to all this unfulfilled potential. It delays all of the possible advancements in technology, museology and artistic field, as well as many others.

Acknowledgments

This paper results from researches developed at the Laboratory of Front Poetics (http://labfront.tk), funded by CNPq, FAPEMIG and PROPPG/UEMG, whose support we wish to acknowledge. We would like to thank also Fernanda Correa for revising the translation of this paper.

References

Books

[28] Peter L. Berger and Thomas Luckmann, The Social Construction of Reality: A Treatise in the Sociology of Knowledge (New York: Doubleday, 1966).

Second and subsequent citations

[14][16] Antonio Valerio Netto, Liliane dos Santos Machado and Maria Cristina Ferreira de Oliveira, "Realidade Virtual - Definições, Dispositivos e Aplicações" (Universidade de São Paulo, São Paulo, 2002), 4.

Edited Books

[19] Roy Ascott, "Art and Education in the Telematic Culture," 1987, in Telematic Embrace, ed. Edward A. Shanken (Los Angeles and London: University of California Press, 2003), 218.

[20][21] Roy Ascott, "Cultivando o hipercórtex," 1997, In: A arte no século XXI: a humanização das tecnologias, org. Diana Domingues (São Paulo: Editora da Unesp, 1997), 337.

[24] Roy Ascott, "Weaving the Shamantic Web: Art and Techoetics in the Bio-Telematic Domain," 1997, in Telematic Embrace, ed. Edward A. Shanken (Los Angeles and London: University of California Press, 2003), 214.

[23] Diana Domingues. A vida com as interfaces da era pós-biológica: o animal e o humano. Arte e vida no século XXI: tecnologia, ciência e interatividade, org. Diana Domingues. (São Paulo: Editora Unesp, 2003), 103.

Journal article (print)

[3] Fabio Bruno, Stefano Bruno, Giovanna De Sensi, Maria-Laura Luchi, Stefania Mancuso and Maurizio Muzzupappa, "From 3D reconstruction to virtual reality: A complete methodology for digital archaeological exhibition," Journal of Cultural Heritage, (Volume 11, Issue 1, January–March 2010): 42-49

[5] Isis Fernandes Braga, Luiz Landau, Gerson Gomes Cunha, "Realidade Aumentada em Museus: As Batalhas do Museu Nacional de Belas Artes". Journal Virtual Reality. Universidade Federal do Rio de Janeiro, Rio de Janeiro, (Volume 4, Number 1, 2011): 35-55.

[7] Isis Fernandes Braga, Luiz Landau, Gerson Gomes Cunha, "Realidade Aumentada em Museus: As Batalhas do Museu Nacional de Belas Artes". Journal Virtual Reality. Universidade Federal do Rio de Janeiro, Rio de Janeiro, (Volume 4, Number 1, 2011): 35.

[11][13] Marcello Carrozzino and Massimo Bergamasco, "Beyond virtual museums: Experiencing immersive virtual reality in real museums." Journal of Cultural Heritage (Volume 11, Issue 1, January–March 2010): 452.

[18]Paul Milgram, Haruo Takemura, Akira Utsumi and Fumio Kishino, "Augmented Reality: A class of displays on the reality-virtuality continuum". SPIE Vol. 2351, Telemanipulator and Telepresence Technologies, Japan, 1994, 283.

[27] Pablo Gobira and Antônio Mozelli, "Reflections on an Immersive Virtual Reality Exhibition." MATLIT: Materialities of Literature, [S.l.], v. 6, n. 3, aug. 2018, 144.

Magazines and Newspapers (online)

[2][4] Jake Cigainero, "European Museums Get Adventurous With Virtual Reality" The New York Times, March 12, 2018, accessed December 27, 2018, https://www.nytimes.com/2018/03/12/arts/european-museums-get-adventurous-with-virtual-reality.html

[12] Enrique Galbadón Peñaranda, "El museo virtual". Revista Digital Nueva Museología, 2015, accessed December 28, 2018, http://nuevamuseologia.net/wp-content/uploads/2015/12/elmuseovirtual.pdf

Websites

[1] Philadelphia Institute website, accessed December 27, 2018, https://www.fi.edu/exhibit/virtual-reality-museum

[22]Phys Org website, accessed January 2, 2018, https://phys.org/news/2014-01-discovery-quantum-vibrations-microtubules-corroborates.html

Proceedings Paper Published

[10] Alessandra de Oliveira Marçal and Edna Maria Campanhol, "A expografia museal: da coleção pessoal ao novo museu". In: IV Congresso de Iniciação Científica - Uni-FACEF, 2010, Franca. (Caderno de Resumos do IV Congresso de Iniciação Científica, 2010.): 16.

[15] Ivan Sutherland, "A head-mounted three dimensional display", (Proceedings of the Fall Joint Computer Conference of 1968, Thompson Books, 1968), 757-764.

[17] Chris Hand, "Other faces of virtual reality", (First International Conference MHVR'94 - Lecture Notes in Computer Science n.1077, Ed. Springer, Moscow, Russia, September, 1994): 110.

[25] Pablo Gobira and Antônio Mozelli, "The virtual reality: interface with technology, digital games and industry." In: Proceedings of 9th International Conference on Game and Entertainment Technologies, (Funchal, Ilha da Madeira: IADIS/MCCSIS, 2016. v. 1): 275.

[26] Pablo Gobira and Antônio Mozelli, " The virtual reality: interface with technology, digital games and industry." In: Proceedings of 9th International Conference on Game and Entertainment Technologies, (Funchal, Ilha da Madeira: IADIS/MCCSIS, 2016. v. 1): 273.

Dissertation or Thesis

[6] Ana Maria B. O. C. Moutinho, "Realidade Aumentada aplicada à museologia". (Master's Thesis. Universidade Lusófona de Humanidades e Tecnologias: Lisboa, 2015.)

[8][9] Bettina Rupp, "Curadorias na arte contemporânea: Precursores, conceitos e relações com o campo artístico". (Master's Thesis. Universidade Federal do Rio Grande do Sul, Porto Alegre, 2010.): 10.

Bibliography

Alessandra de Oliveira Marçal and Edna Maria Campanhol, "A expografia museal: da coleção pessoal ao novo museu". In: IV Congresso de Iniciação Científica - Uni-FACEF, 2010, Franca. (Caderno de Resumos do IV Congresso de Iniciação Científica, 2010.): 27-28.

Andréia Machado Oliveira, Alexandre Montibeller, Bárbara Maciel Pereira, Evaristo José do Nascimento, Fabio Gomes de Almeida, Marcos Cichelero, Matheus Moreno dos Santos Camargo and Muriel Paraboni, "Ai3: Ambientes interdisciplinares imersivos interativos em realidade mista. In: Org. Cleomar Rocha, Proceedings of IV Simpósio Internacional de Inovação em Mídias Interativas, Media Lab/UFG: Goiânia, 2016, 79-88. Andrew McClellan, "Inventing the Louvre: art, politics, and the origins of the modern museum in eighteenth-century Paris," Cambridge University Press: New York, 1994.

Antonio Valerio Netto, Liliane dos Santos Machado and Maria Cristina Ferreira de Oliveira, "Realidade Virtual - Definições, Dispositivos e Aplicações", Universidade de São Paulo: São Paulo, 2002, 1-33.

Athanasios Gaitatzes, Dimitrios Christopoulos and Maria Roussou, "Reviving the past: Cultural Heritage meets Virtual Reality," VAST 2001, Proceedings of the 2001 conference on Virtual reality, archeology, and cultural heritage, 2001, 103-110.

Camila Cavalheiro Hamdan, "Corpos Tatuados: Experiências Sensíveis em Realidade Aumentada Móvel," Doctorate's Thesis. Universidade de Brasília, Brasília, 2015.

Chris Hand, "Other faces of virtual reality", First International Conference MHVR'94 - Lecture Notes in Computer Science n.1077, Ed. Springer: Moscow, September 1994, 107-116.

Dennis Tsichritzis and Simon Gibbs, "Virtual Museums and Virtual Realities", proceedings of the International Conference on Hypermedia & Interactivity in Museums, 1991, 17-25.

Diana Domingues, "A vida com as interfaces da era pós-biológica: o animal e o humano". In: org. Diana Domingues, Arte e vida no século XXI: tecnologia, ciência e interatividade, Editora Unesp: São Paulo, 2003, 95-114.

Durval de Lara Filho, "O museu como um espaço relacional," VII ENCONTRO ENANCIB, 2015. Accessed December 28, 2018: http://enancib.ibict.br/index.php/enancib/viienancib/paper / viewFile/2480/1611

Giovanna G. Casimiro, "Lapso da Interatividade: transfaces museológicas. In: Org. Cleomar Rochas, Proceedings of Simpósio Internacional de Inovação em Mídias Interativas, Media Lab/UFG: Goiânia, 2016, 343-356.

Giovanna G. Casimiro, "Singularidades e espaço expositivo - novos meios a partir da Realidade Aumentada". In: Anais online do 13° Encontro Internacional de Arte e Tecnologia, Brasília. Accessed December 30,2018: https://art.medialab.ufg.br/up/779/o/art13_GiovannaGrazi osi.pdf

Greice Antolini Silveira and Nara Cristina Santos, “A Realidade Virtual e o uso de Ambientes Virtuais na arte. III Simpósio Nacional ABCiber: ESPM/SP, 2009, 1-11.

Laia Pujol, “Archaeology, museums and virtual reality,” Digit·HVM. Revista Digital d’Humanitats, No. 6, May 2004. Accessed December 30, 2018: https://www.uoc.edu/humfil/articles/eng/pujol0304/pujol0 304.pdf

Marcello Carrozzino and Massimo Bergamasco, “Beyond virtual museums: Experiencing immersive virtual reality in real museums”. Journal of Cultural Heritage, Volume 11, Issue 1, January–March 2010, 452–458.

Michael Bajura, Henry Fuchs, and Ryutarou Ohbuchi, “Merging virtual objects with the real world: Seeing Ultrasound Imagery within the Patient”, Computer Graphics. SIGGRAPH’92, Chicago, 1992, 203-210 Pablo Gobira and Antônio Mozelli, “Reflections on an Immersive Virtual Reality Exhibition.” MATLIT: Materialities of Literature, [S.l.], v. 6, n. 3, aug. 2018, 141-148.

Pablo Gobira and Antônio Mozelli, “The virtual reality: interface with technology, digital games and industry.” In: Proceedings of 9th International Conference on Game and Entertainment Technologies, Funchal: Ilha da Madeira, 2016, 273-277.

Paul Milgram, Haruo Takemura, Akira Utsumi and Fumio Kishino, “Augmented Reality: A class of displays on the reality-virtuality continuum”. SPIE Vol. 2351, Telemanipulator and Telepresence Technologies, Japan, 1994, 282-292.

Peter L. Berger and Thomas Luckmann, “The Social Construction of Reality: A Treatise in the Sociology of Knowledge,” New York: Doubleday, 1966.

Rafaelle R. Rabello, “Arte, ciência e tecnologia: Uma abordagem sobre a estética cibernética,” ARTEFACTUM - Magazine of studies in languages and technology, n. 2, year 6, 2014.

Roy Ascott, “Cultivando o hipercórtex,” 1997, In: A arte no século XXI: a humanização das tecnologias, org. Diana Domingues,São Paulo: Editora da Unesp, 1997, 336-344.

Roy Ascott, “Telematic Embrace”, ed. Edward A. Shanken, Los Angeles and London: University of California Press, 2003.

Virgilio Fagone, “Arte, fare, vedere: La critica in azione di C.L. Ragghianti”. In: La civilta’ cattolica Magazine, year 126, volume 2, number 2995, 1975, 350-359.

Author(s) Biography(ies)

Pablo Gobira: Professor doctor at Guignard School of Arts and Graduate Program in Arts at State University of Minas Gerais. Research fellow and manager of Digital Preservation Services of the Brazilian Network at IBICT/ MCTI. Director of Laboratory of Front Poetics (http://labfront.tk). Editor and co-editor of the books: “The memory of digital and other issues in arts and museology” (2019); "Contemporary routes: realities of art, science and technology" (2018); "Multiple interfaces" (2018); "Post-digital features: technological art and culture" (2017); "Reflections on culture: digital books, artistic creation and contemporary reflections" (2017); "Jogos e sociedade" (2012); Walter Benjamin "Lado B" (2011) among others. Researcher of the groups: Archives Center Studies of Writers from Minas Gerais; Studies and practices of Digital Preservation. He works inn curation, creation and production in the field of relations between arts, science, technology and digital culture; as professor of frontier courses like Biological machine engineering (with professores from UFMG, UFV, UEMG and Newton Paiva); and as curator of biennial, exhibitions and artistic residencies. He is coordinator at Extension Institutional Program (UEMG): Rights to production and access to art and culture.

Emanuelle de Oliveira Silva: Undergraduate student at Guignard School of Arts at State University of Minas Gerais, with specialisation in drawing. Has a scholarship in research program in Guignard School coordinated by Prof. Dr. Pablo Gobira on digital arts literacy.

Toward the Experiential VR Gallery using 2.5-D

Sieun Park[1], Suk Chon[2], Tiffany Lee[3], Jusub Kim[4]
[1 4]Sogang University, [2]Rinnsoft, [3]Kookmin University
Seoul, Korea
[1]je4242@naver.com, [2]tians@maat.kr, [3]tiffanyleemm@gmail.com, [4]jusub@sogang.ac.kr

Abstract

Although VR is opening numerous new possibilities, the current widely used way of presenting works of art in virtual reality-based exhibitions is not much different from the way of presenting works in physical galleries. In this paper, we propose a method that transforms the viewer's artwork appreciation experience in virtual exhibitions from "viewing" to more "experiential". Also, we introduce a case study made by applying the proposed method. It aims to provide a more immersive aesthetic experience to visitors in virtual exhibitions.

Keywords

Virtual Reality, Virtual Exhibition, Digital Storytelling, New Media, User Experience

Introduction

Digital technology has been increasingly used in exhibitions to provide more immersive experience. Displaying images on a huge wall and/or animating some of the key elements in the picture are commonly used ways in order to provide new immersive experiences. Furthermore, HMD (Head-Mounted Display)-based VR (Virtual Reality) exhibits that have emerged in recent years can potentially provide much greater new immersive experiences due to the powerful hardware and software system that allows user interactions.

However, user experiences in the immersive VR exhibits still stay mostly in 'viewing 2-D images', which is similar to the way we experience in a physical gallery. In a typical VR gallery, a replica of a physical gallery is created in a virtual environment and audience are asked to appreciate the artworks in pretty much the same way as in the physical gallery, which is viewing 2-D images. Although exhibitions in virtual worlds provide many people, who have not been accessible to the artworks due to physical or economical limitations, with the new cultural experiences, there are lots of rooms for improvements from the user experience point of view, especially considering the capabilities of the recent powerful VR systems.

In this paper, we propose a method that transforms the viewer's artwork appreciation experience in virtual exhibitions from "viewing" to more "experiential" by reconstructing 2-D paintings into 2.5-D works. With this method, users can appreciate artworks in a more active and participatory way. We introduce an example of a work made by applying the proposed method. It aims to provide more immersive aesthetic experiences to visitors in virtual exhibitions.

Related Work

Virtual exhibition is a new form of exhibition that has been enabled by the development of information & communication technologies. Compared to the physical exhibition that requires certain facilities and trained people during certain hours, the virtual exhibition allows anyone in anywhere to appreciate artwork anytime through the Internet and VR/AR devices. Most common type of the virtual exhibition is to present digitized content of the images, films, objects, or commentary materials from the existing gallery archives.

The form of virtual exhibition has originated in the early web exhibition. Web exhibitions occur via cyberspace, accessible by digital devices such as computers or smartphones. This is communicated with audiences by digitizing information of real spaces into 2-D/3-D forms and by creating virtual media.

An exhibition in a virtual space is classified according to its purpose, type and medium, and the terms such as an online exhibition, a virtual exhibition, a virtual museum, and a digital exhibition are being used.

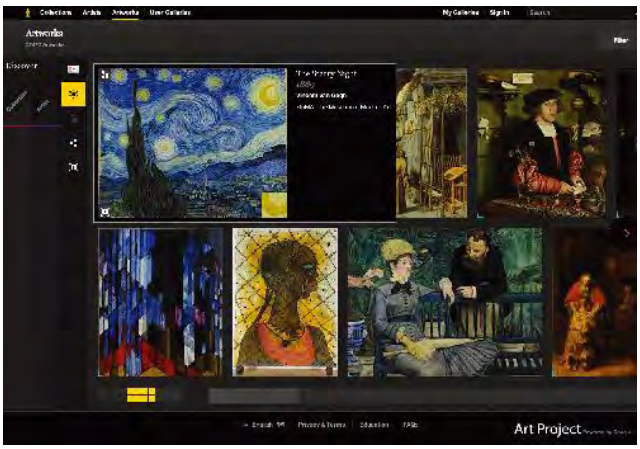


Figure 1. Google Art Project ©Google

Google Art Project is the most representative virtual exhibition project that aims to enable people all around the world to appreciate all the historical masterpieces with high resolution images. Audience can zoom in the high definition giga-pixel images and appreciate material, brushstroke, and

even paint crack vividly [9]. *Google Art Project* is well characterized in various interactive features of virtual art museums. Audience can share responses to works in Google+ and exchange opinions in a virtual chat room. Thus, people of various nationalities, cultures, backgrounds, and classes share ideas in real time. The virtual exhibition aims to overcome the limitations of existing physical exhibitions and increase the level of communication among audience.

Figure 2. Dali Museum ©Dali Museum.

The Dali Museum in Pittsburgh, PA, USA is currently using VR technology in a virtual exhibition. *Dreams of Dali* VR app allows audience to experience the full immersion into the paintings of Dali. Audience can experience moving images, audible scenery, and transformational atmosphere, etc. using various senses [10]. It is gradually being expanded for further experiences into new devices and applications utilizing virtual reality.

The Kremer Collection VR Museum is an example in which a museum exists only in virtual space for the first time. This museum uses photogrammetry technology to restore and display high-resolution images in virtual space [11]. Audiences can appreciate artworks' particularities at closer distances using the latest VR technology.

These virtual exhibitions have overcome the limitations of time and space in physical exhibitions. Anyone who has access to a computer connected to the Internet now can have similar experiences to visiting galleries in New York or Paris no matter where they live on earth and whenever they want to. In virtual exhibitions, large audiences can be accommodated flexibly and problems such as installation, transportation, maintenance, and insurance are no more the issues. Furthermore, virtual exhibitions can be customized to each individual based on the participant preferences for greater experiences.

Limitations

However, most of the virtual exhibitions still adopt the traditional ways of exhibiting artworks. That is, they typically create replicas of physical galleries and ask users in VR environments to appreciate the artworks in pretty much the same way as in the physical galleries, which is viewing 2-D images.

This is mostly because current virtual exhibitions, especially VR galleries, focus on simulating the real-world experiences in physical galleries. Thus, they create the 3-D models that look and feel similar to real physical galleries and display artworks as in physical galleries. Such content design naturally makes audience appreciate the artworks in the similar fashion as in physical galleries.

However, the user experiences in VR galleries do not have to mimic the ones in physical galleries. VR galleries open numerous new possibilities in terms of user experience design. Although the limitations of VR devices such as low screen resolution, dizziness, and inconvenience of wearing still have to be solved, new content design tailored specially for VR galleries could be more powerful in providing new immersive experience to VR gallery audience.

The new VR gallery design should also provide multiple sensory experiences, not biased to a sense of sight, as Marshall McLuhan said, 'not biased perception to one sense, but the recognized perception along with all senses is real perception' [2].

In this paper, we introduce a 2.5-D scene reconstruction-based VR gallery design for more active and experiential artwork appreciation.

Designing Experiential VR Galleries using 2.5D

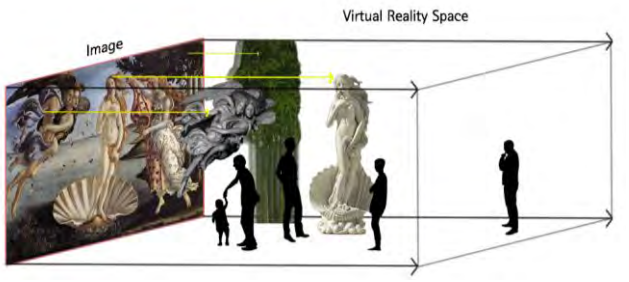


Figure 3. An example of scene reconstruction to 2.5-D © Si-Eun Park.

To make VR Exhibition more experiential, we propose the following method. First, we reconstruct a 2-D painting into a 2.5-D representation as seen in Figure 3, where the artwork is reformed in multiple layers of 2-D elements in depth according to the intention of the curator or the artist. Then, we make some of the elements to be interactive with users through animation or sound. Lastly, we install spatial sound sources in the 3-D space to maximize the sense of space and presence.

Reconstructing a 2-D painting into a 2.5-D representation requires careful planning. The first thing we consider is what story or message we want to communicate through the reconstruction. A good storytelling forms basis for immersive experience. The history of the artworks, the artist information, the curator's exhibition concept, etc. need to be considered at the stage.

The next step is to make decisions on what visual elements in the original 2-D artworks to make as separate layers and also how to place those in the 2.5-D representation. The knowledge about iconology plays important roles at this stage. A 2-D to 2.5-D transformation creates a unique visitor moving path. This newly generated moving path help audience have more active and participatory, thus more immersive experience in the VR galleries. Users can move around all the new spaces created by the reconstruction appreciating the artwork in a close, mid, and distant view and moving in and out of the artwork frame. This helps them experience inside and outside the work, understand the spatial dimension embedded in the work, and be immersed in the work. Curators or artists have to design the spatial layout of the elements in 2.5-D representations and each unique moving path created by the layout provides a unique experience to the user. In doing so, users can experience the artworks via performative behavior.

The other steps include making decisions on which visual elements to make as ones that users can interact through touch, voice, gesture, etc. The interaction output can be animated images, sound outputs, etc. The user interaction is one of the most important keys to making immersive experience as proven in computer games. Besides, spatial sound sources and their locations in the 3-D space need to be determined in order to maximize the sense of space and presence.

Case Study: "VR Liquid Nostalgia"

Figure 4. Tiffany Lee's *Liquid Nostalgia 5* © Tiffany Lee.

Figure 4 shows *Liquid Nostalgia 5* from Tiffany Lee's 'Liquid Nostalgia' series. The series of work were inspired by the Google Map's street view service. By allowing one to explore the different views of the streets throughout the world through the reconstructed photos, it makes one feel like he or she is actually walking around the real world. However, these views of the streets do not reflect the current condition since they were taken at some point in the past. It lets us roam around the streets of the past. The artist felt some kind of nostalgia within these images and decided to call this series of works as 'Liquid Nostalgia', borrowing Zygmunt Bauman's expression.

Figure 5. Google Street View and distance measures © Si-Eun Park.

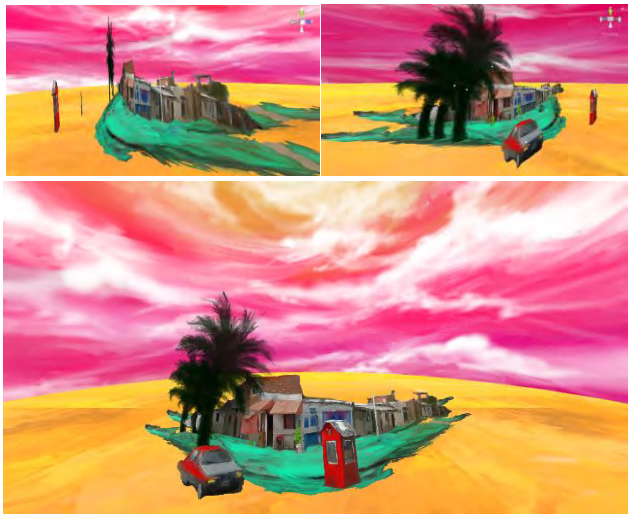


Figure 6. *VR Liquid Nostalgia*. Three different views of the re-created version of Tiffany Lee's 2-D painting work *Liquid Nostalgia 5* by applying the proposed methods © Si-Eun Park.

VR Liquid Nostalgia is the re-creation of *Liquid Nostalgia 5* by Tiffany Lee. We applied the proposed methods to the original painting work and created the 2.5-D representation of it where users can walk around and appreciate the work in more experiential and immersive way. Figure 5 shows the original google street view image and the corresponding 2.5-D representations considering the depths of distant view, middle-range view, and close-range view in the original image. In this case, since the original painting was based on the

real-world buildings, trees, cars, etc., the decision on what to make as different layers and how to place those in the new space were relatively straightforward. Figure 6 shows three different views of the 2.5-D representation revealing how the 2-D visual elements are placed in the 3-D space. Since it is a 2.5-D representation, i.e., each element is a 2-D object with depth information, you can see that the red car or telephone booth gets thinner in certain views revealing that it is not a 3-D, but a 2-D object.

In addition, we have made the cloud and the color of the sky animated to give the user more physical presence. Also spatial sounds were installed such that the closer users get to the vehicle or the tree, the louder sound they hear that the engine or birds make. Such interaction was designed by the original artist to tell the story that she wanted to deliver and to enable audience to have more conversation with her artwork.

Audience Response

From December 13th to 19th, 2018, Tiffany Lee's solo exhibition *Liquid Nostalgia* was held at Art Space Tetra in Fukuoka, Japan. *VR Liquid Nostalgia* was unveiled for the first time in this exhibition.

Figure 7. The *Liquid Nostalgia* Exhibition © Tiffany Lee.

During the exhibition, the audience experienced *VR Liquid Nostalgia* by virtually walking around the 2.5-dimensional objects placed in a 3-dimensional space. Many audiences noted that this experience was rather impressive.

In particular, the audience showed great interests in 2.5-D objects arranged in parallel. The audience spent a great deal of time in walking around the scene while feeling the brushstrokes and texture of the original painting. In addition, the animation triggered by the user location and the spatial sound helped the audience get more immersed in the work.

On the other hand, the exhibition also helped the artist find new insights in communicating with users via VR/AR platforms motivating for future works.

Figure 8. *VR Liquid Nostalgia* exhibited at art space tetra in Fukuoka, JAPAN ©Tiffany Lee.

Conclusion

The emergence of virtual reality technology opens the possibilities of new exhibition methods. In this paper, we proposed a 2.5-D reconstruction based VR gallery design that can make a VR exhibition more experiential.

The process of turning a 2-D image into a layer of smaller 2-D visual elements with depth information doesn't require much artist time and is relatively simple process in terms of technology. However, turning the 2-D into the 2.5-D has profound impact in user experience. User behaviors change from 'viewing' to 'experiential'. They more actively participate in the exhibition.

This change has several implications for content design as well. One of them is the importance of storytelling design since the 2.5-D representation generates a certain visitor moving path, which is equivalent to the time dimension. A good storytelling design will form strong basis for immersive experience. Solid understanding on iconology and human behaviors will also become important for successful content design.

It is the limitation of the proposed approach that only a certain type of artworks can be applicable. Each artwork has unique message, context, and aesthetics. For each one, we should find a new way of having audience better communicate with the author. Through the exhibition design that fully exploits what the cutting-edge VR technology can offer, we can be provided with more immersive aesthetic experiences that cannot be substituted in the real-world gallery visits.

Acknowledgements

This research was supported by the MIST (Ministry of Science ICT), Korea, under the National Program for Excellence in SW) (2015-0-00910) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation)

References

[1] Sun ho Kim, Hyo sub Shin, Se hoon Jung, *VR Journalism Research* (Korea Press Foundation, 2016), 123.
[2] Marshall McLuhan, *Understanding Media -The Extensions of Man-* (MIT Press, 1994), 46.
[3] Kim So Yeon, "Analysis of Online Exhibition Presentation - case study on national science museum in Korea-," *Bulletin of Korean Society of Basic Design & Art* 17, (2016): 51-61.
[4] Kim Hee Kyung, "A Study on the Plan and Development of the Cyber Exhibition," *Humanities Contents* 7, (2006): 51-72.
[5] Park, Hyun Suk, Choi, Seok Hyun, Jeon, Tae Il, "A Study on Types and Exhibition Techniques of Online Science Exhibitions - Focused on the National Science Museum Running Web Page of Online Exhibitions in OECD Countries -," *KOREA SCIENCE & ART FORUM* 18, (2014): 299-317.
[6] Ho-Suon Yoo, Eun-Sil Kim, Su-Jin Lee, Yong Kim, "A Study on a Method to Implement Exhibition Contents Using 3D VR in Online Environment : Focused on the Presidential Archives in Korea," *JOURNAL OF THE KOREAN BIBLIA SOCIETY FOR LIBRARY AND INFORMATION SCIENCE* 28, (2017): 271-292.
[7] Hyung-Jun Jang, Kwang-Ho Kim, "Study on the Influence of VR Characteristics on User Satisfaction and Intention to Use Continuously - Focusing on VR Presence, User Characteristics, and VR Sickness -," *JOURNAL OF THE KOREA CONTENTS ASSOCIATION* 18, (2018): 420-431.
[8] Barnabás Takács, "Immersive interactive reality: Internet-based on-demand VR for cultural presentation," *Virtual Reality*, (2011): 267-278..
[9] Google Art Project website, https://artsandculture.google.com/
[10] The Dali Museum, "Dreams of Dali (2016)", The Dali Museum website, accessed January 1, 2016, https://thedali.org/exhibit/dreams-vr/
[11] The Kremer Collection, "The Kremer Museum (2017)", The Kremer Collection website, accessed October 27, 2017, http://www.thekremercollection.com/the-kremer-museum/
[12] Knise, F, "Immersive media in museums and museum education," (Ph.D. diss., Drexel University, 2017.)
[13] L. Leving, "Multisensory Immersive Exhibitions as Sites for Social Emotional Learning," (Ph.D. diss., University of Illinois at Chicago, 2017.)

Mexican Electronic Art: Reuse and Reinterpretation of Technology

Cynthia Patricia Villagomez Oviedo
Guanajuato University
Guanajuato, Mexico.
oviedo@ugto.mx

Abstract

The purpose of this research is to show part of the Mexican electronic art scenario, which in many cases is produce with limited resources, low-cost materials and free and open source data and software. What characterized the most this artistic works is the concept and the main idea which is related to the Latin American context, because of that, these works of art are unique. The main statement of this research is to find evidence of the importance of the concept despite the materials, more than the spectacle that some works could offer to an audience with unlimited resources. Through this, an analysis of various Mexican electronic art works take place.

Keywords

Electronic Art, Processes, Creation, Reutilization, Reinterpretation.

Introduction

In Mexico Electronic Art has not been studied enough, even though it is a branch of art that has Mexican artists working on the field for more than three decades. The present scenario has lack of spaces for the development of artists projects, there are not enough galleries and museums that are able to show electronic art, on the other hand, there is an on growing number of young electronic artists. That is why the present research focuses on the production processes with lack of resources, as a way to show new artists the possibilities of creation with reuse materials.

Besides this research explores the possibilities of electronic art production by reusing existing materials instead of buying new ones, that makes the concept or the artistic statement more important than the materials itself, avoiding the spectacle that could provide an electronic work of art and giving more importance to smart ideas. That means anyone around the globe could create with electronic sources, no matter if they have, or not have access to cutting-edge technology. Because if people explore analog or digital electronics through art, simultaneously a new world opens up, giving anyone the opportunity to have access to science and technology, which is fundamental in countries like Mexico where the access of that knowledge is not for everybody.

Background of Mexican electronic art

The experimentation with low-cost materials has been common in the present and in the history of art, Art Povera is an example, which was a radical artistic movement that emerged in the late sixties and seventies, where the artists explored a wide range of unconventional processes with the use of nontraditional and everyday materials. Art Povera literary means "poor art", the materials they used were: clay, cloth, tree branches, waste materials, in such a way that challenged and disrupted the values of the gallery system and the commercialization of contemporary art.

Specifically, in the present Latin American context, in Brazil for example, they have a special term for existing materials reutilization called *Gambiologia* which is the practice of making things through unusual materials and smart improvisation, repairing things or creating with what you have at your disposal, means is a form of creative improvisation that uses electronic-digital techniques. In the case of Mexican electronic art, there are various artists that use obsolete technology and low-cost materials due to the Mexican economic system, particularly in the beginning of their artistic life, but not exclusively because we can find examples of electronic art work that has been developed by well-known artists with lack of resources.

Nevertheless, through the essay called *Postproduccion* from the outstanding theorist Nicolas Bourriaud, we can find evidence that the reutilization of materials is a common pattern in contemporary art, he said, the artistic question it is no longer: What is new that can be done? But rather What can be done with…? Speaking about reuse of materials and ideas also. Bourriaud gave an explanation about why the flea market is so important for current artistic practices: in the first place it is important because it brings a collective experience, the chaotic heap of things derived from different individuals, also because in the organization of a flea market the past takes place and through the flea market people have the chance to avoid the industrial commerce and internet sales, finally at the flea market objects from multiples provenances wait for new uses, as Marcel Duchamp said, this is about giving a new idea to an object.

Electronic art production in complex environment

For now, it is necessary to say that the context where a Mexican electronic artist works is complicated. The social, economic and politic conditions add the ingredients of

uncertainty to everyday life. These Mexican adverse circumstances such as poverty, inequity, violence, corruption, drug trafficking, among others, often provides ideas to the artists for their work. The use of subjects related to Mexican context is one of the most important characteristics on Mexican electronic art, these subjects of the art produced in Mexico are based on situations and events that arouse in Mexican environment. It is necessary to say, that most of the time only a Mexican or people involved in Mexican culture can completely understand all the implications and cultural meanings of these pieces; example of that are the works of Rafael Lozano-Hemmer (international artist who born in Mexico City): "Voz Alta", 2008, piece related to the murders committed by the government in 1968, –for more than thirty years it was forbidden in media to talk about this issue; "Level of Confidence", 2015, about the tragic disappearance of 43 students in Ayotzinapa, Mexico in 2014 –to this day, no one knows for sure what happened to them; "Displaced Emperors", 1997, projects the Aztec head-dress of Moctezuma in the facade of the Museum für Völkerkunde in Vienna where the head-dress is kept against the will of Mexicans, despite these, it is necessary to say that Rafael Lozano-Hemmer does not work in Mexico, but knows Mexican culture very well, he creates in other countries like Spain or Canada with their economic support, so Rafael Lozano-Hemmer works are not equal to Mexican art that arises from Mexico's social and economic limitations.

In addition to that, Mexican electronic artists that produces in Mexico shows another reality. In Mexico the elaboration phase of the production processes might be different. According to the interviews made to electronic artists for this research, there is a small group of artists that produced frequently supported with government grants or other type of economic resources. Nevertheless, there are artists that find ideas in difficult conditions, that means artists adapts their production processes to the existing resources, been capable to produce with very few materials. This research focus on those artistic works to study Mexican electronic art, because it is more emphatic with the existing and general situation.

Moreover, this research focus on electronic Art works from the last decade of the XX century and the first decade of XXI century. The research process consists in exploring and describing to generate theory perspectives, as a research strategy we used direct interview with electronic artists through diverse media, like telephone, cellphone, email, video conference, etcetera, even personal visit to art studios, or attending art exhibits and presentations to meet the artists.

Mexican Electronic Art, cases of study

In the context of today Mexican electronic art, we are going to analyze works of art that reuse and/or make a different reinterpretation of existing materials. The Mexican artists are: Arcangel Constantini (1970, was born in Cuautitlan); Ivan Abreu (1967, La Habana, Cuba, now Mexican citizen); Leslie Garcia (1980 *ca.,* Tijuana); Gilberto Esparza (1975, Aguascalientes); Juanita del Carmen Mendoza Ornelas (from *Guanajuato University* under degree studies on Digital Art); τέκτων_{*}.debug() Collective from *Universidad Autonoma Metropolitana, Campus Lerma.* These electronic artists use materials from technological garbage dumps, low-cost materials, free and open-source software to produce art.

"3:00 am" by Arcangel Constantini

Anima is a Netart work developed in 2002 by Arcangel Constantini, it integrates several projects with different tittles: *3:00 a.m., MR vs DR, Azar / chaos, Frecuencia, Retrovisión, Ake/Karas, Mas_numeros* and *Multiver.s.o.s.* In all these projects the reinterpretation of obsolete objects can be seen, also the concept of the artist called "continuous loop" where the same images are repeating constantly in small video sequences.

In the case of "3:00 am", an image appears formed with 25 different segments, inside of each segment a video can begin by clicking above the text "3 a.m.", instantly sounds from the *Santa Martha Acatitla* flea market in Mexico City emerged, the videos and the audios keep going and going in a continuous loop,

The films of the videos were edited at the time of the recording, they used the infrared night vision of the camera to videotape. The lighting was carried out with a hand lamp, which emulated the buyers of the flea market at dawn. The audio was made by the artist Manrico Montero Calzadiaz (Mexico, 1973-2018) and emerges from the original sound of the flea market, generated by the constant manipulation of objects: the movement of the bags in which they pack and unpack, the empty cans, and the noise of the dump trucks emptying the scrap metal. Finally, the objects had a relation with the artist's theory of the "conceptual or continuous loop", that has a relation with the idea of reality and the repeating events in life.

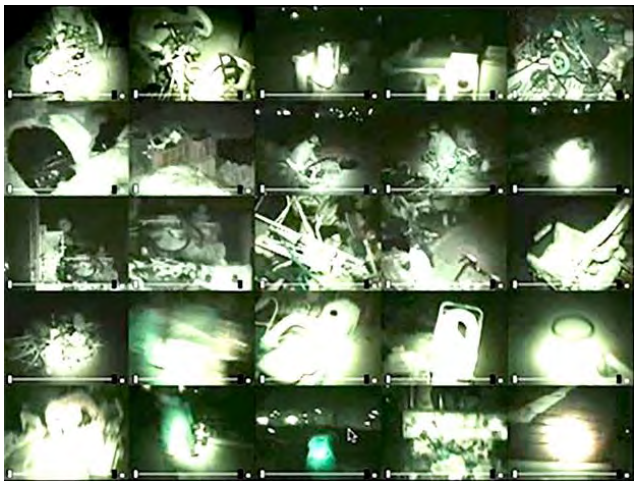


Figure 1. "3:00 am" by Arcangel Constantini, (2002). It is available at www.unosunosyunosceros.com.

"Telematic Sound Weapon", by Leslie Garcia and Astrovandalistas

This work was made by Leslie Garcia within the Astrovandalistas Collective. "Telematic Sound Weapon" (s / f), is a sound installation made using an existing metallic structure in front of *Campo Marte,* which is an equestrian field in Mexico City, used for the practice of equestrian sports and for different military and government events, for example, at the Olympic Games in Mexico 1968, it was the venue for horse riding competitions, inside there is a monumental flag of 50 by 28 meters and a flagpole of 100 meters high; on one side of this field was built in 2012 the "Memorial to the victims of violence in Mexico". However, records have been found in various books and documents (Poniatowska, 1971) indicating that, during the student massacre that took place on October 2, 1968, in the *Plaza de las Tres Culturas* in Mexico, a place also known as *Conjunto Habitacional Tlatelolco,* the lifeless bodies of hundreds of people, most of them students, were buried secretly in the Campo Marte. Leslie García comments the following: "…we found a metal structure of 4 by 6 meters located in front of Campo Marte, a military camp that contains stories of a repressive past that has been forgotten little by little. We intervene the structure with 64 galvanized pipes connected to an engine. This mechanism is activated remotely every time someone writes #BANG-CampoMarte on Twitter" [1]. The pipes made an audible sound each time someone interacts on Twitter (video: https://vimeo.com/46611303). Finally, the work attracted ordinary citizens, soldiers and Internet users, it also gave the opportunity to talk about this topic.

The "Telematic Sound Weapon" is a work designed to make evident the desire of people to manifest themselves both in the physical space of the piece and in social networks, "A weapon is a device that extends the direction and magnitude of a force. We want to amplify a collective questioning about the role of violence in the recent history of Mexico" [2]. On the work website, a public invitation is made to participate in what they called virtual manifestation exercise, where the complete manual is available if the audience want to make something similar.

Figure 2. "Telematic Sound Weapon" (2012) by Leslie García and Astrovandalistas Collective.

Urban Parasites by Gilberto Esparza

"Urban Parasites" was created between 2006 and 2008. The process of creation of the pieces that conform "Urban Parasites" (robots with different names: *Flies, Scavengers ppndr-s, Inorganic Autotrophs, Maraña Mrñ, Hung Clgd, Dblt*) could be seen in the website of the artistic work[3]. In the video of the process of production we can see the artist in a dump among piles of technological garbage, two large cranes rearrange the scrap while Gilberto Esparza recues various objects from the waste; later in his study the artist design different robots with these objects, then he shows his ideas to his crew, engineers and programmers separately, then they built the robots, put them on the light cables of the streets and observe people reactions.

The artist mentioned he uses recycled material and frequently goes to a cellar of a well-known telecommunication company (called Telmex), in this cellar he refers saw different objects to build his robots, he wants the robots to perform in an urban environment; a special cage which is very resistant is the exterior of the robot, is designed to keep safe the cables of the robot and allow it to survive. Esparza made his robots to be capable to live outside for long periods of time, could be months or even years, he said they lived in urban environment and are part of the city landscape, while they are moving they produced sounds.

Gilberto Esparza put his robots in the city of Lima, Peru, people reacted with surprise, they laugh when they saw the "Urban Parasites" mounted and moving on the light cables of the city, asking one to other –What was that! The contrary happened in Mexico City, where people just ignore the robots, the artist thinks that might be because in Mexico City people lost the capacity of been surprised due to the fast way of life and the monotony of the existence in big cities; finally, he said it is good that people ignore the "Urban parasites", that way maybe they could live more.

[1] Lelsie García, "Arma sonora telemática", https://bit.ly/2xgwwrz. Query: February, 2015.

[2] Leslie García, lessnullvoid.cc, 2012, Query: September, 2018.

[3] Gilberto Esparza. http://www.parasitosurbanos.com. Query: January 13, 2013.

Figure 3. Gilberto Esparza, “Urban Parasites” (2006-2008).

Figure 4. Gilberto Esparza (2007). “Autotrofo inorganico”, serie “Urban Parasites”.

ASML (Art Statement Markup Language), by Ivan Abreu

This piece of Software Art was created by Ivan Abreu in 2003, ASML, it is a language that highlight different texts about art that had been written by art critics, these texts are interpreted by machines, in other words, ASML add data to the texts, making them understandable in the machine context.

Markup language add data or meta descriptions to the texts, making them "comprenhensible" in the machines context. Because of the complexity and specificity of the knowledge, there are markup languages that focus on specific context: MathML (Mathematical Markup Language), for mathematics notions; GML (Geography Markup Language), for the geographic information; the well-known HTML (HiperText markup Language), for describing data in the net and many others. ASML is a markup language that allows the machine to understand common entities in the art lectures. Despite of being a scientific project, it is a research about the semantic and grammatical knowledge in the art texts. In some way, these projects try to applicate an objective point of view to several texts characterized by ambiguity and subjectivity [4].

Nevertheless, the artist refers that it is not a scientific project, but a research of semantic and grammar knowledge in art texts. What the artist did in ASML is an attempt to give clarity and objectivity to texts about art criticism that usually have the characteristic of being ambiguous and subjective.

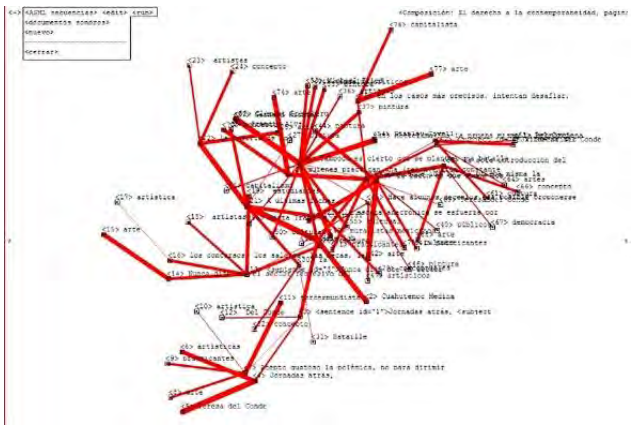


Fig.5. Ivan Abreu, “ASML”, 2003.

Ataraxia, by Edmar Soria and *τέκτων_{*}.debug()* Collective

This artistic development is an electro acoustic piece conformed with assembled multi percussions, electronics and video. According to Edmar Soria, the piece is a constant sound recycling of audible elements that function as an antiphony with the use of sound. Instruments were constructed and assembled from different materials and are used in order to establish a specific range, its spatiality is captured in a virtual way within a multi array system of microphones, the result is a combination of digital and physical resources.

The work was presented on the celebration of the “50th Anniversary of the Leonardo magazine” held in Mexico City on April 19, 2018. The sound artist Edmar Olivares Soria and *τέκτων _ {*. Debug ()* [sic.] Collective, presented “Ataraxia”. The project was directed by the teacher Edmar Olivares and constituted an interesting sound exploration from recycled materials, where they experimented with many reuse materials such as chilies cans, nails, wood, computer parts, metal parts, strings and other resources. In interview Edmar Soria said:

> "... each piece is cut in different ways, some are perforated to explore different sounds, for example, harmonics [...] we designed instruments in order to have certain resonances and we designed other instruments like this little zither [points to a PC case

[4] Ivan Abreu. www.ivanabreu.net, 2012, parr.1-2. Query: August, 2018.

with strings]. The idea is to used recycled and industrial materials to build structures that resonate... the main exploration is from physical space. How to place these sounds in space? But not only that, according to the sound characteristics each element must have a special position in the space, so those instruments do not 'get stuck' with each other, but at the same time it is possible to distinguish all the layers of sound that are happening."[5]

The artist and teacher Edmar Olivares mentioned that the project was only an artistic sound exploration of the concept of resonance through splicing resonance and space. The project is an implementation of scientific and technological knowledge applied to the development of instruments constructed in a creative way with recycled materials.

[5] Interview Edmar Olivares in Centro Cultural Casa del Tiempo, Mexico City.

Fig.6. Ataraxia, (2018) Edmar Olivares Soria and *τέκτων_{*}.debug()* Collective, students of UAM Lerma, Performance on April 19, 2017, "50th Aniversary of Leonardo Magazine", Cultural Center *Casa del Tiempo,* Mexico City.

The invisibility of the urban marginalized, by Juanita del Carmen Mendoza Ornelas

The work done by Juanita del Carmen Mendoza Ornelas is a real-time projection and simulation of the interactive interpreter that was carried out in September 2017 at Guanajuato University, campus Irapuato-Salamanca.

This artistic work deals with the concept of invisibility, the one that unfolds in the context of social processes. The scope of invisibility that is pointed out in this piece refers to the exclusion of individuals inserted in complex sociopolitical and economic structures inside a third world city. This work shows the social structures where the human presence seems to vanish or does not exist, in this cultures there is domination from one group to other

groups. What the artist wanted to show is the relationship between poor, middle class and rich people, where the richest ones ignore the existence of the others, the artist Juanita Mendoza opens a dialogue and invites the audience to make a sincere reflection on this social issue. The fundamentals of this artistic installation are in the Latin American Philosophy of Liberation developed by philosophers, theologians and anthropologists like Juan Carlos Scannone, Enrique Dussel and Rodolfo Kusch,

It is important for Latin America to bring this issues to art because through this action, audiences can speak about it and deep thoughts can emerge, that could be the beginning of a solution. Juanita Mendoza looked for social equality between the different actors that interact in a society, discrimination is a situation that exists in the present days and through the times due to Spanish Conquest of Mexico in 1519.

The installation consists of a montage of several spaces, one perceptually within the other, as the rhetorical figure of the abyss, it is dynamic for the viewer, where the concept of marginality prevails the multimedia interaction. In the installation appear two spaces where two different social conditions are visualized, in the first one the issue of differentiation and exclusion is addressed, it represents a panorama of a marginal society within a city, there are pictorial allusions, figurative projections, in the second space there is the representation of a cabin that symbolizes the fragility of the division into classes and different social strata which coexist.

Fig.7. Juanita del Carmen Mendoza Ornelas, "The invisibility of the urban marginalized" (2017), projection, installation, real-time simulation.

Conclusions

Electronic art in Mexico has gone through different phases, which have helped to strengthen it in the national artistic scene, even though there have been different artistic works with the use of electronics, electronic art does not have a preeminent place in Mexican art. Throughout the last decades there have been different forums where electronic art has had spaces for its exhibition, such as the Alameda Art Laboratory; the CECUT Tijuana Cultural Center; the Center for Art and New Technologies, CANTE in San Luis Potosi (the area of new technologies does not exist anymore); the Carrillo Gil Museum; the Multimedia Center of the National Center for the Arts; the Cyberlounge of the Museo Tamayo Arte Contemporaneo (now disappeared); among other spaces most located in Mexico City, all of which brings with it that electronic art is not completely known by the audiences that attend to museums and galleries. A positive thing is that not all electronic artists like to exhibit in galleries or museums, they exhibit directly in public spaces, seeking in this way to reach the majorities, through these practices they also seek to return public spaces to citizens, nowadays most of the public spaces in cities have been occupied by companies and institutions; example of this type of works are Ivan Abreu public works. However, the advance in the knowledge of electronic art in Mexico advances at a slow pace, while in other countries it is well entrenched and even has spaces for the development of work like: "Media Lab Prado" in Madrid, "Laboluz" in Valencia both in Spain; "Ars Electronica" in Linz, Austria; "SymbioticA" in Pert, Australia; the other side of the coin is in Latin American countries where the spaces for project development operate with limited resources and sometimes, the lucky ones, with grants, such as "Platohedro" in Medellín, Colombia or in Mexico City an autonomous place in San Rafael area called "Crater Invertido".

An important fact in this panorama is that Mexican electronic artists have been producing art no matter if they have the economic or material resources, the examples that we saw in this research proved that artistic electronic creation is far from the limits of having enough resources.

Most of Mexican electronic artists refer on interview they struggle at the beginning of their career, but they said, that was not an important reason to stop working on the field they loved: the electronic art.

Bibliography

Atkins, R. (1997). *Art Speak. A Guide to Contemporary Ideas, Movements and Buzzwords, 1945 to the present* (2a. Ed.). Nueva York: AbbeVillePress.

Debroise, O. (2007). *La era de la discrepancia, arte y cultura visual en Mexico 1968-1997* (1a. Ed.). Mexico. UNAM.

Nicolas Bourriaud, *Postproduccion,* Adriana Hidalgo Ed., Buenos Aires, 2004, p.30.

Poniatowska, E. (1971). *La noche de Tlatelolco* (55ª. Reimp.). Mexico. Ed. Era.

Popper, F. (1993). *Art of the electronic age* (1a. Ed.). Nueva York, US: Thames & Hudson.

Shanken, E., (2009). *Art and electronic media* (1a.Ed.). Londres, Inglaterra, Phaidon.

Tibol, R. (1987). *Graficas y neograficas en Mexico* (1a. Ed.). Mexico. UNAM / SEP.

Wands, B. (2007). *Art of the digital age* (1a.Ed.). Nueva York, Estados Unidos: Thames y Hudson.

Electronic Resources

Gilberto Esparza, "Parasitos Urbanos", https://bit.ly/2xkBYK4, consultado en enero de 2015.

Ivan Abreu. www.ivanabreu.net, 2012. Consulta: agosto 2018.

La autora, "13 entrevistas a artistas", vimeo: https://bit.ly/2Lw0hHT

WMMNA. http://we-make-money-not-art.com/gambiologia/. Gambiologia, the Brazilian art and science of kludging. Query: September 10, 2018.

Author Biography

Professor and Researcher at Guanajuato University in Mexico since August 2002. She is the author of three books, several book chapters and articles about Art, Digital Art, Creativity and Design. Since 2003 she is the editor of the magazine called *Revista Interiorgrafico de la Division de Arquitectura, Arte y Diseño de la Universidad de Guanajuato.* Has made stays in Spain, linked to the research she has been developing.

Has a degree in *Graphic Design,* a Master degree in *Creativity for Design* by The Design School of National Institute of Fine Arts, has a PhD on *Visual Arts and Intermedia* from Universidad Politecnica of Valencia, Spain, her PhD thesis about Processes of Production of Mexican Digital Art received an award called *Premio Extraordinario de Tesis Doctorales* by Universidad Politecnica de Valencia in 2016.

She is a former Member of Mexican National Research System, Level 1, of National Council for Science and Technology, CONACYT.

Mixed Reality Art Experiments - Immersive Access to Collective Memories

Jens Herder[*], Shinpei Takeda[†], Kai Vermeegen[*], Till Davin[*], Dominique Berners[*], Bektur Ryskeldiev[⋆], Christian Zimmer[*], Ivana Druzetic[*], and Christian Geiger[*]

[*] Hochschule Düsseldorf, University of Applied Sciences, Münsterstr. 156, 40476 Düsseldorf, Germany, E-Mail: herder@hs-duesseldorf.de

[†] Independent artist / Director, Antimonument e.V., Reiherweg 23, 40468 Düsseldorf, Germany, st5@atopus.net

[⋆] University of Tsukuba, Tsukuba, Ibaraki 305-8577, Japan, bektour@slis.tsukuba.ac.jp

Abstract

We report about several experiments on applying mixed reality technology in the context of accessing collective memories from atomic bombs, Holocaust and Second World War. We discuss the impact of Virtual Reality, Augmented Virtuality and Augmented Reality for specific memorial locations. We show how to use a virtual studio for demonstrating an augmented reality application for a specific location in a remote session within a video conference. Augmented Virtuality is used to recreate the local environment, thus providing a context and helping the participants recollect emotions related to a certain place. This technique demonstrates the advantages of using virtual (VR) and augmented (AR) reality environments for rapid prototyping and pitching project ideas in a live remote setting.

Keywords

Mixed Reality, Augmented Reality, Augmented Virtuality, Rapid Prototyping, Video Conferencing

Introduction

One of the common applications of mixed reality environments is prototyping of both software and hardware products. Showing a designed, but not manufactured, product in a real environment can be useful for collecting feedback in early stages of development. According to the extended mixed reality taxonomy presented by Paul Milgram and Fumio Kishino [6], mixed reality encompasses different combinations of real and virtual environments, including augmented reality (virtual content placed over a real environment), and augmented virtuality (real content placed over a virtual environment). In case with prototyping, an augmented virtuality environment (for instance, recreated through a virtual TV studio with a green screen setup) can demonstrate a nonexistent environment or a missing object that has been used in the development process in combination with simulations [8, 2]. Furthermore, with the recent developments of mixed reality technologies, both augmented reality (AR) and augmented virtuality (AV) environments could be used for pitching similar applications. For instance, augmented reality applications can be best represented in the environments they are meant to be used in, but in a demonstration over a remote video conference such context might be unavailable due to both physical or financial restrictions.

An overview on how to use different variations of mixed reality environments in context of cultural heritage is given in [1]. Augmented reality can be used to place interviews with contemporary witnesses of the Holocaust into current location like a living room, creating the feeling of closeness and authenticity [5]. Additionally the mixed reality space can be enhanced with animations, such as flying war bombers or snow, adding dramatic effects and providing emotional context to an interview [12]. Historical sites can show missing buildings using augmented reality [7]. Voices, images and video can be embedded into the actual historical location, creating another information layer.

Augmented virtuality environments have been also used to enhance remote collaboration with mobile devices by providing photospherical imagery of the context either from an actual space or virtual space [9].

When showing the use of VR or AR applications, it is important to not only to show the egocentric view of the potential user but also to show the user interaction within the virtual (or real) environment [3]. This exocentric view can be rendered using an external tracked camera which uses the scene from the application. All those renderings can be used in a live setting.

Augmented Virtuality - Atomic Morphology

The original installation Alpha Decay 7: To erase memories was produced and exhibited at TJ in CHINA Project Space in Beijing, China in 2012. The drawings were based on the voice vibration of interviews the artist made with people that have survived the atomic bombing in Japan [11, chapter 11, 12, and 13]. Five years later, the work was reinstalled in the virtual reality in which the artist revisited his memory and created a virtual object to investigate how his memory of working with these stories morphed and shaped his present self in atomic level. The recording took place at a virtual studio as seen in Figure 1. The artist draws a 3D sculpture in a narrow cube using scanned paper drawing from the Alpha Decay 7: To erase memories installation. Finally after the drawing is finished, he destroys his context by throwing away the walls of the cube. The recording was a live performance.

The idea of the second art experiment as seen in Figure 2 is to take images from the archive of the Erinnerungsort [10] and place them in a video performance into the virtual space and drawing lines symbolizing the connections of memories.

Figure 1: Augmented Virtuality: The artist is drawing a virtual 3D painting in the virtual studio. He sees his drawing through a HMD, while recording was done with an external camera to combine the virtual and real space to one image.

An underlying interview of a survivor of the Holocaust recreates the historical context.

The background of this experiment is that dealing with tragic memories, which had an impact in the world history, is difficult. Either only specific memories of individuals can be shown or the compiled dramatic situation of the past becomes abstract without emotional binding. In the past, the artist Shinpei Takeda did interviews with survivors of the atomic bombs in Japan. One very specific, personal skill from him is to draw audio waves (from the interviews) with a brush similar to Japanese calligraphy (Shodō). This is his way to deal with his memories from the interviews. Here he worked in a rather monotone virtual environment with one of his actual sculptures. In that monotone environment, he used Google Tiltbrush[1] to create a virtual sculpture and used the Tiltbrush functions to import images from the Erinnerungsort archive. The artist interacted and placed the images on his temporary sculpture. The results show how to work with images as the artist hears the interviews, it created a suitable environment of access to the stories of other individual. This was also possible because virtual space provided temporary a timeless and spaceless dimensions that are identical to the world of memory. Being able to interact with the photographs in a virtual space added different type of familiarity to the images than looking at them on a flat screen.

[1] www.tiltbrush.com

Augmented Reality - Inside the actual memorial site

Inside the Holocaust memorial Erinnerungsort Düsseldorf, in a seemingly sterile environment, one easily forgets that horrible things happened right at that place. The leading question was how do you visualize it and how do you reveal this emotionally charged memory. Using a sound activated brush, the artist Shinpei Takeda created a virtual sculpture as if memories emerge out of the database computers, where all the interviews and archival information are kept (see Figure 2). The main idea and question is: ”Do memories stay connected to a place, and how can we visualize it?”. After investigating the stories of the survivors of the memorial site Erinnerungsort in a virtual studio, it became important to do the experiments at the actual site of the memorial Erinnerungsort.

By creating a custom paint brush tool for augmented reality that vibrates according to the sound, the artist had a tool at hand with which he can directly intervene on the historically and emotionally charged place, almost in a way that graffiti artists do to the urban environment. In doing so, the goal was to experiment with a virtual intervention at a place that is to be handled with care. A virtual reality headset was brought to the site along with a computer to draw with the custom brush. The headset (Vive Pro) was used with its pre-installed camera in augmented reality mode, so that the artist could actually see the environment while intervening at the memorial site. The audio used was the interview sound of Mrs. Margot Cohen Goldberg, a Jewish woman who had actually stayed at this slaughterhouse before getting transported to Lodz ghetto in Poland in 1942. Three experiments took place: one outside,

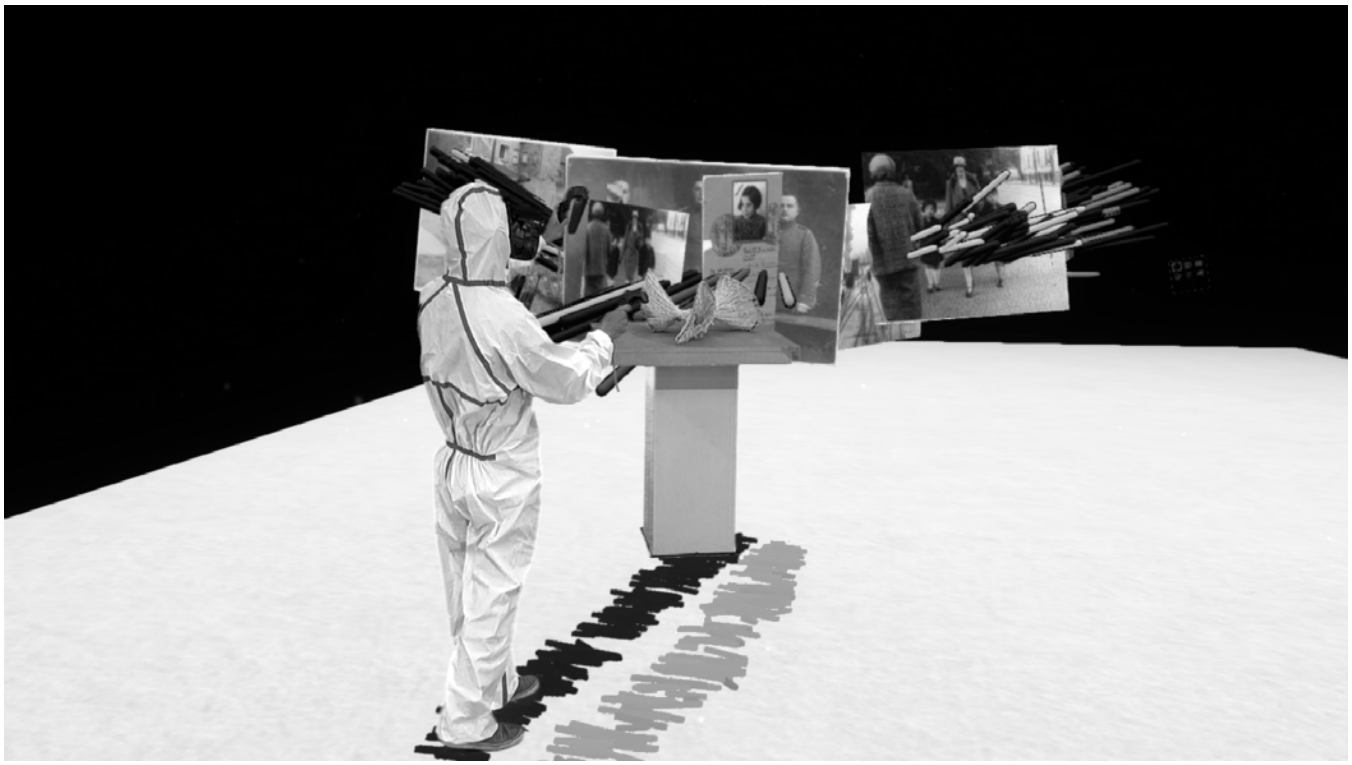


Figure 2: Augmented Virtuality: Using a virtual studio not only the virtual art installation can be seen, but also the artist interacting with his own sculpture and images from the memorial database.

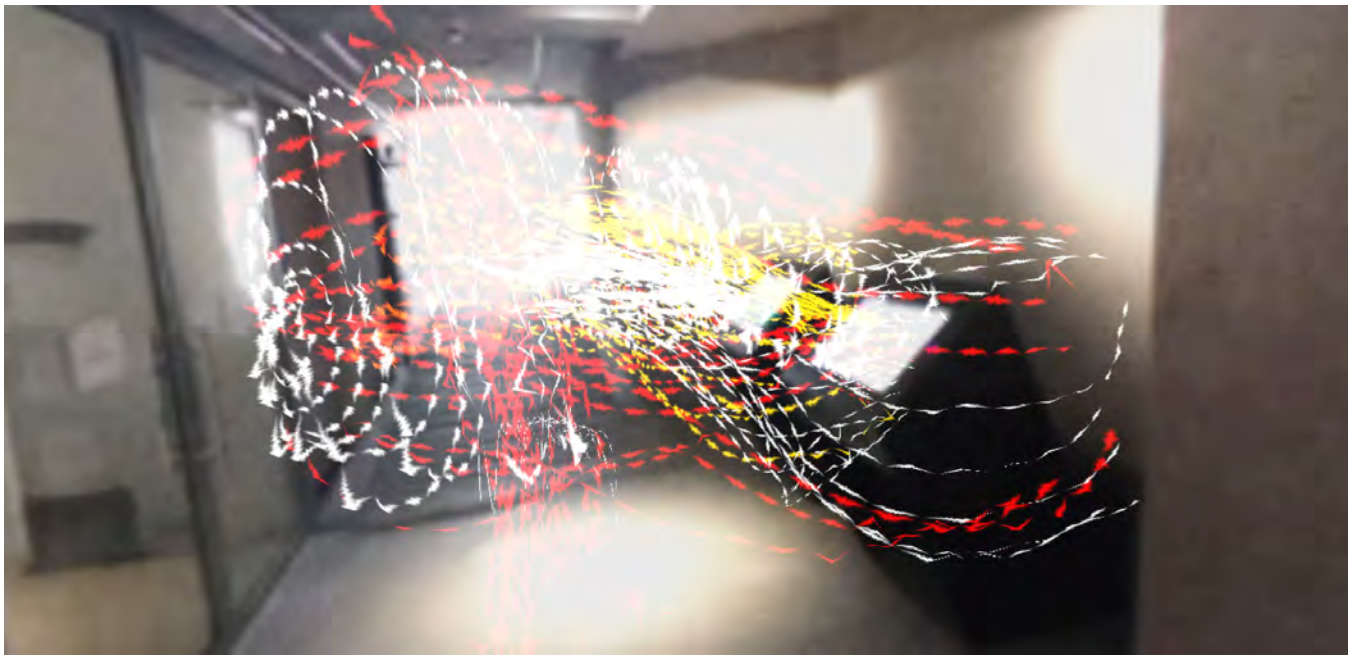


Figure 3: Augmented Reality: A virtual interactive painting that vibrates to the sound of interviews with Holocaust survivors was projected into the real memorial site.

one inside and another one in the underground level where the archival database was located. The system was developed using Unity, SteamVR and the Vive SRWorks SDK. The SRWorks SDK [4] was used to integrate the front facing camera of the Vive Pro into the Unity Engine. In Unity a virtual reality scene was running where the user could use the above described audio-reactive paint brush. The interview sounds were integrated in the scene and acted as the audio source for the brush.

Results were a series of virtual sculptures at the site that interacted with the architecture of the place and in essence attempted to reveal stored memories. It created a difference for the artist to work at the actual place, than creating a piece at a completely virtual environment. The interview sound from the archive activated the lines of sculptures and made the models more intensive and sometimes stressful as to reveal the inhumane nature of the memory. The video of the performance showed the graphics layer always on top, therefore in some situations the depth occlusion was not correct.

Augmented Reality - Using AR to conserve narratives of war survivors

In collaboration with the German public broadcasting station WDR and the VFX company Lavalabs (www.lavalabs.de) an AR application was developed in which survivors of the Second World War got the chance to tell their own stories. The intention was to make their personal history accessible, persistent and comprehensible to users who have difficulties in relating to these memories, e. g. digital natives, or to people who are generally interested to experience stories in a more immersive way. AR provides us with new ways to tell stories about the past in an empathetic way by augmenting the narration with audio-visual assets. Contemporary witnesses of the Second World War will be less and less able to report their experiences. AR offers the possibility of experimental knowledge transfer, which is able to communicate the desired information more interactively than traditional media forms allow. The experience of augmented illustrations can be an effective form of knowledge transfer if the design and technical implementation is done with appropriated means. The potentials of AR in a documentary and artistic context are currently not well explored [12].

In order to experience the story in AR, the user can visually place the contemporary witness in his / her environment using a mobile device. (Figure 4) When the eye witness has been placed, the user can listen to the wartime experiences the respective witness sitting in front of him / her went through as a child. During the narration, the users real environment is extended or modified by AR content that illustrates the narration (see Figure 5). For example, it is filled with dense smoke or he / she can see sparks or WWII bombers flying through his / her living room.

One of the characteristics of this project is that the medium of AR differs in several aspects from traditional documentary film and is perceived differently by the user. While looking at a classic film, it is already predetermined how the camera is positioned. In AR the user has the freedom to decide which image section she / he chooses for a particular scene. The

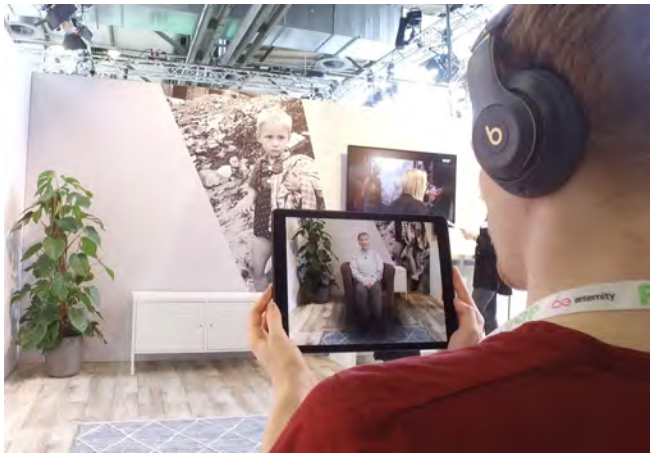


Figure 4: The user is able to place the eye witness in his / her environment

Figure 5: The user's surroundings are extended in real-time by AR elements

scene background could be freely chosen as well: The user is able to place the eyewitness in the living room - but it is also possible to place her, for example, in the park or on a terrace. Therefore, the content presented needs to be designed to work in as many different environments as possible. Since no comparable app was available when the project started, many of these questions were addressed experimentally and with the help of iterative development cycles of design and test.

The visual content for the different narrations was designed to employ the complete range of the reality-virtuality continuum to provide a maximum flexibility of the presented content. At the same time it was important not to focus the center of attention too much on digital effects and away from the contemporary witness' story. Each augmented content is adapted to the eye witness' key experiences in the corresponding story and provides different mixtures between real

imagery and AR elements.

In few cases a complete virtual presentation was chosen while maintaining AR tracking: For instance, when one of the eye witnesses tells about the winter landscape in Russia, the AR environment is slowly fading to a VR presentation of the winter landscape in which the user can look around using his / her mobile device - meanwhile the war survivor remains visible in this environment and proceeds with her story. In the further progress of the story the VR presentation fades away and is replaced by the subsequent AR visualizations, for example by snow which is falling in the user's environment or by a street canyon which is displayed on top of the real surroundings.

During the development process it became clear that fast previews for AR settings were crucial to estimate the impression a user gets when using the app and to support the creative process. This might be done by creating a static mockup, animated storyboards, 2D animatics or by building interactive AR sketches. Another important aspect was how to provide the AR narratives to impaired users. The application provides an alternative "screen recorded" view to see the eye witnesses' stories similar to a "Let's Play" session. No additional voice commentary was added due to the linear character of the story. Instead, subtitles were provided for each narrative. Additional to a traditional touch interface, the application can be operated by swipe gestures in voice-over-mode and provides text-to-speech output.

A container structure is used for presenting the AR content. This allows to extend the user experience with further narratives in the future. Currently, narrations of two living friends of Anne Frank are prepared to be part of the AR application and are expected to be released by the end of summer 2019. Thereafter, it is planned to record personal stories of pupils within WWII.

The AR app is listed with the name "WDR AR 1933-1945" in the Apple AppStore and Google PlayStore and is available for free for ARKit and ARCore capable devices.

A pitch for an art installation, including AR using a video conference

Shinpei Takeda, is an independent artist based in Düsseldorf, who has been working on a theme of memory of the atomic bombing in Nagasaki, Japan for the last 10 years. In collaboration with HSD, the artist wanted to propose a use of virtual reality and augmented reality in general as well as a potential intervention in the hypocenter park in Nagasaki. Since it is the original ground zero, it is also a very emotionally and politically charged place, and any projects taking place in the park are suspect to a high level of public scrutiny. In order to pitch a new project in such a place, to the director of Nagasaki Atomic Bomb Museum, the artist Shinpei Takeda needed to demonstrate the ideas as realistically as possible without bringing the entire team from Germany or leaving the museum.

For pitching the art project at a specific site, which deals with memories from history, a video conference between Germany and Japan took place. A virtual studio in Germany was used to broadcast a composite video signal. As backdrop, spherical imagery from the actual remote place were used, captured two days earlier with a smartphone. With a similar setting to the mixed reality experience in [3] and the program Tiltbrush images were placed within the space and annotated. Figure 6 shows a screenshot of the video conference.

Figure 6: Google Tiltbrush is used in a live setting for prototyping an application space. The context is given through a panoramic image from the actual location.

After introducing the project idea supported by the live constructed imagery, a smartphone with an AR application was shown. For the remote participant, it looked like being at the remote site with the app, as seen in Figure 7.

Implementation

Figure 8 shows the signal flow of video and tracking data in the virtual studio. An external hardware chroma keyer is responsible for keying and mixing. For mixing, the video stream from the camera and rendered graphics are used. The rendered graphics from the software application for the HMD must be converted, because the hardware keyer has only SDI input. An external HMDI-SDI converter converts the video HDMI output from the computer application to SDI. Additionally to the mixed video from the keyer, an egocentric view is captured by a video card. The egocentric view and the keyed video are input signals for the switcher. With the switcher one colleague in the studio was able to switch between the different video streams and determine what was sent to the video conference. Connected to a video server, the output video stream was recorded on local storage. To use the video stream as webcam input for the video conference, the signal had to be

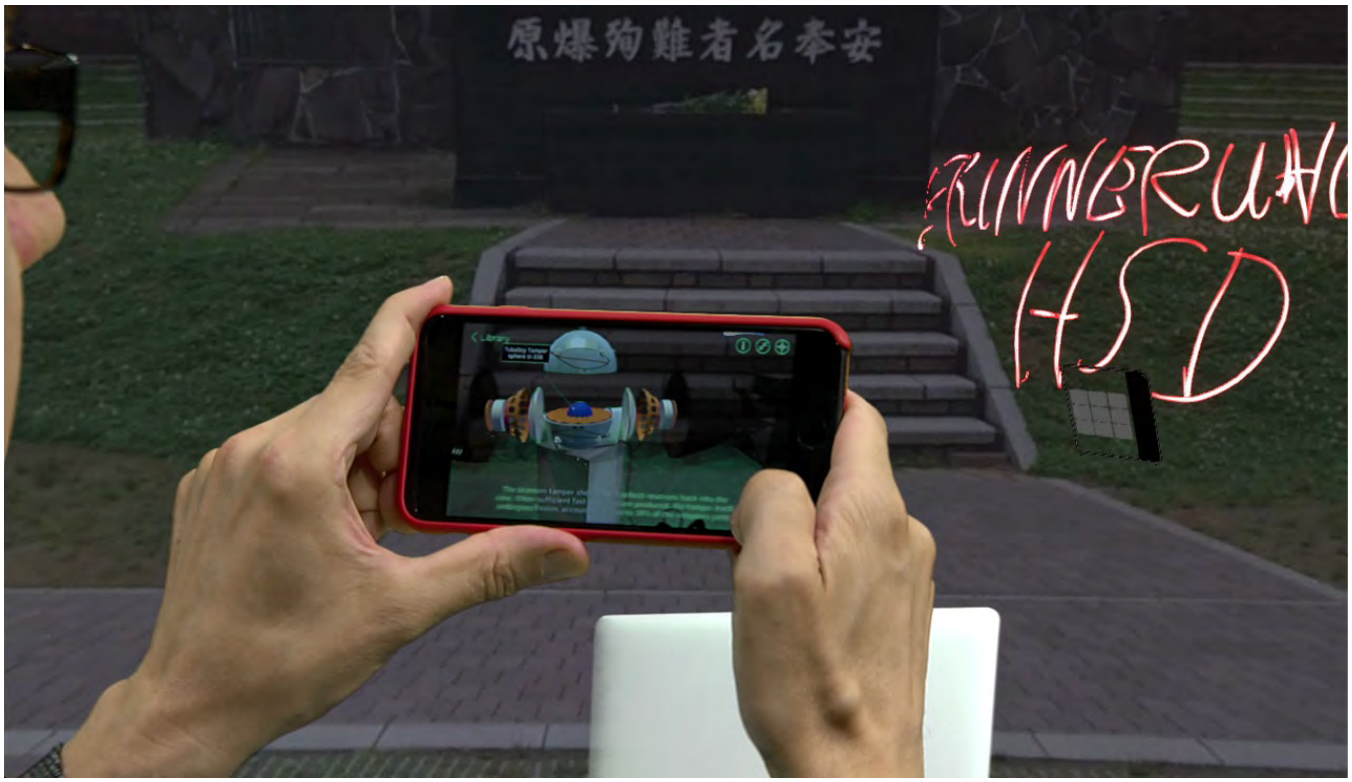


Figure 7: Demonstrating an AR application within augmented virtuality using a virtual studio during a video conference, the artificial background shines through the app because the green on the screen of mobile phone gets also keyed.

converted once more. The SDI signal from the switcher was compressed by an external converter to a more suitable and lighter webcam stream. Via USB the video could then be used like a webcam in the video conference software. The recording took place in a green screen studio. The person showing the AR application was standing in the studio and therefore captured the green background with the smartphone app as well. The AR application on the smartphone showed an augmented reality space placed within a green background. To show the application to video conference members, the smartphone was captured by the studio camera. The camera was connected to the hardware chroma keyer, so not only the green studio background, but also the green smartphone background were keyed, and the background in the studio and the smartphone were replaced by a background image. Like this the AR application in the smartphone was placed in the same location depicted by the virtual background, used as if the smartphone and its user were located at the location depicted by the virtual background.

Discussion

Several projects were presented that either rely on or involve some kind of previsualization in context of accessing collective memories. AR seems to be a feasible utility to focus on the immersive aspect of memories. Interactive and / or transforming elements can be produced in a way which would be challenging by using traditional media forms. AR can be used as a tool for artistic expressions but it is also possible to take the role of an observer in an AR environment. A successful communication and transfer of content that relies on memories also requires viewer's capability for empathy and imagination. AR as a medium here facilitates this personal engagement by offering strong visual and auditive stimulation which in some cases can be also interacted with.

We have also shown that augmented reality applications can be pitched using augmented virtuality in a virtual studio. The shown method makes it possible to demonstrate prototypes in different environments and to change these environments easily. This reduces the time required to demonstrate the prototype in different environments and the potential travel expenses. Artists now have a new tool for pitching their projects in a convincing way. Also on reality-virtuality continuum [6] (see Figure 9) an application might not be classified as one point, because a loop from one point to another can be constructed. Participants of the video conference and watching the recording of the pitch in Nagasaki thought first that everything took place at the actual location and could not believe that everything was created from scratch. The used technology in a studio is complex, but setup can be eased with future developments such as keying without green screen. Mixed Reality is a powerful tool for testing and demonstration and will revolutionize the application development cycle, including pitching project ideas.

The experiments with a virtual studio can be brought to ac-

tual historic sides using augmented reality using similar technology but creates a higher degree of authentication. While the setup outside of laboratories has more limitations because not all tools can be deployed and the space is not a controlled and freely available environment, the spirit of the location can be captured.

Acknowledgments

The realization of the project and its presentation at ISEA2019 was partially supported by the project The Peoples Smart Sculpture (PS2), co-funded by the European Commission, Creative Europe Program, and the project "MARTA - Mixed Reality Art in Public Space", funded by the German federal state of NRW and European Regional Development Funds.

References

[1] Bekele, M. K.; Pierdicca, R.; Frontoni, E.; Malinverni, E. S.; and Gain, J. 2018. A survey of augmented, virtual, and mixed reality for cultural heritage. *J. Comput. Cult. Herit.* 11(2):7:1–7:36.

[2] Geiger, C.; Herder, J.; Göbel, S.; Heinze, C.; and Marinos, D. 2010. Design and virtual studio presentation of a traditional archery simulator. In *Proceedings of the Entertainment Interfaces Track 2010 at Interaktive Kulturen 2010*. CEUR-WS.org/Vol-634, ISSN 1613-0073, urn:nbn:de:0074-634-4.

[3] Herder, J.; Ladwig, P.; Vermeegen, K.; Hergert, D.; Busch, F.; Klever, K.; Holthausen, S.; and Ryskeldiev, B. 2018. Mixed reality experience - how to use a virtual (tv) studio for demonstration of virtual reality applications. In *Proceedings of the 13th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - Volume 1: GRAPP*, 281–287. Santa Cruz, Portugal: INSTICC.

[4] HTC Corporation. 2018. Intro to VIVE SRWorks SDK. https://developer.vive.com/resources/knowledgebase/intro-vive-srworks-sdk/. Online; accessed 2 January 2019.

[5] Ma, M.; Coward, S.; and Walker, C. 2015. Interact: A mixed reality virtual survivor for holocaust testimonies. In *OzCHI '15*. Parkville, VIC, Australia: ACM.

[6] Milgram, P.; Takemura, H.; Utsumi, A.; and Kishino, F. 1995. Augmented reality: a class of displays on the reality-virtuality continuum. *Proc. SPIE* 2351:282–292.

[7] Pacheco, D.; Wierenga, S.; Omedas, P.; Oliva, L. S.; Wilbricht, S.; Billib, S.; Knoch, H.; and Verschure, P. F. M. J. 2015. A location-based augmented reality system for the spatial interaction with historical datasets. In *2015 Digital Heritage*, volume 1, 393–396.

[8] Pogscheba, P.; Stöcklein, J.; Herder, J.; and Geiger, C. 2011. Iteratives Mixed-Reality-Prototyping und virtuelle Studiopräsentation einer Steuerung für ein Indoor-Luftschiff. In *7. Workshop Virtuelle und Erweiterte Realität der GI-Fachgruppe VR/AR*.

[9] Ryskeldiev, B.; Cohen, M.; and Herder, J. 2018. Streamspace: Pervasive mixed reality telepresence for remote collaboration on mobile devices. *Journal of Information Processing* 26(1):177–185.

[10] Schröder, J. 2017. Der Erinnerungsort Alter Schlachthof auf dem neuen Campus der Hochschule Düsseldorf. *Gedenkstättenrundbrief* 3(185):23 –31. (in German).

[11] Taylor, N., and Jacobs, R. 2017. *Reimagining Hiroshima and Nagasaki: Nuclear Humanities in the Post-Cold War*. War, Politics and Experience. Taylor & Francis.

[12] Zimmer, C.; Ratz, N.; Bertram, M.; and Geiger, C. 2018. War children: Using ar in a documentary context. In *3rd Workshop on Virtual and Augmented Reality for Good at the 17th International Symposium on Mixed and Augmented Reality*. IEEE.

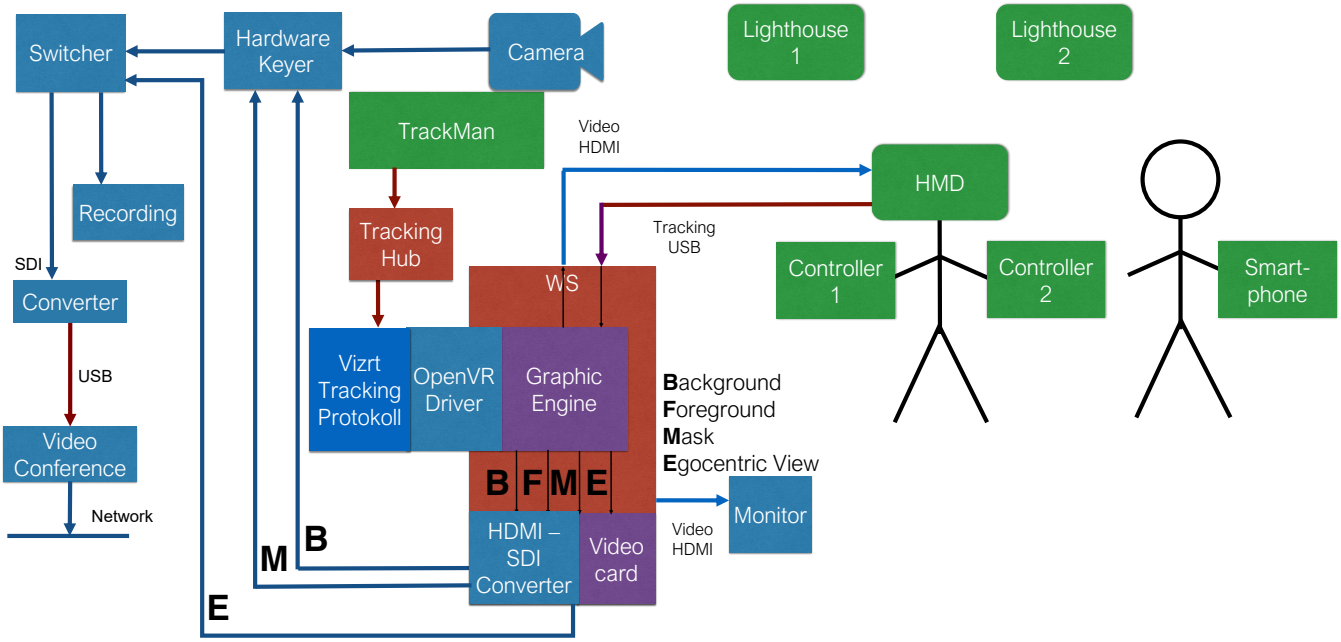


Figure 8: System layout for the virtual studio for a video conference

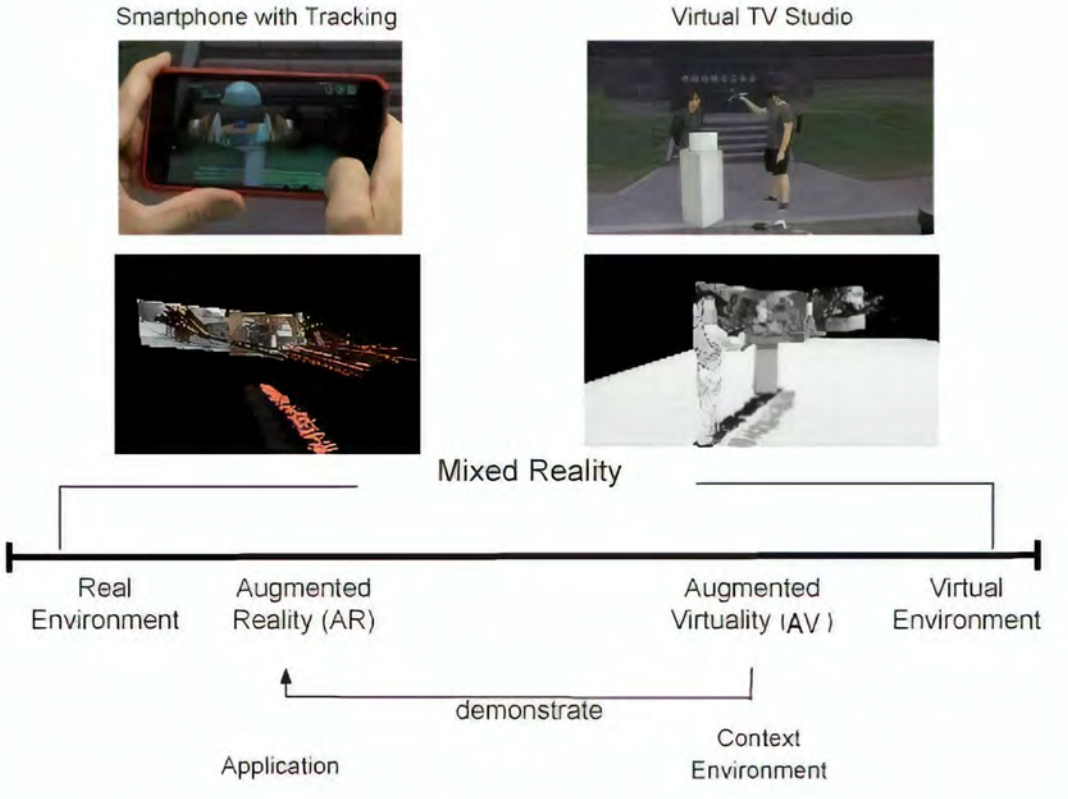


Figure 9: Mixed Reality Continuum [6] classifies Augmented Virtuality (AV) for demonstrating Augmented Reality (AR)

Mobile Art: The Art of the Social

Larissa Hjorth
RMIT University
Melbourne, Australia
larissa.hjorth@rmit.edu.au

Abstract

As mobile media becomes more ubiquitous in everyday life and contemporary art practice, how can we define mobile art? This paper seeks to coalesce some of the ways in which mobile art is being practiced and how we might begin to have a unified definition of mobile art. It seeks to frame the multiple ways in which art is playing in, and through, mobile media as part of a longer history of cultural mobilities and movement. In particular, this paper explores the rise of datafication and quantified self (QS) through mobile apps, and the critical role of mobile art which cannot be underestimated.

Keywords

Mobile art, visuality, mobile media, datafication.

Introduction

As Martin Rieser notes in *The Mobile Audiences: Media Art and Mobile Technologies*, mobile technologies are affording new types of audience engagement, art and narrative forms [1]. In particular, locative art projects have historically been synonymous with early mobile art through collectives like Blast Theory and the theoretical work of Adriana de Souza e Silva [2], Drew Hemment [3] and Anne Galloway [4]. These projects overtly engaged with the changing fabric of urbanity and how we in turn reconceptualize place and space.

As Galloway notes in one of the pioneering articles in the area of mobile media creative practice, key to its success is the "centrality of spatialization, temporalization and embodiment in the performativity of everyday life"[5]. However, just as smartphones blur social, locative and mobile media across a variety of contexts, modes of presence and media, mobile art has become increasingly diverse and ambiguous, especially in terms of blurring new media and art.

Mobile art is as contested as it is divergent—representing a challenge to what constitutes art and the mobile. Mobile art can take various forms aesthetically, technologically and conceptually. It can be designed or experienced in and through the mobile interface. Here the theoretical work of de Souza e Silva, Sheller and Jason Farman has been important in defining the phenomenon. It can be formed and informed by the different spatial registers afforded by mobile technologies today including smartphones and tablets.

Mobile art can be about the conceptual exploration of the intersection between mobile media and art with not necessarily the new media dimension. It can be about probing the affordances of mobile devices and their impact upon place and space. It can be about questioning the social dimensions of ICTs devices. Mobile art doesn't need to be physically moving—much like the work conducted in mobilities studies, the mobile often involves the immobile and mooring [6]. Mobile art can move electronically, technologically, socially, spatially, aesthetically, just as it can be immobile across those terrains. It speaks and contributes to both mobilities and mobile communication studies.

Mobile art is no longer just a site for artist dissemination or self-promotion via social media, but an active part of everyday politics, place-making and creativity [7], [8]. As Marsha Berry and Max Schleser observe in their collection on smartphone art and creative practice, mobile technologies are providing new ways for various disciplines such as filmmaking, screen writing and photography to reinvent themselves, their audiences and modes of engagement [8]. In the coupling of the mobile and art we see artists creating new types of cartographies and ways to imagine, visualize and practice place and embodiment. In turn, this phenomenon requires us to redefine how art is defined, curated, framed and contextualized. Mobile media affords new playful and reflexive practices that are shaping collaborations both inside and outside the art world, as entangled within the often-messy space of the everyday. So how do we encompass selfies, mobile game apps and mobile play interventions under 'mobile art'?

As Mimi Sheller notes in one of the few papers on the topic, mobile art is characterized by *mediality*—that is, a reflexive form of enacted and mediated spatiality [9]. Sheller's examples focus predominantly on media art case studies that explicitly engage with the entanglement between network and place. What becomes apparent is mobile media is no longer a device just for "new media" artists—rather it is providing new canvases, multimedia tools, contexts and social worlds for artists to play and intervene, as highlighted by Mann Bartlett's work. In Bartlett's work mobile media like Twitter become a social and political space to test the role of art. He toys with the collapse between the public and intimate—an adaptation of Lauren Berlant's notion of intimate publics [10]. Hjorth, King and Kataoka note that as social, locative and mobile media render the intimate *public* and the public *intimate*, this is shaping—and being shaped by—the role of place, art

practice, and politics, which in turn provide new models for engagement, distribution and participation [10]. Mobile art is at the intersection of the art/ everyday/social crossroad. And yet, in visual art contexts—like mobile communication field—it has been relatively overlooked. This is despite the fact that the art world has witnessed various returns to the art/everyday/social crossroads from the work of Duchamp's readymades and the ideological and visual propaganda of SI to the emergence in the 1990s of art practices focusing on social relations including Nicolas Bourriaud's notion of "relational aesthetics" [11] or what Grant Kester defined "dialogic practices" [12]. Much of the earlier locative works riffed off SI's techniques like *dérive* ('drifting') [13]. Relational aesthetics and dialogic practices foregrounded the temporal, social relations of artworks rather than their material forms and structures. However, as art critic Claire Bishop succinctly identified, much of these practices were just enacting "aesthetics of the social" [14].

Whereas mobile media—as a lens, incubator, practice and context—*is* located in the messiness of the social and political, not just the aesthetics as Bourriaud's term implied. Thus mobile art has the potential to really test the limits of the relationship between art, communication, collaboration and the quotidian in ways that engage with the messiness of the everyday, of democracy, the social and political. With its emphasis on the social as the medium, social practice becomes even more commonplace in contemporary art, and mobile social media becomes more pivotal.

As this paper argues, mobile art can be viewed as part of broader movement of artists to social mobile media as a site for critique and questioning of contemporary culture and everyday life. Mobile art is inherently interdisciplinary—that is, it does not sit neatly into the silos of disciplines [15], [16]. However, in its interdisciplinary nature, it draws from particular traditions and genealogies that do have discipline bases—art, new media, mobile communication to name a few.

This paper seeks to coalesce some of the ways in which mobile art is being practiced and how we might begin to have a unified definition of mobile art. It seeks to frame the multiple ways in which art is playing in, and through, mobile media as part of a longer history of cultural mobilities and movement [17]. In particular, this paper explores the rise of datafication and quantified self (QS) through mobile apps, and the critical role of mobile art which cannot be underestimated.

Setting the context

From hybrid reality games that deploy mobile media in their game play to artists using their mobile to make and exhibit their work, mobile art has grown into a ubiquitous and emergent field of theory, practice and critical inquiry. As a vehicle for and of the everyday, mobile media is recalibrating the relationship between art and digital networked media, and reshaping how creative writing, photography, video art and filmmaking are being conceptualized and practiced.

This linking of mobile art to broader, more historical movements around cultural forms of mobility is important. For example, media archeologists Jussi Parikka and Jaakko Suominen discuss the rise of mobile games in terms of larger technologies of mobility [17]. Drawing on the seminal work of Erkki Huhtamo, they argue for the need to understand new media technologies as part of recurring cyclical phenomena. Parikka and Suominen argue that there have been multiple forms of mobile media that speak of their cultural mobilities of the time—from books on trains in the 19th century to games on mobile devices in 21st century. They expand upon Timo Kopomaa's discussion that mobile phones are both a continuum from 19th century technologies like the wristwatch as they are *extensions*—encompassing new experiences of place and space [18]. This paradox of both extending earlier practices while also creating new experiences is at the core of the field of mobile media and new media [19], [20], [21].

Examples of the diversity of mobile art can be found across a variety of practices. Artists such as Ai Weiwei (Twitter), Amy Sillman (iPhone) and Jonah Brucker-Cohen to Scott Snibbe (App art), Rafael Lozano Hemmer (locative media) and Man Bartlett ("Social Media Artist") have all been active in utilizing the digital to erode the divisions between (new) media art and visual art under the banner of mobile art. For some, mobile art is evoked through locative media as the intersection between urban performance, transmedia storytelling (often involving augmented reality games [ARG]), play and mobile intervention as explored by the likes of Blast Theory and Proboscis. For others, mobile art involves the using of the mobile device as the incubator, frame, context and content for new forms of creative practice (like mobile movie making) [22]. While mobile media is defined as quintessentially quotidian, within the art world it is often still classified, and rarified, as media arts [23]. In this diversity, this leads us to ask: how do we define mobile art?

In a previous article, I explored the role of mobile art as an often-overlooked area that has been historically sublimated under locative, hybrid, mixed reality or media arts [24]. I argued that while having a long history through various genres such as locative arts and vernacular art practices, mobile art needs to be more robustly defined and taken seriously by scholars. I also argued for an understanding of mobile art as a broader field than just locative media practice which was structured in terms of key three thematic rubrics: intimate co-presence; emplaced visuality; ambient play. These three rubrics sought to consolidate mobile art practices as deploying an overlay between the networked (intimate and co-presence), haptic visualities like camera phone apps (emplaced visuality) and playful interventions in the everyday (ambient play).

Expanding upon the earlier work by the likes of mobilities scholar Sheller who explored mobile art

within new media [9] and Adriana de Souza e Silva [2], I claimed that mobile art helps to reconceptualize the relationship between new media and art in innovative ways [24]. In the article I pushed the debate by resituating contemporary mobile art as a far more diverse set of practices that are not simply about screening digital art on portable devices. Mobile art has in fact expanded the spatial and social field in which art takes place by experimenting with the mobile interface as a bridge between digital and physical space, a hybrid mediation of human sensory perception, and technological connectivity [9].

As smartphones unevenly usher in new types of media practice and modes of co-presence within everyday life, divisions between digital art, media arts and visual art blur. For Sheller, part of the problem with defining mobile art is the way in which it has been sublimated as media arts within visual art discourses [9]. This situation has further been aggravated by simplistic theorizations of the media within the visual arts as out of touch with the pervasive reality of media—epitomized for Sheller by Claire Bishop's dismissal of shifts in contemporary digital art that are, in turn, impacting visual art practice. As Sheller points out, mobile art offers the ability to expand the spatial and social dimensions of art.

Much of the conflation of mobile art as synonymous with media arts comes from its history in earlier exhibitions such as *LEA (2006)* that have focused upon it as locative media [2], [25], [26], [27], [28]. These earlier iterations sought to define mobile art in and around media or digital arts—in doing so, they highlighted some of the ways in which mobile art occupied an exciting area of possibility that promised to interrogate not just mobile communication but art practice more generally. Media artists such as Rafael Lozano Hemmer with his early deployment of mobile media and information and communications technology (ICT) spearheaded a particular imaginary of mobile art within the visual arts as synonymous with media arts. However such a definition neglects to address the ways in which mobile art affords ways to reflect upon intersections between art, user created content (UCC) and the quotidian. By addressing this over-looked and undefined area, mobile art can provide new insights into mobile media communication and art.

Socializing Mobile Art

Although earlier, pioneering work around mobile art was defined by locative media/ media arts projects by the likes Proboscis and Blast Theory, more recently there have been a few exhibitions and publications, which have sought to expand the field of mobile art. One example is Sheller, Jeremy Hight and Hana Ivanson's *LA Re.Play* exhibition [29], which explored "mobile art". This rubric included "international artist working with mobile and geolocated media". Artworks like *Park Walk*—a mobile social and environmental mapping project in and around Grange Park Walk by Martha Ladly and Bruce Hinds—is indicative of the works in *LA Re.Play* and the role mobile art can play in performing, mapping and intervening in a sense of place.

Some conceptual artists, like long-term collaborators Janet Cardiff and George Bures Miller, or Rafael Lozano Hemmer, have established their practice in and through mobile art. Through activating the mobile as the viewing, participatory frame or as the part of the critical making, mobile media plays a significant role. For example, Cardiff and Miller's *Alter Bahnhof Video Walk* at the *2012 Venice Biennale* is a great example of the multiplicity of the mobile device; it performs the work whilst also simultaneously playing a role in rendering audience participation as a form of digital way-faring [30].

In collaborative works with the Boat People Association, the environmental art project *Spatial Dialogues* deployed mobile media games to involve publics in digital wayfaring around a park in Shibuya, Tokyo. *Spatial Dialogues* responded to a post Fukushima disaster context in which the rise of mobile media for citizen engagement cannot be underestimated [31]. Entitled *keitai mizu* (mobile water) the project used Twitter and Instagram in a digital treasure hunt type of game where audiences searched the park for sea creatures within a 10-minute time frame. The work sought to make audiences aware of the underwater cartographies hidden under the park [32]. Here the gamification aspects of mobile apps can be deployed to enhance audiences understanding of their environment through a hybrid reality of physical and digital wayfaring. The sociality of Twitter and Instagram becomes part of the game play and also the mobile art.

Another deployment of mobile social media as part of the participatory art process can be found in my exhibition "The Art of Play" at Centre for Contemporary Photography (CCP in Melbourne, Australia, 2016). *Minecraft* vinyl clouds were on the wall and artificial grass cut-outs on the ground. In the space were wooden cubes mimicking the pixelated space of *Minecraft*. Lego pieces could be found in and around the boxes. Audiences could move the cubes and Lego pieces to make their own worlds. Then audiences could photograph their world and send to the CCP Instagram account. The Instagram images were then printed and generatively exhibited on the wall.

During the exhibition period, the wall filled with the audience-as-artist playful expressions and interventions. Their images went up alongside the exhibited ethnographic images inside people's homes. The audience-as-artist images went from the sanctuary of the gallery space to social media and back to the gallery again—a journey that took on various forms of adaption, translation and transmission. Using mobile art to critique contemporary forms of datafication through a return to (new) materialism and DIY making is crucial. While early forms of mobile art arose from locative media arts to comment on networked notions of place, newer forms of mobile art ***are challenging the role of datafication in everyday life as explored in the next section.***

The Art of Data: Critical Mobile Apps

Just as the history of mobile art is often conflated with locative and media arts, so too is there confusion as between data art and mobile art. At the intersection of the quantified self (QS) movement and gamification [33], mobile media and its attendant apps are providing new ways in which to think about creativity, play and labour in everyday life. For some artists, using mobile apps can provide a space to comment on data politics in powerful ways. This is especially the case against the backdrop of QS, gamification and the increasingly "playful" attitude of contemporary media [34]. As sociologist Deborah Lupton notes, QS allows people to track their lives using digital technologies and to gain a "self knowledge through numbers" [35]. For Lupton notes, "You are your data", and this has both good and bad implications.

As danah boyd and Kate Crawford note, much of the debates around Big Data need to acknowledge that no matter how "big" the data, it is always subjective [36]. Data questions are riddled by the searchers' own perception and thus inherently human in their scope. Moreover, they argue the need for transparency and access to the ways in which the algorithms shape definitions of society. As Laura Watts and Dawn Nafus argue, big data needs to be imagined as more than just algorithms collected by "the cloud" [37]. Rather, "Data Stories speak, not of clouds, but of transformations: in things, in energy, and in experience".

For Cheney-Lippold, the electronically generated data has also become internalized through "soft biopolitics" self-management [37]. In this way, the rise of mobile apps—or "applification"—can be viewed as a commodified blend of work, labor and leisure. Ethnographers Dawn Nafus and Jamie Sherman, deploy Cheney-Lippold's soft biopolitics where "QS movement is best understood as a kind of soft resistance" [39].

According to Nafus and Jamie Sherman "big data is not always about big institutions; it is also about subjectivities" [39]. The rise of Big Data algorithms go hand in hand with the rise in tracking media—encapsulated by mobile, wearables. For Lee Humphreys users who seek to increasingly catalogue and document their life digitally can be characterized by this phenomenon. However, with mobile social networks incorporating and broadcasting personal and locational information of users [40], this creates new issues around surveillance, privacy and control. She argues that we need to understand the qualified, rather than quantified, self [41].

In this debate around data and sharing, José van Dijck's notions are also useful here. For van Dijck [42], paradoxes around datafication persist, especially around the trade-off of personal data (and privacy) being given over to corporate platforms. In the *Culture of Connectivity*, van Dijck identifies how sharing has become the "social verb"—a concept key to many artists' exploration of the social and sharing politics of mobile media.

Much of the literature into mobile visuality—especially in terms of camera phones—engages in the important role of sharing as part of its logic [43], [44], [45], [46]. Scholars such as van Dijck have highlighted the logic of sharing as the default function for much of social media. Expanding on this idea further, Nicholas A. John's argues in *Age of Sharing* that sharing is central to how we live our lives today—it is not only what we do online but also a model of economy and therapy [47]. Tracing across these areas Johns highlights how sharing can be understood as part of caring practices and discourses. But sharing is not always benevolent as much of the critical artwork around mobile art highlights.

Once just a vehicle for dissemination, artists are now deploying what Nathan Jurgensen calls the "nostalgia for the present" aesthetics of Instagram as an extension of their artistic expression [49]. In *Phototrails*, Manovich and his team have conducted a thick visualization of the city through its algorithmically trawled Instagram images to create new ways for understanding the local and vernacular. According to Hochman and Manovich, the key feature of geotemporal tagging is that it "suppresses temporal, vertical structures in favor of spatial connectivities" [48]. What their study does highlight is the complex ways in which camera phone photography, when overlaid by locative media, takes on different spatial, temporal and social dimensions.

The paradoxes and ambiguities surrounding mobile media, datafication and its playful capacity are also heightened in *Data Selfie*. Although not yet available for mobile phone use, *Data Selfie* is a desktop browser extension created by Regina Flores Mir and Hang Do Thi Duc in 2017 that seeks to consider how data mining and predictive analytics are shaping our online data identity. As the *Data Selfie* website notes, "We are not interested in your data. We don't want your data. We don't store your data." [50]1 In a less darker note and under the banner of "order your own freedom", the subversively playful collective known as *Unfit Bits* take everyday items like metronomes and drills to pun on the mobile QS phenomenon. Using the sharing and remixing possibilities of networked media—in what has been identified as the post-internet art movement—is crucial to Ukrainian artist Nastya Ptichek's work. Ptichek uses social media paralinguistics such as emojis (picture characters) and emoticons (typographic characters) to reinvent classic artworks. Drawing artworks from a variety of periods and genre, Ptichek reinvents and remediates through paralinguistic interventions. The colliding of the two worlds—social media vernacular and "high art"—produces some humorous results. Here the high/low dichotomy of modernism is dismantled in favour of the playful.

The rise of *emojis* and other forms of ASCII-based non-standard variants such as emoticons are highlighting the role of digital media to create different types affective affordances [51]. The long history of emoticons in media practice textual communication [52] has been well documented. More recently, research

into *emoji* has highlighted its significance as historical, social and cultural objects [53]. As Luke Stark and Kate Crawford note, LINE in Japan has introduce the "next-level emoji" through their deployment of Stickers. As they observe, "Stickers, crucially, are proprietary to each platform that sells them" [52]. They argue that, "stickers represent an attempt on the part of social media platforms" which in turn play into identify politics. And yet, what Ptichek's work suggests is a more complex relationship in which paralinguistics can be understood as an emergent artform whose impact shouldn't be underestimated.

From body measuring devices such fitbits and apps to measure sleep, one could argue that everyday life is being colonized by big data. So much so that artists such as Russian photographer Egor Tsvetkov have explored how "easy" it is to track down anonymous people via social media. In his 2016 project, *Your Face is Big Data*, Tsvetkov took photos of strangers on St. Petersburg's metro and then used facial recognition software (FindFace [54]) to identify them on social media. He then paired their social media post with his photo. These images show the power of social media for stalking and rendering the stranger intimate. In the social media pictures the subjects look seductive or good-looking, while in their "everyday" pictures taken by Tsvetkov they look like a lesser version of their selves. The message his work disseminates is clear with regards to the performativity of social media in the face of a darker, less glossy reality.

Using social media to play with ideas about data and art reception can be found in many art practices. For example, conceptual artist Anastasia Klose, who uses everyday forms of quotidian performance in her art, often deploys Instagram and Facebook to comment on the politics of social media in relation to art.

More than a like: Conclusions on mobile art

In this paper I have sought to explore the diversity of emergent practices constituting mobile art especially in an age of datafication. This chapter began with outlining some of the ways in which the field initially emerged in media arts and hybrid reality areas. However, just as the smartphone has become a ubiquitous space for DIY quotidian ordinary expertise, so too has what constitutes mobile art become increasingly complex to map. I argue that like the shift in art towards "social practice" mobile art offers particular forms of insight and experimentation into the medium of the social.

Here artists can critique identity politics of Instagram (e.g. Richard Prince) as well as provide space for reflection around emerging self-tracking and datafication phenomenon—as highlighted by the work of Tsvetkov. Rather than exhaustive, this paper considered how mobile art is heralding ways in which to rethink the relationship between the quotidian, social, and the politics of data through some key creative practice examples.

As I suggest, more research is needed in this interdisciplinary area. Like many interdisciplinary areas it is inherently messy. But focusing on this messiness, as a product of the social, means that not only can mobile art teach us about disciplines such as art, mobile communication and digital media. It can also provide new ways for conceptualizing the interdisciplinary as core to contemporary society.

References

[1] Rieser, Martin. 2011. *The Mobile Audiences: Media Art and Mobile Technologies*, ICI Global.

[2] de Souza e Silva, Adriana. 2004. "Art by Telephone: from Static to Mobile Interfaces." *Leonardo Electronic Almanac*, 12(10), http://www.leoalmanac.org/leonardo-electronic-almanac-volume-12-no-10-october-2004/ Accessed 4 January 2017.

[3] Hemment, Drew. (ed). 2006. LEA Locative Media Special issue, *Leonardo* 14(3). http://leoalmanac.org/journal/vol_14/lea_v14_n03-04/guested.asp. Accessed 20 October 2017.

[4] Galloway, Anne. 2010. "Mobile Publics and Issues-Based Art and Design." In *The Wireless Spectrum: The Politics, Practices, and Poetics of Mobile Media*, edited by B. Crow, M. Longford and K. Sawchuck, Toronto University of Toronto Press.

[5] Galloway, A. (2004). "Intimations of everyday life: Ubiquitous computing and the city." *Cultural Studies*, 18(2–3): 384–408 (385)

[6] Hannam, K. Sheller, M. and J. Urry (2006) Editorial: Mobilities, Immobilities and Moorings, *Mobilities* 1 (1):22.

[7] Hjorth, L. 2013. "Frames of Discontent: Social media, Mobile Intimacy and the Boundaries of Media Practice." In *New visualities, new technologies: The new ecstasy of communication*, edited by J. Macgregor Wise and Hille Koskela, 99–118. New York: Ashgate.

[8] Berry, Marsha and Max Schleser. 2014. *Mobile Media Making in an Age of Smartphones*. London: Palgrave Pivot.

[9] Sheller, Mimi. 2014. "Mobile Art." In *The Routledge Companion to Mobile Media*, edited by Gerard. Goggin and Larissa Hjorth, 197–205. New York: Routledge, p. 376

[10] Hjorth, Larissa, Natalie King and Mami Kataoka. 2014. (eds) *Art in the Asia-Pacific: Intimate Publics*. New York: Routledge (p. 2)

[11] Bourriaud, Nicolas. 2002. *Relational Aesthetics*, translated by Simon Pleasance and Fronza Woods with M Copeland. Dijon: Les presses du reel. First published in French 1998, by same publisher as Esthétique relationnelle.

[12] Kester, Grant. 2004. *Conversation Pieces: Community and Communication in Modern Art.* Berkeley: University of California Press.

[13] de Souza e Silva, Adriana and Larissa Hjorth. 2009. "Urban spaces as playful spaces: A historical approach to mobile urban games." *Simulation & Gaming* 40(5): 602–625.

[14] Bishop, Claire. 2006. "The Social Turn: Collaboration and Its Discontents." *Artforum*, February: 179–185.

[15] Lury, Celia., Fensham, Rachel., Heller-Nicholas, Alexandra., Lammas, Sybille., Lasr, Angela., Michael, Mike and Uprichard, Emma. (eds) (2018) *Routledge Handbook of Interdisciplinary Research Methods*. London: Routledge.

[16] Lury, Ceila and Wakeford, Nina. (eds.) (2012) *Inventive Methods: the happening of the social.* New York: Routledge.

[17] Parikka, Jussi and Jaakko Souminen (2006) Victorian Snakes? Towards A Cultural History of Mobile Games and

the Experience of Movement. *Game Studies*. http://gamestudies.org/0601/articles/parikkasuominen
[18] Kopomaa, Timo (2000). *The City in Your Pocket. Birth of the Mobile Information Society.* Helsinki: Gaudemus.
[19] Arnold, Michael (2002) On the Phenomenology of Technology. *Information and Organisation*. 13(4): 231-256.
[20] Bolter, Jay and Richard Grusin. 1999. *Remediation*. Cambridge: MIT Press.
[21] Chun, Wendy. 2017. *Updating to Remain the Same*. Cambridge: MIT Press.
[22] Berry, Marsha. 2017. *Creating with Mobile Media*. London: Palgrave.
[23] Bishop, C. 2012a. "Digital Divide: Contemporary Art And New Media." *Artform*, September, available at http://artforum.com/talkback/id=70724.
Bishop, C. 2012b. *Artificial Hells: Participatory Art and the Politics of Spectatorship*. London: Verso.
[24] Hjorth, L. 2016. "Mobile Art: Rethinking intersections between art, user created content (UCC) and the quotidian." *Mobile Media & Communication.* doi:10.1177/2050157915619210
[25] Tuters, M. and K. Varnelis 2006; Beyond Locative Media: Giving Shape to the Internet of Things, *Leonardo* 39

(4) August, p.357-363
[26] Hemment, D. (2006) locative media, LEA special issue, 14 (30, http://leoalmanac.org/journal/vol_14/lea_v14_ n03-04/guested.asp
[27] Benfold, S. and G. Giannachi. 2011. *Performing Mixed Reality,* Cambridge, MA: MIT Press.
[28] Benford, S., Greenhalgh, C., Reynard, G., Brown, C. and Koleva, B., 1998. Understanding and constructing shared spaces with mixed-reality boundaries *ACM Transactions on Computer-Human Interaction.* 5(3), 185-223
[29] LA Re.Play exhibition (2012) See Aceti, Lanfranco, Hana Iverson and Mimi Sheller (eds.) 2016. *L.A. Re.Play: Mobile Network Culture in Placemaking,* 21(1). http://www.leoalmanac.org/l-a-re-play-volume-21-no-1/
[30] Hjorth, L. and S. Pink. 2014. "New Visualities and the Digital Wayfarer: Reconceptualizing camera phone photography", *Mobile Media & Communication* 2(1): 40–57.
[31] Gill, T., B. Steger & D.H. Slater (2013) *Japan Copes with Calamity.* New York: Peter Lang.
[32] Hjorth et al. (2016) *Screen Ecologies*. Cambridge, MA: MIT Press.
[33] Deterding, S., D. Dixon, R. Khlaed and L. Nacke. 2011. From game design elements to gamefulness: Defining "gamification". Proceedings of the 15th Inter. Academic Mindtrek Conference, pp. 9-15.
[34] Sicart, M. (2014) *Play Matters*. Cambridge, MIT Press.
[35] Lupton, Deborah. 2016. *The Quantified Self: A Sociology of Self-Tracking.* Cambridge: Polity Press.
[36] boyd, danah and Crawford, Kate. 2012. "Critical questions for big data." *Information, Communication & Society*. 5: 662–679.
[37] Watts, Laura and Dawn Nafus. 2013. *Data Stories*. Orkney: Brae Editions.
[38] Cheney-Lippold, John. 2011. "A new algorithmic identity: soft biopolitics and the modulation of control." *Theory, Culture & Society*. 28: 164–181.
[39] Nafus, Dawn and Jamie Sherman. 2014. "This One Does Not Go Up to 11: The Quantified Self Movement as an Alternative Big Data Practice." *IJoC,* 1784–1794. http://ijoc.org/index.php/ijoc/article/viewFile/ 2170/1157 Accessed 2 June 2017, pp. 1793, 1786.
[40] Humphreys, Lee. 2011. "Who's watching whom? A study of interactive technology and surveillance." *Journal of Communication,* 61(4): 575–595.
[41] Humphreys, L. (2018). *The qualified self: Social media and the accounting of everyday life.* Cambridge, MA: MIT Press.
[42] van Dijck, J. (2014) "Datafication, dataism and dataveillance: Big data between scientific paradigm and ideology." *Surveillance and Society*, 12(2): 197–208.
[43] Frohlich, David, Allan Kuchinsky, Celine Pering, Abbe Don, and Steven Ariss. 2002. "Requirements for photoware." In CSCW'02: Proceedings of the 2002 ACM conference on Computer Supported Cooperative Work, 166–75. New York: ACM Press.
[44] Kindberg, Tim, Mirjana Spasojevic, Rowanne Fleck, and Abigail Sellen. 2005. "The Ubiquitous Camera: an In-Depth Study of Camera Phone Use." *IEEE Pervasive Computing* 4(2): 42–50.
[45] Van House, Nancy, Marc Davis, Morgan Ames, Megan

Finn, and Vijay Viswanathan. 2005. "The Uses of Personal Networked Digital Imaging: An Empirical Study of Cameraphone Photos and Sharing." *CHI 2005,* April 2–7. Portland, Oregon, USA.

[46] Koskinen, I (2007) *Mobile Multimedia in Action.* London: Routledge.
[47] Johns, Nicholas. 2016. *The Age of Sharing*. New York: Wiley.
[48] Hochman, Navar and Lev Manovich. 2013. "Zooming into an Instagram City: Reading the local through social media." *First Monday*, July. http://firstmonday.org/ojs/index.php/fm/article/view/4711/3698 Accessed 10 October 2017.
[49] Jurgensen, N. 2011 The faux-vintage photo. The Society Pages.http://thesocietypages.org/cyborgology/2011/05/14/the-faux-vintage- photo-full-essay-parts-i-ii-and-iii/
[50] *Data Selfie* https://dataselfie.it
[51] Pavalanathan, Umashanthi and Jacob Eisenstein. 2016. "More emojis, less :) The competition for paralinguistic function in microblog writing". *First Monday*, 21(11). November doi: http://dx.doi.org/10.5210/fm.v21i11.6879.
[52] Crystal, D. (2001) *Language and the Internet*. Cambridge: Cambridge Uni Press.
[53] Stark, L. and K. Crawford (2015) The Conservatism of Emoji: Work, Affect, and Communication. *Social Media and Society.* https://doi.org/10.1177/2056305115604853
[54] https://en.wikipedia.org/wiki/FindFace

Using the Internet as a platform to destabilise gallery spaces, curation and artistic practice

Carly Whitaker
Independent Artist and Curator
Johannesburg, South Africa
whitaker.carly@gmail.com

Abstract

Floating Reverie is an online digital residency program started in early 2014 as a result of a perceived lack of platforms & opportunities available for artists using new media & digital culture in South Africa & Africa. This paper looks at how Floating Reverie, an alternative art space, can both provide new creative research & challenge the way in which we position traditional structures like the gallery. It will also position a curatorial networked method as a way of decolonising the curatorial process & curator. The Internet presents an entirely new space for artists versus tradition or conventional galleries or exhibition space which can be limiting and restrict their structure & implementation. It has the power to offer a platform to artists to destabilise these conventions. This article interrogates the residency as process & creative practice for contemporary African artists, breaking with established traditions & providing an alternative through the Internet.

Keywords

Internet art, digital residency, networked curatorial practice, decolonization, global south

Introduction

Alternative art spaces situated in the digital realm can both provide new creative research and challenge the way in which we view the traditional. This article presents Floating Reverie, an online digital residency programme, as an alternative art space to 'traditional' ways of framing, presenting and engaging with galleries, curation and artistic spaces (1). Through Floating Reverie's residency platform and post-digital exhibitions, a new mode of curating will be presented, a networked curatorial method (2) as a way of potentially decolonising, providing alternatives, which are inclusive, verses the 'traditional' exclusive curatorial process and curator, shifting the power dynamics. Specific residencies and artists who participated in Floating Reverie's *//2Weeks* will be presented as a solution or way forward to the established, traditional gallery and exhibition system. This way forward or re-envisioning, ultimately redefines what creative practice could be, what curation is and the role of a curator in this context; by offering an alternative to traditional structures and systems.

Floating Reverie: an online residency programme

Floating Reverie is an online digital residency programme started in early 2014. By the end of 2018 over 36 artists participated, four collectives and one cross residency collaboration, all of which will have culminated in five post-digital exhibitions (a period ending early 2019). The majority of the artists are from South Africa due to context, although some are from the United Kingdom, and a collective from New Zealand participated in September 2017. The platform consists of two components: the two-week residency programme, and annual post-digital exhibitions in which selected participants come together to present work cumulatively.

The platform and its various components seek to create new dialogues with artists around the digital medium through offering an alternative space for creative research, concepts and practice. The extent to which this happens is up to the artist. The residency program happens once a month, for two weeks. Artists are invited to engage with the thematic of repetition and produce work online every day for two weeks, establishing a network through the online medium on their selected platform (3) through their repeated engagement with their work and concepts. An initial network forms online, through the curation of monthly artists, orientated around Floating Reverie. A subsequent curation occurs of their own individual residencies (or through their response to a previous residency) during the two weeks establishing a network within their own residency. This multi-layered network is developed as a result of production and curation, and is what makes this platform unique.

Decolonising through alternatives

This active and continuously reflective pursuit is something which has emerged through my sustained engagement with artists and galleries in the digital sphere. It is extremely important for the platform to be continuously reflecting on the successes and failures of the system so that it can meet artists' needs and requirements. Floating Reverie is a space that provides artists with an opportunity to be included because the platform provides an alternative to many current and traditional systems or frameworks

which exist in contemporary art. The destabilising, reviewing and critiquing of these structures and systems is not unlike conversations surrounding decolonial discussions and strategies. The scope of decolonial thought and the calls to action are not to be taken lightly as Tuck and Yang (2012) suggest in their article *Decolonization is not a Metaphor*. They acknowledge the "ease with which the language of decolonisation has been superficially adopted into education and other social sciences" (Tuck and Yang 2) which can cause it to be diluted or approached conveniently or insubstantially.

Floating Reverie does not specifically seek to decolonise, but rather seeks to offer alternatives, present reflections and critiques to artists and collectives who are developing unconventional practices, engaging with new mediums and want to consider their research or process as a part of, or as the final outcome. The description of Floating Reverie deliberately doesn't draw on or reference words like 'gallery' or 'exhibition' when positioning the residency platform, removing traditional power structures that are associated with a traditional gallery.

The initial intention was born of my frustrations with the then-contemporary art scene in Johannesburg and South Africa, and its limited platforms for experimental practices and digital art. The strength and potential of the platform quickly emerged as much more than this: as both a space of potential and a space of inclusion, and that it should be presented as such. Floating Reverie cannot be seen in its entirety as a fully decolonial project, but perhaps it is symptom of its time, a frustrated and unfulfilled time where a concentrated effort on a small scale reflects a bigger, broader dialogue. Floating Reverie is not a large scale project, nor does it seek institutional recognition, but rather persistently seeks to allow artist to continue to generate alternative creative practice, to subvert the power relations set up by galleries and to overcome them.

The Internet is an open and (seemingly) free space which can provide artists with a similarly free or open opportunity for their creative practice. Digital/cyber/technological colonialism is a reality which artists in our context and location should be and are aware of. Whilst many artists are actively seeking to decolonise it through initiatives and interventions (4), other methodologies of decolonising this space include opening it up and creating more inclusive spaces. The responsibility is twofold, it is about fighting for spaces of inclusion and fighting against spaces of exclusion. Floating Reverie is about rebelling against exclusivity and continuing to offer a space of inclusion for a diverse group of artists who are often excluded from the contemporary art scene, and for mediums that are excluded from the contemporary art scene. These mediums are not generally considered inside the scope of the contemporary art scene for various reasons ranging from practicalities to a more conceptual lack of understanding. This is not to say that there aren't galleries or institutions who are making an effort to both educate their staff and audience, however they are in the minority. Reaching beyond this scope only seems natural, creating new spaces for the medium to grow.

These new spaces can be seen in many of the residencies. Thuli Gamedze's residency took place in May 2017, *WOW_3000ZF : c o n s p i r a c y d e - p o l i t i k*, (fig 1) providing a free online course to the public (within and beyond the Floating Reverie network) with the intention to "challenge its students to consider the tensions between South African art making practices during and post-apartheid, exploring whether the Rainbow Nation project was one that included the de-politicisation of our art practice" (Gamedze). Each day she uploaded course content, a lecture, or video emphasising participation, inclusion and the generation of knowledge, in a way that Gamedze describes as "experimental education practices, and irrationality" (Gamedze). She followed a seemingly expected format of a course outline concluding with an exam and referencing the form of online courses. Yet the content and the manner of uploading, subverts our previous understanding of what it means to learn and challenges existing colonial pedagogical structures that seem to be entrenched in our institutions. Whilst participating in Gamedze's online course it was difficult to position myself as a participant, a learner or student, a user or a viewer.

fig 1. Screenshot from Thulile Gamedze's residency. *WOW_3000ZF : c o n s p i r a c y d e - p o l i t i k, 21 May 2017.*

It is not an online gallery

The inherent nature of the online medium presents artists and curators alike with affordances and constraints, enabling us to access and view work differently from the physical structure of, or in, the gallery. A traditional gallery, a white walled one or black box (for videos), is a construct from the 'modern west' and encourages the final artwork to be presented as a complete artwork, viewed in a designated time and place by a viewer. The gallery is positioned, as a final 'resting place' for the artist's creation, for their pro-

cess; yet doesn't always facilitate the viewing of or expose the process. The presentation of this process or production is almost actively hidden or denied. The gallery acts as an authoritative space, deciding what is or isn't accepted into the space and what is or isn't classified as art, assuming a certain position on it. It is a space that has a legacy of generating power dynamics and often perpetuating existing ones. It is often a space of exclusion, with very little empathy for those who are exclude or what is excluded, from medium to viewers to high or low art. Galleries often don't have the self-reflexivity that includes dealing with these paradigms either, so they move un-selfconciously, acting upon a space without theoretical grappling with this, which can be problematic.

The Internet is a relatively new and vast space for artists, versus traditional or conventional galleries or exhibition spaces, which can be limiting and restrictive in their structure and implementation. Floating Reverie offers a platform to artists to subvert these conventions. Floating Reverie acts as a site and framework for the selected artists to record a repetitive, creative output which functions as a conceptual development and research. The residency becomes a model for the presentation of digital work, replacing certain established gallery conventions in the contemporary art world, such as the exhibition and the showing of work.

In Beryl Graham and Sarah Cook's book *Rethinking Curating* (2010) the authors explore various themes and topics around what they term 'new media'. Two themes, which are of particular relevance in an analysis of Floating Reverie, are *time* and *space*, in relation to the exhibition, the institution and the audience. Their discussions are orientated around a broad definition of 'new media'. My application is specific to Internet based artworks as framed by, or for, Floating Reverie. Cook and Graham state "the conventional gallery is conceived for the time span of looking at an object rather than anything based on time" (Cook and Graham 100). The Internet inherently exist outside of a perceived notion of time, it is on 24/7 as the authors acknowledge (Cook and Graham 102).

Floating Reverie uses this and plays with it as a format and medium itself, with the artist revealing each iteration of the residency day by day. Only once the residency is completed in the assigned two weeks will a viewer be able to see the body of 'work', or process, in its entirety. There is something magical that happens on a daily basis while the artist contemplates/considers their next 'check-in' or iterance. Audiences wait for the next iterance, only able to view the work up to date as the narrative in the residency progresses. However, the work is still accessible at any point during the residency and post the residency, unlike a conventional gallery which has operating hours. The viewer is also able to access the work from a location via a url whether it's at home, at work on their laptop, or on a mobile device whilst commuting. The location and device can change the way you experience the online digital medium.

Cook and Graham explore the materiality of space the digital occupies. They describe code as "immaterial, or at least tangibly imperceptible", and the working with it as the ability to "mediate ideas through the medium itself… a kind of invisible, dematerialized activity" (Cook and Graham 64). Brooklyn J. Pakathi's residency *my weight in grams* (fig 2), leveraged an existing platform, using temporary Instagram Stories (also known as Instastories) as a mode for communicating and reflecting on how "aspirational validation seeks to imbue its users" (Pakathi) and the active seeking of it by the users through their posts. In his residency he portrays intimate thoughts and poses questions on the relationship between a "multi-layered url behaviour that often masks the pull of irl ubiquitous normality" (Pakathi) (5). Pakathi sets up and prompts conversations which occurs daily over the two weeks, through iterance's of these feelings as he grapples with inclusion and acceptance online, referencing the language and recurring motifs used in Instagram Stories and by its users.

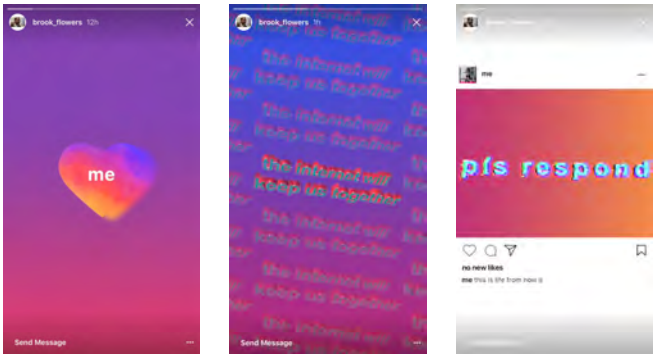


fig 2. Screenshot from Brooklyn J. Pakathi's residency.
my weight in grams, June 2017.

There is a presumption that no physical space exists online or in the digital medium, however through the residency programme I have come to disagree with this presumption. Pakathi carves out this space respectively, allowing the user to access a fragment or glimpse into his thoughts. Cook and Graham suggest that it is possible for "work on the Web to be site specific" (Cook and Graham 66). This is the case for artists like Pakathi who have used an existing framework or format for their residency, leveraging an existing seemingly 'public space' whilst artist like Gamedze established their own context. Gamedze uses her own dedicated website to communicate and distribute each lesson or instruction.

Cook and Graham state that "place is inherently tied to the question of the work's distribution" ((Cook and Graham 66) which seems essential to social media networks which Floating Reverie relies greatly on to disseminate

each residency. Pakathi's work existed on his and Floating Reverie's Instagram profile, which enabled him to access two very different audiences based on the other Instagram accounts that follow him and Floating Reverie. The work was the secondarily redistributed through Facebook as an update channel using Floating Reverie's page. This redistribution is also seen as a re-contextualisation and not an iterance of the actual work. Cook and Graham state that "the notion of a local audience literally goes out the window" (85), however defining locality is important when considering what a local audience could mean online, especially when engaging with 'site specific' work. Pakathi's audience was local to his residency, to his profile despite being geographically dispersed. These works in actual fact are more "material in the consideration of their presentation because of the social connections and possibilities for engagement" (Cook and Graham 68).

Curating online artworks

In her Introduction to the book *Nettitudes* Josephine Bosma describes the "curator, conservator and archivist all becoming co-producers of an art work" (Cook and Graham 19). Cook and Graham state that the curator is no longer "placing an object, but providing a 'platform' for participation according to the artist's blueprint" (Cook and Graham 137). This is precisely the role that Floating Reverie provides on the initial instance of curation.

Cook and Graham suggest that due to the fact that the characteristics and aesthetics of digital art constantly changing, a curator needs a framework which can adjust and change alongside it. This framework should allow for investigation and exhibit the work that "allows for both the aesthetic and the practical consideration of not only those characteristics but also the behaviors of new media to be evident" (Cook and Graham 154). They describe three different models of exhibitions 'iterative, modular and distributed' (Cook and Graham 154–155). Whilst all could be applicable to both Floating Reverie and the artists' individual residencies, the last model 'distributed' relates closely to the model that I have described and am attempting to develop 'networked curatorial practice'. The distribution model is based on "Net- or Web-based art practices and describes how formal exhibitions might not be the end result at all", but instead these 'exhibitions' or presentations of work leverage off of existing frameworks or curators create their own infrastructure (Cook and Graham 154). Floating Reverie allows the artists to decide which they feel is more suited to the concept and work the artist is envisioning. Floating Reverie deliberately doesn't house the residencies as subdomains within its domain and wants the practice to exist outside of the 'system', independently. This reflects the beginning of a networked curatorial practice and is in complete contrast with the gallery system which seeks to contain the works within their location or domain.

Louwrens Ferreira's residency *Behind the Sounds (2015)* fig 3. re-contextualised used accidental field recordings "by applying compositional processes to the raw material as a way of representing the internal and inaudible processes that took place and could not be captured" (Ferriera). These daily iterations interacted with each other by chance as each day you were able to hear a different combination of sounds simultaneously playing them and allowing them to load at different times based on file size and Internet speed resulting in a variety of TAZs. This performative nature changes and exists autonomously within the space, temporary to the viewer.

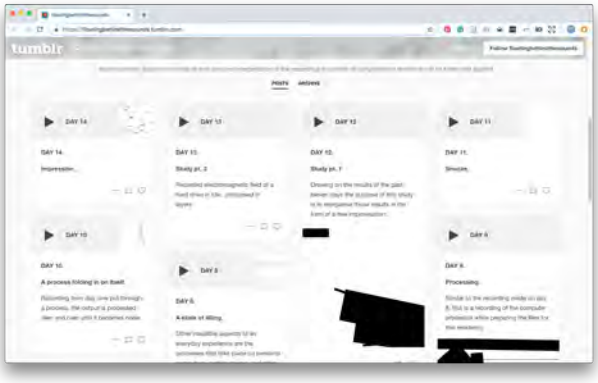


fig 3. Screenshot from Louwrens Ferreira's residency. *Behind the Sounds (2015)*

In Steve Dietz's article *Curating Net Art, A Field Guide* in the book *New Media in the White Cube and Beyond* edited by Christiane Paul (2008), he presents two questions for curators of internet art that should be considered in relation to each other. He asks "how to curate and present the net art that artists have created and will create using the tools available to them and whether these artistic practices affect curatorial practice itself" (Dietz 77). Floating Reverie does not decide on how the artist curates their residency, it is up to the artist to generate and come up with a solution that they feel best suits their practice and the medium. This is purposefully done as the medium itself should assist in determining the outcome in order to overcome existing hierarchies of institutions and place the curator and artist on the same 'level'. It also starts to beg the question of what the role of the curator is when curating artworks which are seemingly immaterial. Immateriality according to Joasia Krysa is central to the way in which we need to rethink the role of the curator and the act of curating. In her article *Distributed Curating and Immateriality* published in Paul's book, Krysa describes the curator as having a diverse range of skills and activities that it should involve from "intellectual activity […] classifying […] establishing display modes and handling technological aspects of production […to] the management of the 'social consumption' of curated artworks" (Krysa 91). She goes on to reference Lazzarato, suggesting that "if curating as a practice facilitates the production of 'informal, cultural and affective

content,' the practice of curating can be seen as 'immaterial' (in Lazaarato's sense)" (Krysa 92). It seems as the power relations shift, from placing the curator in a position of extreme authority and rather placing them in relation to the artist and their process, the curatorial mode shifts towards something more collaborative and less one directional. Krysa states that artworks which can't be "curated in any traditional sense because their transformative and immaterial nature defies simple categorisations or control over predetermined curatorial meaning" (Krysa 92).

Whilst the residency is not an exhibition, the collective presentation of the works seem to be reminiscent of an exhibition whilst the medium, the process and research components that are part of the residency and inherent in the medium seem to warrant the "reorganisation of power and centers of control" which seem so entrenched in traditional and contemporary institutions (Krysa 97). Whilst Floating Reverie might appear to be the authority in determining the limitations and constraints of the residency and the scope of the post-digital, it is ultimately up to the artists to access the network or medium and manifest their practice from within it. The artists generate or produce meaning.

Another dimension to the curatorial network that exists within Floating Reverie is the means of communication – how do people know about the residency; how do people know to check each day? The platform relies heavily on the artists' networks; the network Floating Reverie has and the disseminating nature of social media. In his essay titled *The Curator's New Medium,* Omar Kholeif explores how algorithms curate content for us which transcends the average curators' capabilities, he also acknowledges the reluctance of contemporary practice to understand and or give attention to this new medium which "has started to shift the hierarchies by which conventional curatorial practice is admired, taught, and implemented in the contemporary sphere" (Kholeif 79). He describes this as the "supposed democratization of curatorial practice" which threatens the "traditional art historical approach to curating" as a specialist skill or reflect specialist knowledge (Kholeif 84). Floating Reverie seeks to overcome this through the various networks that it creates and filters into, whilst relying on established algorithms on existing networks.

Acknowledging that the Internet is not necessarily a place or space that is perceived as democratic, inclusive and empathetic is a necessary part of Floating Reverie's vision whilst simultaneously acknowledging what it can afford artists. Not everyone has access to the Internet, and not everyone is able to understand it as a 'public space'. This public space is not without its colonisers, authoritarians and gatekeepers. It does however provide the opportunity for anyone with access to subvert existing institutions by using platforms differently, and by challenging the norms, or authority of those who exert control or prescribe specific and accepted ways of being present on the Internet. The Internet exists in a state of continuous flux, it is a space where we haven't by any means reached our limits or full potential, and presents artists with access to its languages and an almost unlimited 'canvas' or space in which to reimagine art. In this way, it is open, and it affords artists a space that breaks away from the existing structures.

Positioning creative practice as research online

Floating Reverie acts as a site and framework for the selected artists to record a repetitive creative output which functions as research. It seeks to use the mediums capabilities in order to present a new type of creative research. The initial conception was personal, for my own practice, which seemed exclusive when platforms are so needed in South Africa for artistic and creative production. There are so few available, let alone ones that specialise in Internet or digital mediums in South Africa. New modes of display and production need to be supported and developed. I found my own practice thrived or was able to develop in interesting ways within constraints. Residencies are usually time orientated, allowing for concentrated dedicated practice to emerge in isolation, removed from external influences. This principle is simply carried over to the Internet, manifesting in two weeks.

Online digital art, Internet art or networked art are just some of terms that are used to describe or label artworks that exist exclusively on and has been specifically made for the online medium. The two defining characteristics of the medium the hypertext/hypermedia and the non-linear connections which are created as a result of these hyperlinks establish, enable experimental outcomes, continuous or ongoing practices to occur unlike no other medium. This is the entry point for Floating Reverie.

Conclusion

This initial engagement with Floating Reverie as a space which uses the Internet as a platform to destabilise gallery spaces, curation and artistic practices is part of a bigger research project that I am undertaking where I am interrogating online curatorial practices and methods in a Global South context. The next step in my research is to position it more thoroughly within its context in South Africa and to do an in-depth analysis of the strengths and weakness or failures and successes. It is important to understand the residency programme as part of an intention to change the way the 'gallery' is positioned and as a result, creative practice. It is fundamentally about presenting and providing a space for process, presenting research and creative practice in an alternative way which destabilises the role of the gallery, the 'final' artwork and the curator. It is my deepest wish that Floating Reverie will continue to offer this space for artists and practitioners continually whilst remain self-critical and able to evolve with the needs and requirements of artists.

Endnotes

(1) Traditional in this sense, implies that this practice is orientated around a specific place origin. The format of display is something that originated in western spaces with particular modes of production in mind, and the way exhibition spaces have been imagined in the past relates to this 'tradition' of display. Since the advent of the incorporation of media outside of these 'traditional' modern art strictures, curators have been grappling with ways to deal with the display of it.

(2) I have been using the term ‘networked curatorial practice’ in order to position my practice as an artist and as a curator. It is not a term that I have directly come across in other author’s writings, although the sentiment has been implied. For me, the term describes a curatorial practice that emerges within a network as a relational entity, in the residencies by the artists and the residency holistically through my selection of the artists and subsequent documentation of the residency and lastly through the post-digital’s relationship to the residency. It should also be noted that establishing the scope of this method is part of a bigger research investigation that I am conducting.

(3) These platforms or social networking sites are often Tumblr or Instagram, but artists can also choose to develop their own platform and use a designated html page.

(4) These initiatives and interventions include but are not limited to collectives like CUSS and NTU. Artworks like *NERVOUSCONDITIONER.LIFE.001.NTU* which is an “independent online network, created to explore the possibilities of a safe and independent space on the Internet: free of discrimination, speech control and surveillance” (Rezaire, Sekhukhuni, and Dennis).

(5) Here the use of term *url* is a metaphor for existing online, referencing a url (uniform resource locator, or web address) which can house a domain name and is a link to an html page. *url behaviour* would be behaviour online. *irl* here stands for *in real life*, offline, and seen as anything that happens in ‘reality’ versus the events or manifestation of events online.

References

Books

Bosma, Josephine. *Nettitudes: Let's Talk Net Art*. NAi Publishers, 2011.

Cook, Sarah, and Beryl Graham. *Rethinking Curating: Art after New Media*. MIT Press, 2010.

Kholeif, Omar, editor. *You Are Here: Art After the Internet*. Cornerhouse Publications, 2013.

Edited Books

Paul, Christiane, editor. *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. Illustrated edition, University of California Press, 2009.

(Cambridge and London: MIT Press, 2003), 50.

Journal article (print)

Tuck, Eve, and K.Wayne Yang. "Decolonization Is Not a Metaphor." *Decolonization: Indigeneity, Education & Society*, vol. 1, no. 1, Sept. 2012. *decolonization.org*, http://decolonization.org/index.php/des/article/download/18630.

Whitaker, Carly. "Floating Reverie: A Networked Curation Experiment." *Technoetic Arts*, vol. 12, no. 2, Dec. 2014, pp. 197–205. *CrossRef*, doi:10.1386/tear.12.2-3.197_1.

---. "Post Digital 2015." *Issuu*, https://issuu.com/floatingreverie/docs/floating_reverie_post_digital_2015. Accessed 31 Aug. 2017.

---. "Post-Digital 2014 Catalogue." *Issuu*, https://issuu.com/floatingreverie/docs/postdigitalcatalogue. Accessed 31 Aug. 2017.

Journal article (online)

Krysa, Joasia. *Curating Immateriality: The Work of the Curator in the Age of Network Systems*. Autonomedia, 2006.

Magazines and Newspapers (online)

Connor, Michael. "What's Postinternet Got to Do with Net Art?" *Rhizome.org*, http://rhizome.org/editorial/2013/nov/1/postinternet/. Accessed 25 Nov. 2013.

Gamedze, Thulile. *THULILE GAMEDZE :: POST RESIDENCY INTERVIEW*. http://floatingreverie.co.za/?p=421. Accessed 6 Sept. 2017.

Websites

Ferriera, Louwrens. *OCTOBER //2WEEKS :: LOUWRENS FERREIRA*. http://floatingreverie.co.za/october-2weeks-louwrens-ferreira/. Accessed 28 Aug. 2017.

Pakathi, Brooklyn J. *BROOKLYN J :: POST RESIDENCY INTERVIEW*. http://floatingreverie.co.za/?p=423. Accessed 6 Sept. 2017.

Rezaire, Tabita, et al. *NERVOUSCONDITIONER.LIFE.001.NTU*. 2015, http://tabitarezaire.com/ntu.html.

Telepresence: A Collective Virtual Reality Performance Experience

Kiran Bhumber and Nancy Lee
Vancouver, Canada
kirandbhumber@gmail.com, hi@nancylee.ca

Abstract

Telepresence is an eight-minute, 8.2 channel surround sound VR performance experience where audience members are seated in rotating chairs in the center of the sound system and performance space, each wearing an Oculus Go VR HMD, as a trumpet player performs around them. In this paper, we explore the relationships between culture, presence and choreography, and how they are constantly in feedback with mediated technologies. This is followed by our methodology, which outlines the musical composition and sound choreography, and the technical and artistic development of VR components. Lastly, we conclude with artistic reflections based on our 17 performances from ourselves as creators, our creative collaborators and audience members.

Keywords

VR performance, virtual reality, trumpet performance, spatial music

Introduction

Philosopher Salome Voegelin states that hearing, listening and perceiving sound are different levels of engagement that make it possible to explore a plurality of possible realities; "these realities do not present an untrue counterpart, opposed to the unmistakable reality of an actual truth, but prizes open a window on the ambiguity of the reality of the actual world, allowing an individual to inhabit worlds of 'what could be', instead of 'what is'"[1]. Voegelin's theory can be applied to a VR experience by a participant's ability to be present and explore between multiple worlds: 1) the physical world 2) sound/technologically mediated world.

Telepresence (2018) invites participants to create their own narratives between worlds and to explore their possibilities based on their sensory perceptions, which create shifts in their physical movement and gaze. *Telepresence* is an eight-minute, 8.2 channel surround sound VR performance experience. The performance takes place in a physical performance space with an octophonic sound system, four tube amplifiers and a live trumpet performer. Eight audience members are seated in rotating chairs in the center of the sound system and performance space, each wearing an Oculus Go VR HMD, as the trumpet player performs around them. *Telepresence* has been performed five times at Emily Carr University in Vancouver, Canada, in September 2018, twice at our artist studio in Chinatown Vancouver in November 2018, and ten times at artist-run centre Western Front in December 2018.

Unlike most traditional VR experiences, *Telepresence* is designed as a collective and social experience. Much like going to a music concert or a cinema, participants view the virtual composition simultaneously with one another. However, instead of wearing binaural headphones traditionally used to experience VR works, the audience is united by the 8.2 channel surround sound design, four tube amplifiers and physical trumpet player performing around them. As such, this work seeks to redefine the conventions of the concert setting by reversing the hierarchy between visual and audio elements within a virtual performance environment. Our primary question explored in the work is: How can virtual reality enhance a live musical performance without overshadowing the aural experience?

In this paper, we explore the relationships between culture, presence and choreography, and how the three are constantly in feedback with mediated technologies. This is followed by our methodology for the creation of *Telepresence,* which outlines the musical composition and sound choreography, and the technical and artistic development of VR components. Lastly, we conclude with artistic reflections based on our 17 performances from ourselves as creators, our creative collaborators and audience members.

Figure 1. Telepresence performance at Western Front.

Research Context

Technology influences our understanding of ourselves, our culture and the experienced world. Media technologies determine how cultures structure the process of remembering, just as remembrance affects the way in which we make use of media devices [2]. While technology influences the way a culture remembers, the culture itself influences the way in which these technologies are used. This feedback loop is manifested through an individual's interaction with mediated technologies. David Rokeby argues that "to the degree that the technology transforms our image in the act of reflection, it provides us with a sense of the relationship between the self and the experienced world" [3]. As this transformation of the self occurs through interactive technology, so too will the individual's sense of self evolve within a culture. Rokeby's argument can be applied to interactive technologies and performances where the "experienced world" is combination of virtual and real-world scenarios as what Paul Virilio describes as "stereo-reality"[4]. In this setting, the transformation of our image is reflected through our gaze and body positions that change as the experience unfolds. The active changes through our body positions ultimately affect the progression of the work. The work can thus be seen as a reflection of our relationship between our sense of self and the experienced world. Laurenzo, Klein and Clark's VR music performance *Awkward Consequences* (2012) resonates with this perspective. Instead of a literal narrative, the work is a reflection of a (meta)-narrative between the audience and the environment. *Awkward Consequences* is a live guitar and electronics performance for up to 100 audience members, with networked mobile devices in VR cardboard viewers displaying interactive visuals [5]. In both *Telepresence* and *Awkward Consequences*, a live performer is present and influencing the audience's perception of the piece. The main difference between the two pieces is that *Awkward Consequences* is staged in a proscenium configuration and *Telepresence* is staged as a 360-degree performance where the audience is witnessing and participating on the stage.

Based on our experience of working in VR on 360 dance film *Tidal Traces* [6], we found it necessary to continue our research, as informed by Michael Klien's (2008) definition of choreography as a way of seeing the world [7]. Utilizing a choreographic perspective, we can better understand how physical, sonic, and virtual spaces impact audiences' bodies and their perception of performance. The audience has to navigate between a physical performance space they inhabit and a virtual reality space they see through the direction of their gaze and the direction their body is facing. Since *Telepresence* exists both in a physical and a virtual space, it is crucial to the audience's sense of presence to create a transitional environment from the physical stage to the VR stage or virtual environment (VE) before the performance [8]. This transitional environment can focus the audience's attention to the stage when they enter the physical space of the performance. The intention is to the direct the audience's gaze to the stage through the use of lighting - illuminating a cluster of seats in a darkened space, where seats are arranged in the center of an octophonic sound system. The lighting design and seating arrangement of the space can imply that the audience is both a spectator and spectacle of the performance.

The modal elements constructing *Telepresence* combine to create a heightened sense of stage presence of the performer in the virtual and realworld environments. Since the work is experienced and performed within a 360-degree staged area and VE, the definitions of presence will be informed through the relationship between the performers (human and virtual) and participants. Cormac Power's *Presence in Play* (2008) describes the types of presence that audiences experience during performances – here, we focus on auratic presence [9].

Power's auratic presence refers to the "extent that the spectator feels a heightened presence in the actor... [Auratic presence] seeks to enhance the actor's presence or aura" [10]. The inability to see the performer affords the audience to focus on the work's travelling and ancillary sounds: footsteps, breathing, garment sounds of the musician, and so on. This exchange between performance input and audience perception also relates to presence within the VR stage. Visual components, including the skybox and game objects, can be interpreted as actors whose energies and movements can be perceived as occurring within the real world. Although non-existent, the performance characteristics of the visual actors also produce auratic presence experienced by audiences. The performer's auratic presence, physically and virtually, elicits bodily reactions from the audience. Although the audience cannot see a physical and virtual representation of the performer, the sonic interaction between performer, VE and audience, can enhance the audience's awareness of the performer's presence in *Telepresence.*

How does the design of our virtual and sound environment influence the audiences' bodies? How does the audiences' gaze activate their bodies, their bodies' perception and awareness, and how does this impact their experience of this performance? In designing the VE, we used virtual scenography as a way of increasing visual, aural and physical engagement with the audience for a more immersive experience. [10] We animated the skybox to draw attention in directions correlating to the movement of the sound; to create a sense of spaciousness; to induce sense of physical motion; or to change the way the spectator is physically seated in the chair. Limiting the audience's perspective, by using dim lighting in the physical space, and using negative space in skybox composition of the VE, can enhance feelings of

presence [11]. Similar techniques were used to craft space through surround sound.

Spatialization has been practiced in music and performance for centuries to create immersive sound experiences – from choirs performing antiphonally, such as Palestrina's work in the 16th century, to present day electroacoustic works. However, in these two instances, there remains a clear distinction of normalized concert setting social roles (performer and audience member). *Telepresence* seeks to redefine the traditional concert setting by blurring the relationship between audience and performer. Virtual reality affords this possibility by obscuring the audience's visual sensation and perception of the real-world performance and transforming a passive audience into an active one by giving agency to their experience.

Witnessing a live performance requires the spectator and the performer to be engaged in a co-dependent relationship, each of which is aware of the other [11]. Lombard and Ditton [12] state that psychological engagement in VR is linked to a sense of intimacy. By abolishing the familiar concert setting, we are allowing both audiences and performer to enact and perceive the work with limited biases that would normally exist through visual awareness of the performance. This mediation allows the performer and audience to interact on a more intimate level; the performer can physically move through the space and play in close proximity to the audience member. In turn, the audience's bodies can physically react to the performer and shift their gaze and movement without the influence of the visual biases. It allows more autonomy for both audience and performer. Audiences are free to interpret the work as they experience it through their bodies, and the performer can respond based on the audiences' body language.

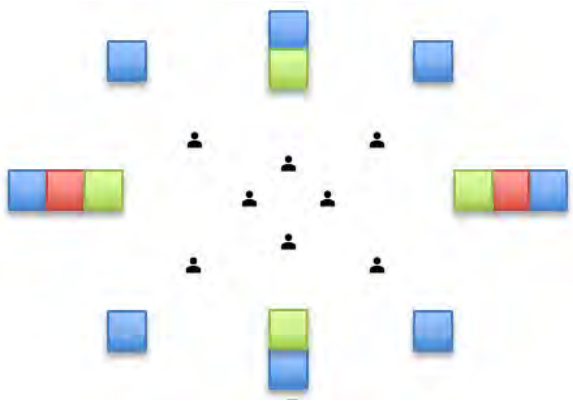


Figure 2. Diagram of sound staging and audience seating. (Legend: Blue = speaker, red = subwoofer, green = tube amplifier)

Methodology

Musical Composition and Sound Choreography

We chose a combination of an 8.2 speaker and four tube amplifier array, thus using 14 amplified sound sources to emphasize the focus of the participants bodies as shifting between the physical and VE space. This would also trigger the audience's proprioception which would further solidify their physical awareness within the two worlds. The two sound sources were located at different planes - the 8.2 system was at head level (when sitting) and the amplifiers were at seat level. Bhumber created the 8.2 soundtrack, while Carter created the quad amplifier sound.

Creating a sense of space through sound became the first objective for the start of the composition. Experiments with different timbres, frequencies and their velocities across the 8.2 speaker array were conducted in order to establish the dimension of the room. From this, we established that short, fast moving sounds were appropriate for triggering changes in proprioceptive focus through our physical changes body position and gaze. These sounds thus created a collective awareness of space, and became the primary point of focus that guided the audience through the work. Long-sustained sounds had the opposite effect. They influenced our bodies into a static position.

Next, we examined how Carter's presence and performance characteristics affected our focus. The term "Sound Choreography" was coined for these studies and were lead by choreographer Emmalena Fredriksson. During our full team rehearsals, we sat in the performance space with our eyes closed and experienced Carter's trumpet playing in various physical configurations and sound characteristics. We found that his playing, while travelling around us, focused our attention to the surrounding space, and that we moved our body position in accordance. When he played stationary in close proximity to us, we shifted our focus inwards, and our bodies became more static. Carter explored producing unconventional and human sounds in these configurations such as mouth noises, whispers and vocal sounds to gage our reactions. The information gathered from the studies informed the structure of both the spatial and live-performance composition.

The sound choreography studies, combined with JP Carter's practice of looping various unconventional and highly-processed trumpet sounds, became the primary source of compositional material. Three contrasting loops became the source of three compositional movements. Carter describes his loops in this quote: "The first loop (#61) is a collage of random trumpet flourishes, utilizing traditional and extended techniques, improvised and highly processed. The second loop (#13) is three note melody played very slowly, featuring medium to lower tones. It is highly processed to create a sub bass low drone, with the melody heard vaguely

near the end of the section. The third and final loop (#69) has a 'walking pace' rhythmic element, with soft staccato trumpet shots, and a recurring single note melody". The 8.2 spatial sound was created to both complement and oppose the loops. The individual tracks of the 8.2 soundtrack were then placed and spatialized using the Reaper DAW and Cuckoo's ReaSurround plugin, while the panning of the tube amplifiers was controlled through a pedal.

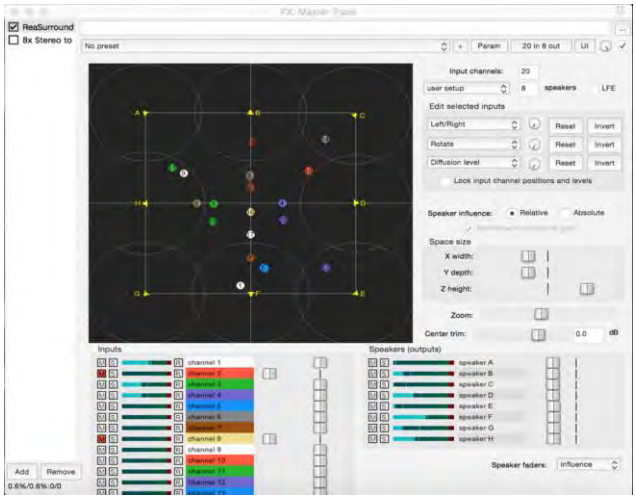


Figure 3. Screen capture of spatialized audio in ReaSurround using Reaper DAW.

Skybox

Collaborating with visual artist Laine Butler, Lee generated four colour palette sets based on the feelings evoked by the 8.2 soundtrack and trumpet loops. The colour palettes are then used to build stills in Photoshop that are then imported into After Effects to animate into a 360 video for the skybox. Keeping in mind the intention of this piece, – to develop a VE that supports the sonic environment – our main challenge with the skybox was creating an "illusion of depth" and a sense of spaciousness to support the spatialized live performance. How could we create a VE that reflected the physical space established by the sound? At first, we conceptualized spherical skyboxes in Unity (using the equirectangular skybox mapping method of a 360 video), where the interior of the VE is as if we were inside a spherical universe. However, we found that when we mapped our abstract visuals as a spherical skybox, the interior of the VE felt too small and claustrophobic. Although the skybox was technically mapped at an infinity distance from the camera view, the VE did not create a sense of space - the virtual universe felt like only spanned a few meters from the camera view.

We tested placing multiple game objects in the VE to see if visual references would help create a sense of space. The game objects helped the VE feel a bit more spacious, but we would then need to justify the presence of these random game objects from an artistic standpoint throughout the piece. Some of the game objects also needed to be placed very far from the camera view – sometimes so far that it's hard to see – in order to induce the feeling of spaciousness. What if the audience never notices these reference point game objects and does not experience the piece in virtual spaciousness we had intended? We were also weary of game objects distracting the audience from the aural experience.

Our solution to our depth dilemma was to conceptualize the interior of the VE as a cube. This option was conveniently inspired by the cubic language used for skybox mapping in Unity and in After Effects. Cube-mapping is a method used to map a VE as a 6-sided cube and is utilized to perceive and work with 360 videos on a 2D screen without the distortions of spherical/equirectangular mapping. Although the interior of a cube-mapped skybox is usually seamless so viewers do not notice the 12 edges of the cube's interior, we thought that we should subvert the use of the cube-map method for the skybox and make the cube-map edges visible, so viewers feel like they are inside a cubic environment rather than a spherical one. We developed video animations in After Effects and intentionally "mis-mapped" it as a 6-sided cubemap skybox in Unity (Figure 4) (when an equirectangular option should have been used). The mis-mapping of animations made the 12 cubic edges of the cube-maped skybox very pronounced, hence making the interior of the VE cubic. The use of edges/lines in a virtual space creates perspective, which then created the illusion of depth and sense of spaciousness we were trying to achieve.

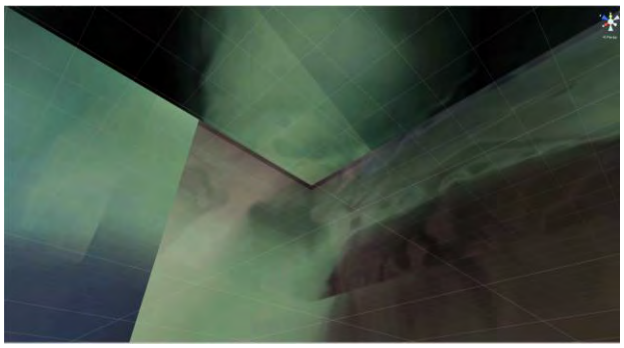


Figure 4. Screen capture of skybox "edges" during movement 2 in Unity.

Game Objects

We felt the need to have something fill the virtual space in an unobtrusive way that would contribute to the volume and ambience of the VE, especially in the beginning when the sonic space is being established. We experimented with different types of fog (volumetric and sheet particle). We used sheet particle fog since we were able to animate it with less framerate drops on the Oculus Go. We created two game objects in Cinema 4D that were imported to Unity as an Alembic file. We created an audio reactive render material for these objects and activated the microphones on the

Oculus Go, so these game objects can interact to the live music performance via FFT analysis.

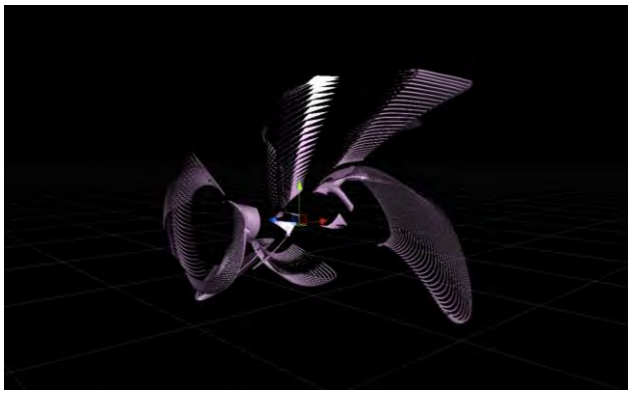


Figure 5. Screen capture of two audio-reactive game objects from movement 1 in Unity.

Network client

The VE was deployed as a stand-alone Android application from Unity which was then installed individually on each Oculus Go. A network client was developed in Unity by Ian Lavery so all the Oculus Go's would connect to a centralized server. The VR experience can be launched for playback at the same time in all the Oculus Go's. We developed a broadcasting system that listens for each Oculus Go's connection to confirm that each individual Oculus Go is connected to the server. Each Oculus Go's serial number is coded into a number corresponding to numbered labels on each headset so we know exactly which headsets are connected and which ones are not, for ease of troubleshooting during performance.

The Formal Structure

Movement 1

Sound: Performer is unseen as audience is seated for the experience. Short percussive/ industrial style sounds are triggered sporadically from the individual speakers, and slowly increase in speed and attack density throughout the multichannel speaker arrangement. The stereo trumpet loop is triggered and distributed through the quad tube amplifier setup. The loop is panned across the middle of the stage from the two horizontal and two vertical amplifiers on the same plane. The performer enters the stage and begins by circling around the perimeter of the performance sphere while playing short mezzo-forte to forte notes, which mimic the trumpet loop, towards the ceiling. By the end of the movement, the performer has threaded through the performance space and around the participants, and has moved off stage. The sporadic samples have built up to a cluster of explosions, which circle around the performance space and dissipate.

VE: Violet particle fog emerges from below in a black empty space; pink static forms as electric sheets travelling across the VE reacting to the direction of the spectator's gaze. Pink, violent and blue lines and pixels animate sporadically around the skybox to the music.
Two pulsing objects slowly appear from the far right and far left of the spectator and float towards the spectator. The violet fog dissipates. The two objects are metallic pink, with complex rib patterns arrayed in three directions. The individual ribs pulse in reaction to the frequency and amplitude of the music. The objects rotate as they become nearer, enveloping the spectator in between as they intersect. The objects then fly out towards the darkness as two gaseous planes appear directly above and below the spectator.

Movement 2

Sound: A bass drone enters and is doubled with higher frequency sounds which pulse through and fill up the performance space. A cold, arctic-sounding pad emerges and travels in a slow, semi-circular motion in each half of the room. A highly-distorted trumpet melody crescendos through the amplifiers and continually becomes more cohesive as the feedback in the distortion is decreased. The performer starts to play in close proximity of the participants' heads; by producing quiet, bubble and whisper-like sounds next to their ears. The result causes the audiences to shift their attention and body towards the nearest oncoming sounds.

VE: The gaseous planes are animated with pastel green, pink and blue rotating porous sheets, revealing darkness through its imperfection as the sheets construct and deconstruct. As the arctic sounding pads occur, gaseous vertical planes construct around the spectator in a counter-clockwise direction, forming four walls around the top and bottom planes and closing the spectator inside a gaseous cube.

Movement 3

Sound: The intention of the final movement is to bring the aural focus of the participants to the real acoustic performer. As such, the sound starts with familiar musical motifs such as a steady rhythmic line. As the rhythm fades out the performer plays long sustained notes and slowly walks out of the performance space. The last sound that is heard is a long tone produced at the front of the stage.

VE: The gaseous cube begins evaporating as a blue, pulsing, cellular membrane dissolves into the cube; the scene is now much darker. A cloud of violet fog forms above the spectator and a trail of falling fog begins circling the spectator. As the music quiets, the blue, pulsing membrane transitions into darkness. At this point, all that is left is a trail of falling violet fog travelling towards the abyss below as the sound of a long-sustained tone is maintained until the end of the performance.

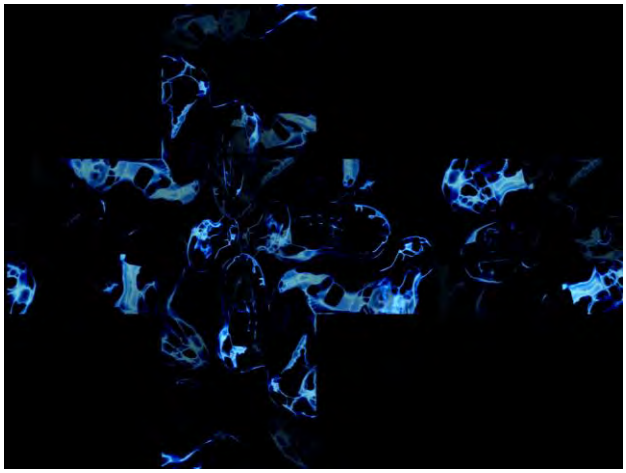


Figure 6. Screen capture of skybox in movement 3 as a 6-sided cube map.

Artistic Reflections

We have performed *Telepresence* in three different settings - a brand new motion capture studio at Emily Carr University (Figure 8), our artist live/work studio in an old building in Chinatown Vancouver (Figure 7), and a historic performance theatre at artist-run centre Western Front. We asked some of our participants and team members who have viewed the piece more than once to reflect on their experience of *Telepresence*. Some of the common themes from the audience's reflections were: (1) the physical performance space and participants mental state impacted the perception of the piece (especially for those who saw the piece in three different settings); (2) physical posture of the body from gaze direction influenced perception of the piece; (3) the combination of abstract aural and visual elements, the lack of realism and virtual bodies, provoked a meditative state or sense of "forgetting the self"; (4) Carter's performance in close proximity to individual participants influenced their change in focus and body position throughout the experience.

A prominent observation from our team, who have experienced the piece many times, claims that each different performance space profoundly influences the perception of the piece. It is no surprise that room acoustics alter the way in which music is heard as stated in point (1). However, we believe that other intangible and unmeasurable characteristics account for the difference in perception. The symbolic meaning of the space and its intended use could subconsciously alter the mental expectation and resulting behaviour of the audience. The cultural tradition associated with a black box university studio versus a historic performance theatre differ drastically. Culture sets a precedent on how one would normally behave in these spaces. The stress driven environment of a university space may have influenced a tenser state, resulting in a less physically-receptive experience, whereas a historical performance theatre could promote a more relaxed state and openness to explore.

Figure 8. Rehearsal in Chinatown artist studio.

The willingness to explore and perceive the work was accounted by the different physical postures and gazes that participants exhibited. Visual artist and advanced VR user Jonny Ostrem describes point (2) in the following anecdote: "I was struck by how the my body's orientation affected my mood/disposition/mode of thinking...there was a moment where the viewer watches the skybox above...In this moment with my head tilted up, I found myself in the same mental space as one is when looking at the stars or laying in a field of grass - I was overcome by contemplation. I wondered if posture could activate state of mind."

Rakinder Sidhu, art director and novice VR user, supporting point (3), compares *Telepresence* to an abstract painting or an instrumental song, in the sense that there were no words to describe what the piece really meant, and that there were no distinguishable figures in the VE. The abstract nature of *Telepresence* offered room for discovery in the VR medium. Fredriksson, who has experienced *Telepresence* in every performance setting, also echoed point (3) - she felt no

Figure 7. Telepresence performance at Emily Carr University.

concern of her own body, and that her ego is not important to the experience of this piece because "there was no need for interpretation or understanding".

As creators of *Telepresence*, we were able to observe the physical behaviors of the participants throughout each performance. We noticed that participants would have sudden bodily reactions to Carter's performance when he played in close proximity to their heads which further support points (2) and (4). After performances, participants would frequently approach us enquiring about Carter's live trumpet performance, commenting on when they were able sense his presence by their ability to distinguish between the acoustic, electroacoustic and ancillary sounds.

Taking the audience's experience into account, we wonder if experiencing the work multiple times at a same location would create a more cohesive interpretation. Would the audience members exhibit similar movement behaviors and create a communal perception of the piece?

Were we successful in reversing the hierarchy between aural and visual elements of Telepresence? Probably not. VR is still such a new technology for the general public, we think that the novelty of the technology may have overshadowed our intention to evoke a state for deeper listening. The majority of our audience are novice VR users - if they were avid VR users, would their perception of the sound be more heightened?

Conclusion

"If being an artist requires questioning the nature of art, technologically mediated artistic production also requires challenging what technology is, what its social roles and possibilities are" [5]. *Telepresence* encourages aesthetic questioning of its VE through music and live performance. Although *Telepresence* may not have successfully reversed the hierarchy between visual and audio elements in a virtual performance environment, it does challenge the definition of the traditional concert setting. *Telepresence* blurs the relationship between the audience and performer through its staging; the performer and audience are constantly in dialogue by shifting their bodies, gazes, footsteps and sounds based on each other's presence. These interactions are also situated within the same performance space, with no proscenium separation. Furthermore, *Telepresence* challenges the conventional application of VR as a medium. The discourse of emerging technologies is often driven by capitalistic interests which lacks critique on its social imprint. We believe artistic applications of VR will diversify the medium, which will create space for innovations and new ways of understanding ourselves. Participants in *Telepresence* are active producers and consumers of culture, engaging with technology and social choreography, carrying their embodied experience into the piece. Their interpretation of our work is also a reflection of the dialogue between them and us as creators. Through a broader lens, the piece can be seen as a metaphor for how we navigate through stereo-reality in our everyday lives, and that there is no longer a clear distinction between the real world and the technologically-mediated virtual world [13].

Acknowledgements

We acknowledge that this project took place on the unceded, traditional and ancestral lands of the Squamish, Tsleil-Waututh, and Musqueam peoples. We want to thank DB Boyko and Western Front Society (Roisin Adams, Aram Bajakian, Caitlin Jones, Ben Wilson and Lief Hall) for producing this project. We also want to thank Basically Good Media Lab (Maria Lantin, Alan Goldman and Sean Arden) at Emily Carr University of Art + Design, CreativeBC, Province of British Columbia and Canada Council for the Arts for supporting this research. Lastly, we want to thank our wonderful creative team and collaborators for making this project possible: JP Carter, Laine Butler, Ian Lavery, Emmalena Fredriksson, Andie Lloyd, Michael Fowler, Eli Muro, Jevan Crittenden, Sarah Genge and Jelissa Classics.

References

[1] Voegelin, Salomé. *Sonic Possible Worlds: Hearing the Continuum of Sound*. NY, NY: Bloomsbury Publishing, 2014.

[2] Plate, Liedeke, and Anneke Smelik. 2013. *Performing memory in art and popular culture,* London:Routledge

[3] Rokeby, David. "Transforming Mirrors: Subjectivity and Control in Interactive Media,." In *Critical Issues in Electronic Media*, ed. By Simon Penny. New York: Sunny Press, 1995, 133-158

[4] Oliveira, Carlos. Global Algorithm 1.7: The Silence of the Lambs: Paul Virilio in Conversation. Journal CTheory. 1996. Retrieved from http://journals.uvic.ca/index.php/ctheory/article/view/14317/5093

[5] Laurenzo, Tomas, Tobias Klein, and Christian Clark. "Awkward Consequences" In *Proceedings of the International Symposium on Electronic Art*. Durban, 2018, 43-48.

[6] Lee, Nancy, Emmalena Fredriksson, and Kiran Bhumber. "360° Dance Film: Reflections on the Making of Tidal Traces". In *Proceedings of the International Symposium on Electronic Art*. Durban, 2018, 104-111.

[7] Klien, Michael, Valk, Steve, and Gormly, Jeffrey. 2008. Book of recommendations Choreography as an aesthetics of Change. Limerick, Ireland: Daghdha Dance Company Ltd.

[8] Steinicke, Frank; BRUDER, Gerd; HINRICHS, Klaus; STEED, Anthony. Gradual Transitions and Their Effects on Presence and Distance Estimation. In *Computers and Graphics*, Amsterdam, Elsevier, 34(1), Feb 2010, 26-33.

[9] Power, Cormac. *Presence in Play*. 2008. Amsterdam: Rodopi

[10] Reaney, Mark. "Virtual reality and the theatre: immersion in virtual worlds". In *Digital Creativity*, 10(3), 1999, 183- 188.

[11] Samur, Sebastian Xavier. Comparing Stage Presence and Virtual Reality Presence. In *Brazilian Journal on Presence Studies*. 6(2), 2016, 242-265.

[12] Lombard, Matthew and Theresa Ditton. At the Heart of it All: The Concept of Presence. *Journal of Computer-Mediated Communication, Online, International Communication Association*, Sep 1997, 3(2).

[13] Slavoj Žižek. *Lessons from the 'Airpocalypse.* Posted by Museo Nacional Centro de Arte Reina Sofía. June 30, 2017. Retrieved from https://www.museoreinasofia.es/en/multimedia/slavoj-zizek-lessons-airpocalypse.

Authors Biographies

Kiran Bhumber is a media artist, composer, musician and educator based in Vancouver, Canada. Kiran constructs interactive installations and performance systems that allow performers and audiences to engage with themes relating to cultural memory, embodiment and nostalgia. She has performed and presented her works throughout North America, Asia, Europe and Australia including conferences and festivals such as MUTEK, The International Symposium on Electronic (ISEA), The Toronto International Electroacoustic Symposium, Vancouver International Jazz Festival, International Conference on Live Coding, and New Interfaces for Musical Expression (NIME). Kiran holds an MA in Media Arts, a Certificate in World Performance Studies at the University of Michigan and a Bachelor of Music from the University of British Columbia.

Nancy Lee is an interdisciplinary media artist, filmmaker and electronic music curator. Nancy recently directed a VR 360 video dance film Tidal Traces" produced by the National Film Board of Canada which has been screened at Mutek, SXSW, and Cannes Film Festival. Nancy is a co-founder of electronic music and art collective Chapel Sound – a collective that has supporting emerging artists in Vancouver for the last 6 years. This year, Nancy co-produced CURRENT: Feminist Electronic Art Symposium, a 5-day multidisciplinary and intersectional music and electronic art symposium working with women and non-binary artists. Supported by BC Arts Council and Canada Council of the Arts, Nancy has performed and presented her work at Vancouver International Jazz Festival, New Forms Festival, International Symposium for Electronic Art (Vancouver & Durban), International Electroacoustic Music Festival, the conference New Interfaces for Musical Expression (Australia), and The International Conference on Live Coding. Nancy is a 2018 YWCA Women of Distinction Nominee for Art, Cultural & Design and is named one of BC's Most Influential Women in STEM for 2018.

Hauntology, the Penumbra, and the Narratives of Play Experience

Lindsay D. Grace
University of Miami, School of Communication
Florida, United States of America
LGrace@Miami.edu

Abstract

This paper collects a series of heuristics in game level design to articulate the relationship between designed experience, perceived experience, and the mechanics of play. This work aims simply to illuminate core concepts as a guide for framing the relationship between designer/author and player/participant. It is offered simply as a philosophical lens for perceiving and designing the dynamic between created works and their perception by players. It does so by offering the concept of nested narratives - recursively experienced between the played narrative and the designed narrative. It is an adaptation of Derrida's Hauntology, applied to the context of narratives in game design, at the scale and pace of 21st century game design. In short, games are always haunted by the ghosts of the author's designed narrative, it's manifestation in player's actions, and the player's self-authored explanation of their experience. This view can be used to design experiential, multi-narrative focused games and plays on the notion of games as penumbra. They are the penumbra which lay like ghosts in each new design.

Keywords

Digital Narrative, Recursion, Level Design, Hauntology, Critical Design

Introduction

Understanding digital narrative has typically been framed in relation to earlier media. While books, film and other linear forms offer some analogy, it's also clearly articulated by many in digital narrative studies that being digital offers much more possibility [1]. It is from the narrative and philosophical foundation of interactive narrative, whether the long history of theater [2] or the champion of more recent technology focus [3]. Meta-perspectives, such as Koenitz's theoretical framework [4] bring into view a contemporary perspective that looks at the intersection of vectors and offers foundation for design and implementation. Likewise, scholars, like Jenkins have made observations about the uniqueness of games and ludology to explain the richness of digital interactive narratives [5]. However, it could be equally useful to add to this milieu, another perspective. It may be useful to analyze and design from perspectives informed by aesthetics, computation and philosophy.

Reference and allusion to work sometimes takes a generation or two to manifest. The Futurists' concept of simultaneity, for example, reveal themselves nearly 50 years later in the writing of authors like Kurt Vonnegut. In Slaughterhouse Five for example, Vonnegut uses the device of a science fiction – becoming unstuck in time – to play with the notions of simultaneity [6]. Simultaneity is a concept, futurist artists employed to provide a sense that logical spatial relations had been superseded [6]. Like Vonnegut's characters, who see a person's entire life like a stretch of mountains, from baby legs to geriatric legs, the work of visual simultaneity is a collage of moments in time viewed at once. Today, the core computational method for such work is iteration and self-reference, the simplest elements of the programming convention of recursion.

Recursion, the repeated application of a self-referential procedure, is important to another 20th century literary work, Derrida's Specters of Marx [7]. This post-mortem analysis of Marxism's effects on society became one of the philosopher's most-referenced works. At its core is the concept of hauntology [8]. In simplified terms hauntology is the notion that each work references a past work and is subject to its reference in the present and past. In short, a work that is written today is both referential to prior work and guided by it. The work is in colloquial terms, haunted by the work prior to it. This haunting not only shapes the author's decisions, but the ways in which it is read. The work started a trend in both critical work and psychoanalytical research [8].

As recent as 2012, Fisher examined the hauntology of music, shining a light on the tension of electronic music's present on its projected future [9]. From this work the argument is made that 21st century music is haunted not by its past, but by the projected future the 20th century had primed its audience to expect. Fisher writes "what haunts the digital cul-de-sacs of the twenty-first century is not so much the past as all the lost futures that the twentieth century taught us to anticipate." The result, in Fisher's view, is "the acceptance of a situation in which culture would continue without really changing." While Fisher's work primarily focuses on music, it's worthwhile to ask – what if the same ghosts are beginning to appear in the world of designing playful experiences.

Much of the work in digital narrative ignores visual and philosophical hauntology. Yet, similar to Fisher's critique of 21st century music, 21st playful experiences struggle against the weight of a future-optimistic promises of the prior century. But, unlike 21st music, they are also haunted by the scale and effect of past experiences. They are like Janet Murrary's well regarded book on digital storytelling

– Hamlet on the Holodeck[1]. That is, contemporary playful experiences are caught between the grand dream of the imagined future (i.e the Star Trek Holodeck) and the monumental cultural presence of work by greats like Shakespeare (e.g. Hamlet). They are even, perhaps, possessed by them as aspiration and benchmark.

This paper explores, through philosophy and heuristics, how understanding the recursive relationship, the kind of haunting of designed experienced and played experience, can be employed to create critical level design. Doing so affords such design the ability to move freely apart from these future and past references and expectations. They free the work from the curse of the specter. Otherwise, these ghosts which haunt the design, are a kind of shadow which shapes each new game, despite the reference's opacity.

Understanding the Experience.

When players report their experiences they often assume the first-person narrative. A player might claim they did one action then the next, as in, *I jumped then I kicked* or *I captured the base then moved my squad to the North*. This is fundamental to the experience of a game, and ultimately to the experience of a level's design. The level, from basic game design is a series of design concocted problems to which the player provided solutions. When the fiery dragon swung his tail, I, the player, jumped. When the goliath fell, I used its body to reach that which I could not previously. Players experience the level as a narrative. They experience it as a series of events executed either through their own actions or their actions represented by an in-game avatar. This is, in part, why game designs may focus on game verbs – the things player do in a game. It is also why in the grand framing of media, readers read a book, viewers watch a film, and players describe what they do in a game.

The experience of the level thus becomes the narrative of the level. Although the designer did not inherently design the game as a series of specific actions, from its very first play, the level's narrative is written in sequence. If a player fails to solve a level's puzzle in the appropriate order, for example, those non-sequiturs or failed attempts are still written into the complete narrative. The player may have run in circles, but those circles are part of their story. So too, when they get stuck, that becomes part of the narrative.

This is the first reason why the well-constructed level is so important. Well-constructed levels result in good narratives. They result in experiences that are direct, clear, complete and logical. That does not mean that these levels are easy. It instead means that their complexity is not superfluous. A superfluous complexity reads like a narrative that is rich in detail, but lacking in pace, plot, character, theme or other essentials that make for compelling storytelling.

Consider, for example, a fictional game in which the player must destroy an invading horde of dim-witted but brutal aliens. A cut scene illustrates their violent brutality toward the player's family and then switches to level one of the game. The player character walks a bit, jumps over some platforms and then is confronted with a 6-digit code breaking puzzle. The player narrative is a bit awkward in this case. From the player's perspective, the narrative is simple- *my family was beaten by an invading alien horde, so I went and solved a puzzle.*

Much like the fundamentals of narrative design, this experience seems inadequate. The response is inadequate to the event that transpired. By the most critical eye, the narrative reads akin to something horrible has happened, *so I played chess*. Realistically, level designers do such things with careless execution of requisite player actions. Tutorials may be packed into early levels immediately or even during high tension events.

One such example, from an otherwise exceptional game, is found in Knights of the Old Republic [10]. The player is confronted with an emergency situation in which their spaceship is being attacked. A non-player character rushes in to provide mission objectives. While the ship is being breached, a particularly novice player can wade through 15 minutes of player narrative-disrupting instructions on equipping their character and leveling up. Meanwhile, the player character's comrades are battling and being slaughtered. The player's narrative reads, *I awoke in the middle of a large battle; I promptly attended a workshop on equipping a laser gun and leveling up my character*. The player does not report the necessity of training, just the sequence of tasks they accomplished to move the story forward.

For this reason, it is important to remember that players are perpetually writing the story of their play experience, and as such, their expectations are often fed by the expectations of cohesive, engaging narrative. Games are experienced narratives, even when their narrative is very light. Players report game actions as stories, sequentially organized even if that sequence was not explicitly structured by the games author. This is clearly true of digital games for which narrative is an essential lure, but it's also true of all manner of games. Players of Hopscotch or Four Square report their player experience as a series of events. Even players of kissing games do so [11].

At the same time, for narrative heavy game designs, level designers are contributing the elements that in aggregate comprise the entire story. Level designers are the action authors, architecting the actions that when compiled move the story forward. At its simplest, level designers are plotting the path between plot elements. They provide the challenges that result in the player moving between designed plot elements. Ultimately level designers are creating the interstitial plot elements, the actions that players report as their actions and accomplishments.

Herein is the challenge for designers. Not only are players experiencing a narrative they write as they play, but designers and writers are also seeking to construct a narrative. This is sharply contrasted to other media. Readers of books do not report both the narrative of their book and their actions. Readers do not report, *I read the first sen-*

tence and it said Call Me Ishmael and then I wondered, who is Ishmael? Film audiences do not report books by starting with their trip to the theater, articulating the refreshments they purchased and then interspersing their reactions to the film with the events on screen. They do not report when they crossed their legs during the movie. Even players of analog games, save for role playing and alternate reality games, are unlikely to communicate both the player and player character action while also reporting the play narrative.

Consider the following two narrative samples of player character game reports:

> I was the boot and I passed go 4 times before I was able to purchase Park Place. I landed on Baltic Avenue and had to pay, but that was okay because I collected the money back from the community chest. Eventually I won by owning the most real estate and bankrupting the other players

> I was walking with a guide when 3 wolves attacked. I shot the wolves, they were hard to shoot at first, and then I climbed into a cave. I explored the cave for a while before I came upon a wild bear that was really hard to kill. After climbing some other obstacle and doing some really acrobatic stunts I found the first clue that set me on my adventure.

The first description is provided from a fictional account of playing Monopoly. The second is provided from a fictional account of playing Tomb Raider 2. These are both narratives of the experience and at the surface they both read as similarly complimentary reports of action. They are a sort of plot for player responses to the challenges presented in game. However, one is the product of a structured narrative the other is the result of a game system that has no specific narrative script.

Monopoly [12] is a game system, with a basic algorithm that is balanced between trips around the board and the element of chance. It has theme and rhetoric and tells a varied story of sorts about real estate monopolies and financial systems. But the story is baked into the game system. Monopoly was not designed to tell a specific story, but instead to tell the same basic rhetoric in each play [13].

The Tomb Raider II game[14] and related franchise, on the other hand is a playable narrative experience. There is narrative writing behind the game and the player's actions rest inside this narrative. In games like this, the levels rest between complete stories that follow narrative arcs and endeavor toward Aristotelian structure. In such cases, there are two narratives at work in one experience. There is again, the narrative of the player's experience – the actions they take in resolving each of the games problems. At the same time the player is contributing toward the exposure of the designer-writer narrative. This is the narrative that shares attributes with the other narrative traditions – books, film, theatre and others.

In terms of the hauntology there are many specters floating about both the player and the designer. For the player there is the ghost of narrative structure, which lures the player into wanting to frame their experience into a narrative arc or 3 act structure as so many of the stories they have experienced have offered in the past. This siren call exists, even when a such structures aren't there, because they player has failed to follow design parameters or when the functional necessities of operating in a plays space necessitate tutorials, evaluation and explanation. For the designer, the specters are the projected path of player performance, a speculation of a future the designer can never full see. There is also the ghost of past narratives, which may be explicitly or inadvertently references, but still cas4t their shadow on the constructed experience. Each, player and designer, are also haunted by each other asynchronously – as design imagines and expects, and player reads those expectations and travels that path plotted by the designer.

It is the interplay of these two actions, the actions of the author in writing the narrative and the actions of the player in acting within the level that define the contemporary challenge of level design and its ghosts. Level design does not operate outside the authored narrative, it exists between them, allowing both game author and player author to meet. Somewhat appropriately, they meet at a nether space of illusion.

The Illusion of Control

Game designers and authors frequently reference the illusion of control. In short, the illusion of control describes the false impression game designers provide players. A player may, for example, think they are making meaningful choices in a game when by design, their choices are actually meaningless. Choose to go right or choose to go left, each path will bring the player to the same location. The illusion of control is often described as a tactic for player engagement. Players will, as the former logic goes, feel more engaged because they will believe in their agency. Players are engaged by an illusion, or playing among the penumbra of core set of choices.

Interestingly, this tenet goes both ways. Players are also authoring their experience. Players can choose to accept the illusion of control, in much the way audiences of a magic show commit to fictions to enjoy the experience. Yet, like magic shows, players can choose to subvert the performance. Players are not subject to the experience authored by designers and writers; they commit actions to perpetuate them. Players subscribe and commit through action - they do not merely watch. Beyond watching, they must choose to accept and act on provided game verbs and challenges.

When players fail to accept or understand the illusion, a variety of level informing experiences occur. First, and perhaps most disastrously, players can simply get stuck. As an example, in Halo, very early in the experience the player witnesses non-player characters in the player's squad scale a wall. The player can't scale walls. The result

is unsurprisingly a wide variety of forum posts and general confusion about where the player is supposed to go next.

From this perspective, two illusions have come undone. First, the illusion that the author, here a level designer, can control player actions dissipates. What dissipates is the illusion that the designer produced path controls the player. Unlike a film, that affords cutaways, detail shots and other devices that serve to direct the viewer's gaze – these devices are not present in the aforementioned Halo level. The result is players who attempt unsuccessfully to scale a wall they can't. The illusion is comprised of evidence from the world. This evidence comes with assumptions that the player can do what the non-player characters can and that following the non-player characters serves as a guide for where to go next. This impression comes from the experience of playing former games and from the fundamental assumption that the game would not present a player with an unsurmountable challenge so early in game play.

The second illusion to come undone is demonstrative. The level demonstrates abilities the player does not have. The player witnesses a possibility space and pursues it, only to discover those possibilities are an illusion. The illusion is that a player can control their character to do what non-player characters can. Players can't and in so discovering the level designer has broken one of the first rules of magic – never reveal the trick. Getting stuck, in this case, and the resulting solution (go another way) is tantamount to seeing up the magician's sleeve and revealing a collection of tells that relegate magic to mere devices tucked unceremoniously up the designer's sleeve. Worse, this happens early in the game and leaves the player with an unintentional anxiety.

This is a problem that reveals itself in every designed moment that leaves player wondering – how was I supposed to know that? Such issues in level design are not merely oversights, they are illusion shattering. They take the magic away. They disrupt the narrative because they disrupt the illusion of control. The player is constructing their play narrative, but abruptly there is a break in the story. The story ceases to make sense. The flow is off. The experience is incorrect. More than a McGuffin, more than a cinematic departure or a software bug, such experiences have players walking off the narrative edge of the world. These are moments the illusion of a ghost, is revealed to be mere trickery, or phantasmagoric.

It is, from player experience, worse to have an intentioned narrative break than it is to have an un-intentioned one. A bug is the result of variability, but moments where the player is left thinking they should have understood something and didn't are the result of intentioned design. It's not that the player broke the experience; the experience was meant the way it occurred and simply doesn't work. It is the difference between accidently hitting someone and purposefully taking a swing. In terms of traditional level design, these abrupt breaks are the moments when the designer reminds the player that they are the author of the experience, not the player. To further the analogy, the author of the experience is not only taking the illusion away, they are steering the player in a wrong direction.

There is however, a silver lining in understanding these occurrences. A good level designer can also understand such moments as opportunities. Much like the magician who feigns a mistake to demonstrate more magic, these abrupt breaks can be employed to make critically valuable level design experiences. From the philosophical perspective of Derrida, they can serve to give body to the specter.

An apt example of such design rests in the game, Eternal Darkness [15]. A horror game by narrative convention, the game actively breaks the fourth wall by addressing the player (not the player character). The game warns of corrupted game save data, shows a software crash screen (aka the blue screen of death) and goes black as though the game console's power has been cut. The game feels haunted by critical failures. In short, it adds its narrative specters to the experience of the player. The player's tensions are heightened as they feel the anxiety of not knowing what happens next, and of feeling, a bit, like there may be a ghost in their machine.

Critical Level Design

Critical failures are failures of essential elements of a system. When a car's engine fails, it is a critical failure. To be critical, one must either be essential (as in a critical leader for an organization) or full of careful, examined critique. Critical Gameplay [16], is a term used to describe games that aim to critique conventional game play as a means of critical evaluation. The games intentionally fail to meet typical expectations and in so doing, raise new questions for critiquing those expectations. From 2009-2016 the Critical Gameplay games provided critique of game conventions as varied as enemy stereotype, affection in games, and the value of seeing the world. The games were lauded and awarded by a variety of critics and shown in well regarded venues like Singapore's Art-Science Museum and Brazil's FILE Festival.

Critical level design comes from this notion of critical gameplay. What if level design not only acknowledged the relationship between player and author narrative, but it actually embraced it? This offers a third dimension of level design. This is dimension that lives between the space of player action and author decision. Unlike many games, which allow player actions and the scripted author narrative to exist in parallel, such level design affords for clever and engaging consequence. They take the magic beyond the parlor performance toward mind-bending, ambiguously real experiences.

Consider, again, the experience of Eternal Darkness [15]. In this psychological horror action adventure game the player investigate a murder. During gameplay, rather unexpectedly, the player is told that there is a problem saving their game and their data is corrupted. The result is a heightened level of tension. A level of tension that exists within the game, but persists within both the player character's world and the player's world. It is analogous to that

unexpected knock on the door that jolts Ouija board players. Even if the knock is revealed to be the pizza delivery person, the tension and engagement persist. The reported technical glitch in Eternal Darkness is a fake, but it's one that strongly effects the level's designed experience. It does so, by acknowledging the specters that haunt the experience. In this case, they are the fear that some portion of the designed experience is real. Or more practically, that real consequences, such as losing progress in a game, are really happening. They nod to a ghost to imbue it with presence.

There have been a variety of games that have employed some version of this experience. With Zack Gage's Lose/Lose [17] players destroy spaceships which actually represent random files on their hard drive. Destroying a ship destroys a file, adding a new level of critical anxiety to the destruction of virtual ships. In the Visit [18] players use their conventional platformer expectations to disastrous ends. When the player squashes a crab in their way, they are jailed and must complete the same level again, facing the scorn and ridicule of being a notorious murderer. Steamshovel Harry [19] lampoons the experience of tutorial heavy games by setting the player up to expect a small succinct player control tutorial. 15-minutes in, when players are still learning interplanetary physics before ever starting play, they catch the joke.

This is not to say that level design via critical design methods is appropriate for all scenarios. Similarly, like magic, its overuse becomes its demise. Where once devices like novel fonts or frame wipes were interesting, their overuse can quickly become the Comic Sans typeface or star wipe of design practice. Critical level design is then more an opportunity to ask the question about how player action and authored narrative may be explored in unison. It is an appropriate design practice as practice. It is a way to think critically about assumptions level designers are making and where those assumptions intertwine with player assumptions. Perpetually acknowledging the specters of game design may move the experience from an engaging illusion to discomforting cacophony.

The Recursion

While critical level design affords for the occasional epiphany moment that hyphenates a game experience, it is likely not the solution for sustained level design. A game chockfull of critical level design is more likely to feel like an Avant-garde arrangement appropriate to esoteric audiences, than becoming the popular game of the year. Instead the appropriate solution and design technique may be to understand the interrelationship between the two narratives –player action and author action.

Until now in this writing level design has been discussed as two parallel paths. The player makes actions designed into the game. The author makes global decision about how those actions aggregate or result into a complete narrative. The notion is that there are two perspectives, that of the architect of the experience (the game or level author) and that of the user (the player as author of their actions). The game, and more specifically, the level is the place in which these two meet.

However, the game and level are not the only place in which game author and player author meet. They also meet in gamespace. Gamespace is the greater area around the game. It is the space that persists when the digital game is powered down. It is the space that pervades social media, meme generation, and ultimately other games. The phrase, "your princess is in another castle", has meaning to players that extends beyond the game in which it first appeared [20]. Its meaning includes a myriad of emotions and experiences, from the disappointment of knowing your game goal has only partially been met, to conjuring the specter of possibility that the game goal may not be achievable at all. That one phrase persists as a meme and when embed in other games conjures all references to it.

In the context of meme's interplay of storytelling mediums, and the reference both conceptually as hauntology and literally as ghosts, it's important to reference the phenomena of creepypasta games. In short, creepypastas are ghost stories that are born on the Internet, to which creepypasta games owe reference or subject. For more detail, it is best to read Crawford's analysis of glitch horror and the ways in which real-world anxieties around technology haunt the narratives and scenarios of Internet born ghost stories [21].

Gamespace is the specter by which all game authors are haunted. No game exists in a vacuum and no level design decision stands without previous reference. The problem is that every player does not have the same references from which to draw. Players may know that a ray of light cast on an object may indicate a quest. Players may not know specific control schemes or assume certain textures imply a scalable or unscalable wall. However, the reality is that as the length and variety of game experiences continues to grow, so to do the variety of references. Gamespace is not a narrowing space, it is an expanding one, more akin to an ever expanding ray of light than the limited cannon to which it is sometimes ascribed.

This is the challenge level designers struggle with frequently. If the player has played a certain game, a level designer can expect that they know something about the level. If the player has not, then the level becomes harder. Likewise, if the player has played a certain game, the level may be too easy or too similar. This particular challenge is not limited to games, as cinematic and narrative conventions in film and books have also struggled with this. In reality, humanity lives in a sea of reference [7].

Yet there is something that distinguishes games from other media, beyond human computer interaction and user experience. It is the action. It is the doing. The player acts on the narrative and reacts to the reference. Each player brings with them their own references, or their own gamespace, which they share formally or informally with other players. Players play with ghosts, and designers conjure them.

Since this game space exists and persists beyond the game, as forums, as gameplay videos and as social media memes, the level designer is at once designing from their gamespace and responding to the gamespace of their community of players. Level designers are balancing the expectations of their genre, game type, narrative style and aesthetic. The level is an apex of these elements and more, which are constantly effected by their referential histories. These histories include interaction standards, problem solving strategies, and even cross-media conventions. While violent games like God of War: Chains of Olympus [22] can aptly use the weight of a victim's dead body as a puzzle element that same level design would be grossly incongruent with the themes and referential history in Animal Crossing [23].

Good level designers are aware of this interplay. They understand the methodologies to balance the gamespace experience with the game experience. They know which ghosts to call and are aware of what is mostly like to haunt their creation.

Likewise, players understand how to conjure the appropriate references from their gamespace to the player action experience. Effective players do not seek level cues in 3D Role Playing Games that they learned in simple 2D platformers (unless there is homage built into the game). This is where level design becomes a recursion.

Extrinsic gamespace informs the narrative in two distinct ways. First it provides the initial input that propels expectation in the level. Player narratives begin with a fundamental set of expectations in much the way a linear story is framed as Hero's Journey or Aristotelian Structure. It is these traditions that discern a tragedy or comedy, the one ends in death, the other in marriage. In games, everything from preliminary reviews, Internet chatter, and Twitch streams effect the player before they ever engage in the game, and after they have.

That foundational player expectation, the desire to put a linear structure to events, initiates the player's goals and framing of the experience. The level designer knows this and must act upon such assumptions. The level designer is consistently aware of the conventions of their environment, including those that come with gamespace reference.

Secondly, the gamespace narrative is informed by the narrative reporting on the game. The player does not merely play the game, they report to themselves or others the events of their play. This is typically an omniscient report which moves between player as in-game avatar and player as user. The result is gamespace narrative that includes reflections on how the player felt and what the player did. Level designers consider this, in practical terms as working to frustrate or facilitate the player. It also includes fundamental questions about how player actions integrate into the larger narrative of an entire play experience.

From this lens, level design is constantly reflecting on itself like a hall of mirrors, but also feeding its next step based on previous input. As such level design becomes a complex function of player narrative, game narrative and extrinsic gamespace. The result is that each level becomes a miniature narrative encapsulated within a larger narrative which in itself exists in greater narrative contexts.

This is the recursion that creates effective level design. The level designer is aware of the narrative constructed by the player in solving the challenges placed before them. The level designer incorporates that narrative to propel the greater game narrative. Each of these is received and evaluated respective of the greater game space. None of these elements exists independently; instead they are a function of constant interplay, as the experience of prior level within the same game effects the reception of subsequent levels. Solving a puzzle on level 2, makes a complex puzzle on level 9 a bit more apparent but the more complex puzzle is only interesting if it likewise propels the greater narratives.

The player's story is a result of a series of recursions, between level design and the player's own gamespace. Their ability to meet the challenges of the game is informed not only by their extrinsic experiences, but by their continued engagement and commitment to the actions of the game. The player must proceed through the loop of playing and learning to achieve their goals within the game. Yet, as they learn, they become a different player that must be met with more substantial challenges and whose gamespace has expanded to include the previous experiences provided by the level design.

To round out the analog to hauntology, the specters that haunt the designed experience only exist when they are acknowledge. Their substance comes not only from the shadows they cast, but from the acknowledgement that those shadows exist. Moving toward or away from a ghost, is acknowledgement of its presence and it's power.

Such play is subject to a narrative and experiencing constellation. This narrative and experiential constellation allows the level designer to create a complex and satisfying experience from the conventional feedback loop of player and game. The result is a player population constantly seeking a better iteration, a new solution from the same basic input, but like a recursion, at least slightly better than the last. They are chasing shadows which must grow to fill the space of the last one cast, or ghosts that grow larger by the balance of light than by the ephemera of their existence.

Acknowledgements

This research was supported in part by the generous funding of the John S. and James L. Knight Foundation.

References

[1] Murray, J. H. (2017). *Hamlet on the holodeck: The future of narrative in cyberspace*. MIT press.

[2] Laurel, B. (2013). *Computers as theatre*. Addison-Wesley.

[3] Alexander, B. (2017). *The New Digital Storytelling: Creating Narratives with New Media--Revised and Updated Edition*. ABC-CLIO.

[4] Koenitz, H. (2010, November). Towards a theoretical framework for interactive digital narrative. In *Joint International Conference on Interactive Digital Storytelling* (pp. 176-185). Springer, Berlin, Heidelberg.

[5] Jenkins, H. (2004). Game design as narrative. *Computer*, *44*, 53.

[6] Poggi, C. (1992). *In defiance of painting: cubism, futurism, and the invention of collage*. Yale University Press.

[7] Derrida, Jacques. "Spectres of marx." *New Left Review* 205 (1994): 31.

[8] Davis, C. (2005). Hauntology, spectres and phantoms. *French Studies*, *59*(3), 373-379.

[9] Fisher, Mark. "What is hauntology?." *FILM QUART* 66, no. 1 (2012): 16-24.

[10] Star Wars: Knights of the Old Republic. Bioware, LucasArts, 2003.

[11] Sutton-Smith, Brian. "The kissing games of adolescents in Ohio." Midwest Folklore 9.4 (1959): 189-211.

[12] Magie, Lizzy. J. "The Landlord's Game-board." U.S. Patent No. 748,626. 5 Jan. 1904.

[13] Orbanes, Philip E. Monopoly: The World's Most Famous Game--and how it Got that Way. Da Capo Press, 2007.

[14] Tomb Raider II. Eidos Interactive, 1997.

[15] Eternal Darkness. Sanity's Requiem. Silocon Knights. Nintendo Game Cube. 2002

[16] Grace, Lindsay D. "Critical gameplay: designing games to critique convention." Proceedings of the 20th ACM international conference on Multimedia. ACM, 2012.

[17] Lose, Lose. Zach Gage, 2009. http://www.stfj.net/art/2009/loselose/

[18] The Visit. Fietzek, M. Hummel, B., Gross, I. , 2012.

[19] Steamshovel Harry. Project Nova, 2013

[20] Super Mario Bros. Nintendo. 1985

[21] Crawford, Emily E. "Glitch Horror: BEN Drowned and the Fallibility of Technology in Game Fan Fiction." *Transactions of the Digital Games Research Association* 4, no. 2 (2018).

[22] God of War Chains of Olympus. Sony Interactive Entertainment Santa Monica. 2008

[23] Animal Crossing. Nintendo. 2012

Author Biography

Lindsay is Knight Chair of Interactive Media and an associate professor at the University of Miami School of Communication. He is Vice President for the Global Game Jam™ and Vice President of the Higher Education Video Game Alliance.

His work has received awards and recognition from the Games for Change Festival, the Digital Diversity Network, the Association of Computing Machinery's digital arts community, Black Enterprise and others. He authored or coauthored more than 50 papers, articles and book chapters on games since 2009. His creative work has been selected for showcase internationally including New York, Paris, Sao Paolo, Singapore, Chicago, Vancouver, Istanbul, and others. Lindsay curated or co-curated Blank Arcade, Smithsonian American Art Museum's SAAM Arcade, the Games for Change Civic and Social Impact program and others.

He has given talks at SXSW, the Game Developers Conference, Games for Change Festival, the Online News Association, the Society for News Design, and many other industry events.

Between 2013 and 2018 he was the founding director of the American University Game Lab and Studio in Washington, DC. From 2009 to 2013 he was the Armstrong Professor at Miami University's School of Art. Lindsay also served on the board for the Digital Games Research Association (DiGRA) between 2013-2015.

From real to virtual embodied performance - a case study between dance and technology.

João Martinho Moura [1], Né Barros [2], Paulo Ferreira-Lopes [3]

[1, 3] CITAR, School of Arts, Universidade Católica Portuguesa, Porto, Portugal
[2] Balleteatro, Porto, Portugal

Abstract

Co:Lateral is an artistic project that aims to explore the means offered by digital technologies in performance. We conceptualized, developed and implemented a digital artifact, resulting in a digital performance based on the structure of realities born of a body and its double in movement. In this project, authors carried out a research and experimentation process in close collaboration with a contemporary dance company, in order to design the relation between real and virtual body and extend it in a relationship of intimacy with interactive virtual reality. The performative discourse that resulted from this dialogue allows a poetic impulse that evokes moments of the death of the swan immersed in an immaterial space of light and projection: a phantom of a dance file that now returns to a reality of illusory imprisonment. We will make a general introduction to digital art and interactivity, introducing the concept of digital performance and its contextualization in digital and contemporary art.

Keywords

Digital Performance, Virtual Reality, Dance, Embodiment, Cyberspace, Media Arts.

Introduction

William Gibson was the first to use the phrase cyberspace in 1984, in his futuristic novel Neuromancer [1]. Since then, there has been much debate about how this medium should be defined and conceptualized. We will make a general introduction to digital art and interactivity, specifically associated with the field of artistic performance. We approach the concept of digital performance and its contextualization in digital and contemporary art. In the following sections, we present the development of the Co:Lateral performance (figure 1) and its different components: a) the body traced in time, b) body extended in depth, and c) sound development.

Digital art and interactivity

We can define digital art as art produced in digital environments, characterizing itself as a virtual process carried out through software. The term digital art is applied to contemporary art, which uses methods of production using digital media [2]. Kuspit states that, in this area, the importance of "code creativity" goes beyond the creativity of the image, being the central element in artistic creation. Marcos, Branco, and Carvalho define digital art as art that explores the computational environment as a tool and material for creation [3]. Interactivity is present in digital art when it is possible to create a dialogue between the spectator and the artistic creation [4]. Thus, an artistic creation that involves interactivity allows the existence of communication, based on a critical and reflexive action. The interactivity becomes, therefore, a tool for the artist, being a characterizing element in the relation between the artist and the creation, and the relation between the creation and the spectator that experiences it [5].

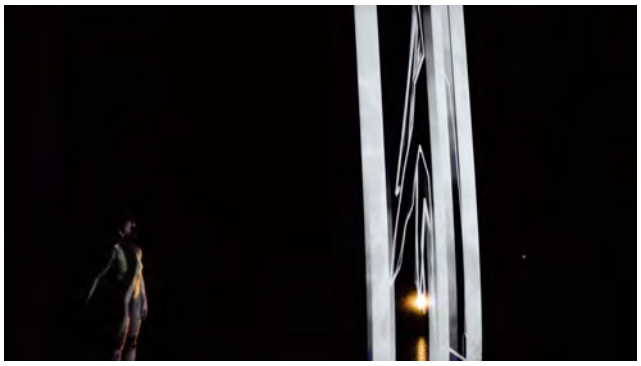


Figure 1: The Co: Lateral performance, presented at the Teatro Virgínia, Torres Novas, on February 24, 2018.
Photo: Raul Sousa. (Balleteatro)

For Ascott, the concept of interactive art encompasses diverse adaptive practices, media, structures, and environments, allowing the action of the subject who experiences the creation, participating in and interacting with the work [4]. For the authors, the concept of digital art is closely linked to the concepts of interactivity, simulation, and artificial intelligence. The development of systems, structures, and strategies that mobilize feelings and emotions in the viewer, promote the experimentation in the multimedia and hypermedia environments and the subsequent acquisition of meanings. The Co:Lateral project, continuously being developed since 2016 until now, was originated by the NUVE performance [6] (Fig. 2), initiated in 2008, from the same authors. In both projects,

interactivity is a relevant factor, since the entire creative process translates into an artistic output of the conjugation of the real process, the performer, who is exploring space, its real and physical movements, and digital space, which is transformed by these movements.

Figure 2: Essays with Né Barros and João Martinho Moura, for the piece NUVE, in the black box of Balleteatro (2009).

Digital performance

Several contemporary dance companies in Europe are experimenting with new ways of presenting choreographies and movements using digital media [7]. When a performance is conceptualized, there is a process of mediation, translation, and regulation of the inner and outer space, the relationship between ourselves and others [8]. In a digital performance, where technologies play a relevant role, they can be seen not as tools, but as filters for our meetings with others or with ourselves [9]. Here, performance is supposed to involve attention, perception, and reflection, translated so that there is space for a change, an evolution, in the sense that the performative practice is a partial and temporary redefinition that consists of attempts to do something new at the moment. For Saltz, performance, such as dance and theater, is a visual and auditory event, but above all, corporeal [10]. For Dixon and Kozel, performance translates into an emerging state, a deep interconnection between reality and fiction [11][9]. For Fred Forest, art maintains close relations with reality and seeks to use its influence to modify its perception [12].

Regarding the definition of the concept of performance, while Schechner [13] sees it anthropologically, arguing that it embarks on all human activities, Saltz draws a line that defines performance as art, as the action of acting before an audience, and staged performance, where the actions performed in that context are aesthetically significant. The digital term, when applied to performances, is seen as an instrumental facilitator concept, which offers its users a series of tools with interactivity, sensitivity, and subjectivity that, due to their theatrical effects, become characters on stage [11][9]. A digital performance attempts to transcend the division that seems to exist between the underlying concept of performance and its implementation and interpretation, an attempt that is facilitated by digital technologies, creating a virtual world where the real is experienced, transcending its physical limits [14]. According to Dixon, the use of digital technologies in performances is generally referred to as 'digitally manipulated content' and 'technical'. Candy and Edmonds argue that the exploration and development of this type of performative art has revealed that the relationship between artist, his work and the public has become unpredictable and malleable, influencing both the creative process and the control exercised over the same process [15]. Digital performance places special emphasis on interactive and real-time performing arts such as dance, theater, music, and circus, which makes performative arts and digital art increasingly integrated [14]. Digital technology associated with the digital performing arts raises issues related to the notion of identity, origin and temporal linearity, which transforms production into reproduction [16], but the virtual and the real do not oppose but converge, since the experience of the virtual is real and as we inhabit this reality, we are even more human [17]. William Forsythe presented in 1999 a pioneering tool, in CD-ROM format, developed in ZKM, for the analytical vision of dance, using technologies of overlapping of graphic elements on an image with a moving body, where there was a follow-up of positions of the body, generating dashes, points over time [18]. Digital performance, according to Skjulstad, Morrison, and Aaberge, is concerned not only with the application of technology but also with its potential for creative expression and is therefore considered the most active field of digital performance [19]. Jacquelyn Ford Morie refers that many critics of virtual reality describe that participants enter the virtual world and leave their bodies 'behind'. However, the author argues that the participant's body is synchronously incorporated into the virtual self that enters the world within the screen, which is created from what the body experiences [20]. That results in a visualization, an increasingly imperative aspect in a perspective of the public sharing of the result of objects that, from a geographical point of view, incorporates a certain invisibility in the production of art or artistic expressions [21].

Development and representation of the body in Co: Lateral

In the next sections, we will present the developments in the construction of the Co:Lateral performance.

The body traced in time

In Co:Lateral, the image capture process is performed through a set of depth cameras, and tests were performed with various camera models [22] [23] [24], and software developed specifically for the interactions, using *openframeworks* development libraries [25], *Processing* [26], *OpenCV* [27], *Unity3D* [28], applying various computer vision technologies, such as background subtraction [29] and the optical flow technique [30], with

the aim of capturing with good definition the silhouette of the performer, and the directions of movement of parts of the body, respectively. This contour is a set of sequential x and y coordinates, which form a closed polygonal blot corresponding to the figure being captured. Locations X and Y of these points were exploited in order to apply techniques of generative procedural movements, with selective randomness, using algorithms of controlled random generation [31]. It is, therefore, a generative drawing that follows the original silhouette. Although different from the original drawing, there is the notion of preserving the human form. Through the Lucas-Kanade algorithm [32], the movement acceleration of the body's parts is detected, thus enabling a better perception of the movement in real time. Throughout the presentation of the performance, there are different visual moments. The contour of the silhouette attracts some points. This attraction causes a greater concentration of points along the contour limits, which makes the concept of the human figure to be perceived during the simulation [33]. The movement of these points, although largely influenced by the attraction of the figure, is also random [31]. Since the silhouette of the figure is a sequential and structured set of points, graphical explorations can then exist from these points, where a set of white straight lines arises from silhouette points and ends at a randomly chosen point in space.

crucial to the body's experience, performance, and training in the improvisation of dance and movement. Blom and Chaplin [1988] describe kinesthetic awareness as a primary perception and self-awareness of the moving body [34].

During the process of developing and testing the Co:Lateral performance, these techniques have been tested several times and truly explores the possibilities of the application of digital art in dance in its various dimensions, such as space and time, suggesting and reinforcing that time and context of the piece are more than framing dimensions for the art experience [35]. An environment in which the authentic or inauthentic expression of the persona requires that we distinguish between context and transcendent authenticity [36], and the necessary prototypical nature of such creations, situated as they are in a field of interactions in which continuous connection is desired [37], it converges to the part Co:Lateral the desired fluid character. According to this concept, the computer, as a random access memory device, allows us to 'incorporate' the capture into a non-linear format, allowing not only a structural approach to how this data can be retrieved but also the ease of computing new recombines that result in the generation of new data that has never actually been recorded [38].

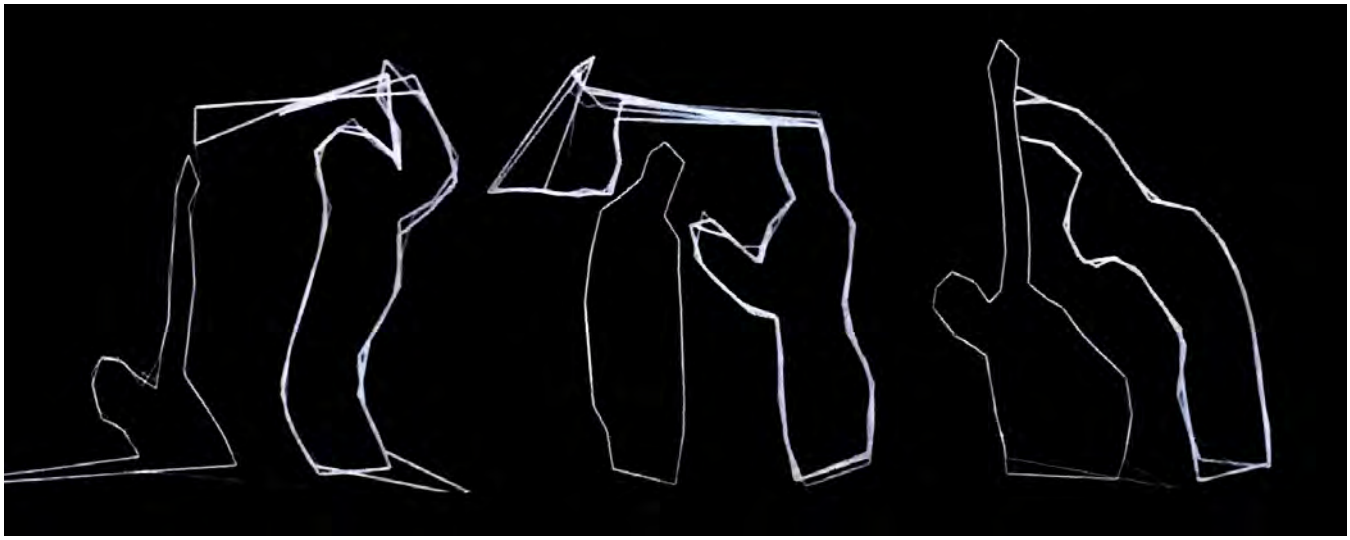


Figure 3: Virtual doubles in Co: Lateral.
The same performer interacting with himself in space and time (2018). Photo: Raul Sousa (Balleteatro)

One of the most peculiar moments of the performance is the simultaneous visual representation of several different points in time. Here time is explored in dance and space. We keep a few seconds of movement that occurred immediately in previous moments, and we confronted the performer with them in the sense of having a kinesthetic awareness of interaction (Figure 3). The kinesthetic sense is recognized as

The body extended in depth

The emerging work of dance performance in virtual reality began to develop new types of practice using specifications of virtual technologies [39]. The images and scenes in Co:Lateral are triggered by the movements of the performer, using virtual reality technologies. Nowadays the definition of virtual reality is associated with the use of equipment that is placed in front of the users' eyes, called HMD (head mounted displays). One of the inventors of this technology

was Ivan Sutherland, who stated in 1968 that the fundamental idea behind the three-dimensional display is to present the user with a perspective image that changes according to their movement [40][41]. Since then, and especially in recent years, virtual reality technology is evolving rapidly, making the definition of virtual reality precocious regarding specific devices, as they may fall into disuse in a short time [42]. The base configuration of the Co:Lateral piece provides for an audience-level virtual reality experience, in the midst of total darkness in a showroom, with a transparent display between the audience and the performer. This screen is not seen in the dark but reacts if images are projected, causing an illusory effect that the image is floating in the air. The performer and the audience come in the same image, and the reflex of the performer's movements is projected on the transparent screen, a kinetic environment with which the performer is in continuous body dialogue with the image in front of him. One of the central questions in cognitive science is how we experience ourselves in a body that interacts continually with the environment, and experiencing our self as being within a body and more specifically a body that feels 'ours' which moves according to our intentions, obeying our will [43]. In Co:Lateral the three-dimensional body is captured in real time, using multiple cameras, using point cloud technology [44].

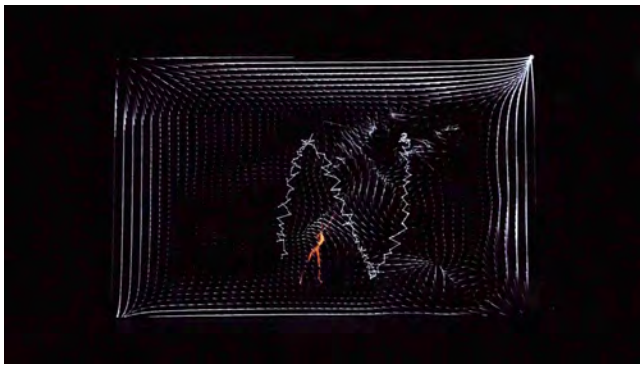


Figure 4: The movement of the performer's amrs, captured over time, and a generative trait has a letter N (of 'no'), drawn by the performer Sónia Cunha. Photo: Raul Sousa (Balleteatro)

In the first visualizations of the piece, only two-dimensional representations of the moving body (figure 3) are projected, but in certain specific moments, we turn to the Z coordinate, which allows us to obtain more information, such as the body part closest to the camera. Jaron Lanier was one of the first artists to use gestures in electronic art with a device called Z-Glove [45], using the hand in virtual environments to manipulate virtual objects that appeared in an image, suggesting, at the time, a wide spectrum of possibilities of representing objects in virtual environments of interaction. In figure 4 we see a moment in which the performer develops, literally in the air, a gesture that materializes the letter N (of the word "no"), projected between the performer and the audience. In Co:Lateral, throughout the performance, the gestures are analyzed continuously, and specific scenarios are taking into account for the interactive narrative of the piece. Figure 5 shows an important moment, where the performer gently 'touches' many white vertical bars, bars initially well marked, rigid, symbolizing a prison, but which, after interaction, project and react smoothly to virtual touch, immaterial, in fact, but real in the imaginary of the audience. With time and stronger movements, the bars end up forming a volumetric image of the moving body.

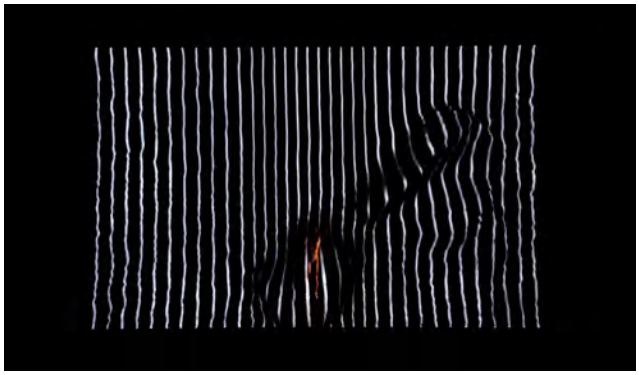


Figure 5: The performer body is represented volumetrically in a curtain of white lines. Photo: Raul Sousa (Balleteatro)

The representation of the body is often divided into two aspects: body schema and body image [46]. In addition to perceiving the world, we also perceive ourselves and perceive the effects we have around us. We can, therefore, differentiate between two types of self-attribution: body property and agency. Essentially, we can define the property of the body as the feeling that something is part of our own body, for example, knowing that my arm is mine, being the agency, and on the other hand, the sensation of directly causing changes in the environment [46]. In figures 6 and 7 we present the volumetric body under different capture points.

The Sound in Co:Lateral

A sonority was developed, present throughout the performance, with the concern of establishing an aesthetic correspondence between the images developed. We out-encoded sound algorithms, synthesized in SuperCollider software [47]. Besides, real-time sound algorithms were created and triggered at specific times throughout the narrative, or triggered live by the performer's movements. These sonorities were developed in Pure Data software, whose patches were incorporated in the performance software, using the ofxPd library [48] and *libPD* [49]. The development of this particular sound benefited the performance, due to its reactive nature.

Conclusion

The Co:Lateral project is characterized by a permanent duality in the dialogue it establishes with the public. The duality between the real image, the artist who is physically

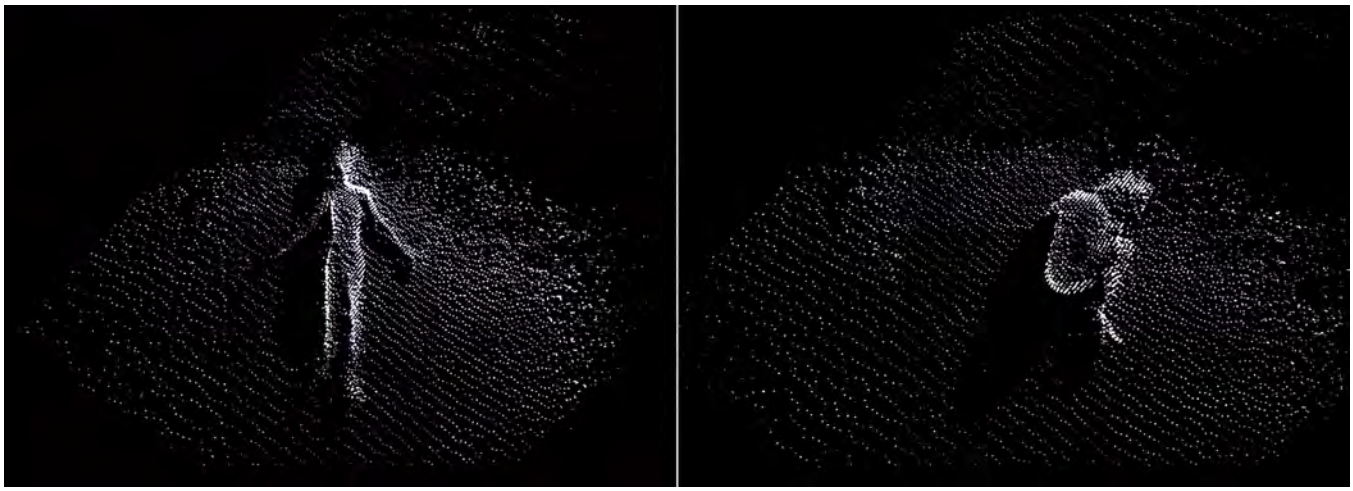


Figure 6 and 7: Depth representation. The body is presented in volumetric points. Photo: Raul Sousa (Balleteatro)

present on the stage and the virtual image that is being projected. The performance's configuration presents the projected image on a transparent canvas, which makes in the dark, the virtual forms are appreciated in an almost holographic format, between the performer and the audience. The use of images or light systems is a normal technical procedure in dance. The application of images, projected on the stage, allows the choreographer to create the correct visual environment for the transmission of the idea at work. This technique allows the placement of certain scenographic environment that would be difficult to build physically on the stage.

With the increasing use of projection techniques on stage, we observe a relevant factor to consider, the attention that the viewer makes available to the various visual elements on the scene. In this context, the problem arises that Katie Mitchell called 'attraction of the screen' [50], being the projected image a very present component in the performance. In some informal inquiries to the audience shortly after the various presentations, made last year, some viewers only noticed the correlation between the dancer and the virtual image in the middle or at the end of the performance. Throughout the development, we chose to put moments without visual projection halfway through the performance, slightly increasing the light on the stage, informal breaks without technology, that configure a better perception of the spectacle by the public. Digital technologies are constantly evolving, and their growing exploration in performance has been very prominent. The constant emergence of new and advanced motion capture devices, combined with the progressive power of real-time computational processing, offers the possibility to exploit these technologies for visual, auditory and kinetic artistic creation.

The dialogue between digital art and performance allows us to generate a communicative space that challenges the limits of choreography and recaptures gesture and movement, creating a space for experimentation with new performative possibilities. In all the procedural regime in which the interactivity is translated, between the performer and the digital creation, we can highlight a potential and singular gesture. In the device in which the performance happens, the gesture acquires a unique impact in its expansion and displacement. The micro, minimal dimension of a given action, acquires a determining function in the narrative construction of the performative object. It materializes, thus, the impossibility of return, as well as, the degree of visibility that becomes practically total. The dimension of the imperceptible, inherent in much of the action on the scene, shifts exclusively to the metaphysical dimension of poetics under construction. What is done happens without flight or absence, but it is precisely for this reason that the fragility and error of the gesture in progress are exhibited. We are never as fragile as in a place where at our minimum gesture everything is exposed. In part, Co:Lateral, turns out to be a narrative about the impact of existence: it makes other plans and segments of the gesture exist; is an absolute presence as an immediately visible consequence of the gesture.

On the other hand, Co:Lateral gives us the double, gives us the memory, gives us the life and the infinite expansion of that memory. Although the play calls death and imprisonment through images, visualizations and even music, it is the complement of the life in question: the presence and its eternal repercussion. The performative comes to exist only in this dimension of production of virtualities where they play expanded and displaced forms of the gesture and, above all, of the generative gesture. The concentration in each point of the body, which the interaction between body and technological device promotes, realizes and renews bodily consciousnesses, gives new life to the gesture.

Video excerpts from the Co:Lateral performance can be viewed at the following link: http://jmartinho.net/colateral-isea-publication/

Figure 8: Final interactions in Co:Lateral. Photo: Raul Sousa (Balleteatro)

Acknowledgments

We thank the entire team of contemporary dance company Balleteatro for all the support in the presentation of the shows. To the CITAR (Research Centre for Science and Technology of the Arts) for its support in the research conducted in this project. To the UNESCO Braga Media Arts organization, for the support in part of the hardware. To Casa Rolão for the support in space for rehearsals. We also acknowledge Direção Geral das Artes, Portugal, for financial support. Special thanks to the openframeworks community on their open-source software contributions for the digital arts.

This publication is sponsored by National Funds through FTC – Foundation for Science and Technology under the project UID/EAT/00622/2019.

References

[1] D. Kuspit, 2005. artnet® Magazine - Features - The Matrix of Sensations by Donald Kuspit. artnet, 2005.

[2] C. Gere, 2006. *Art, time, and technology*. Berg Publishers, 2006 ISBN: 9781845201340.

[3] A. F. Marcos, P. Branco, and J. Á. Carvalho, 2009. The Computer Medium in Digital Art's Creative Process, in *Handbook of Research on Computational Arts and Creative Informatics*, IGI Global, 2009, pp. 1–25. DOI: 10.4018/978-1-60566-352-4.ch001.

[4] R. Ascott and E. A. Shanken, 2007. *Telematic embrace : visionary theories of art, technology, and consciousness*. 2007 ISBN: 9780520222946.

[5] J. M. Moura, A. Marcos, N. Barros, and P. Branco, Jun. 2014. NUVE: Resizing the Digital Gesture, *International Journal of Creative Interfaces and Computer Graphics*, vol. 5, no. 2, pp. 87–100. DOI: 10.4018/ijcicg.2014070106.

[6] J. M. Moura, A. Marcos, N. Barros, and P. Branco, 2012. NUVE : na senda da performance digital, *Proceedings of 6th International Conference on Digital Arts - Crossing Digital Boundaries, ARTECH 2012, T. Chambel, A. Ariza, G. Perin, M. Tavares, J. Bidarra, M. Figueiredo (Editors).*, pp. 179–186 ISBN: 978-972-98464-7-2.

[7] as part of the M. D. S. C. at B. U. Noémie Solomon, . Choreographic Objects: Fresh Research Perspectives in Dance and Digital Technology. [Online]. Available: https://www.brown.edu/academics/theatre-arts-performance-studies/news/2015-02/choreographic-objects-fresh-research-perspectives-dance-and-digital-technology.

[8] J. Moura, 2012. A Dança como Performance Digital: O Projeto NUVE, Universidade do Minho, 2012.

[9] S. Kozel, 2007. *Closer: performance, technologies, phenomenology*. MIT Press, Leonardo Book Series, 2007 ISBN: 978-0-262-11310-6.

[10] D. Z. Saltz, 1997. The Art of Interaction: Interactivity, Performativity, and Computers, *The Journal of Aesthetics and Art Criticism*, vol. 55, no. 2, pp. 117–127. DOI: 10.2307/431258 ISBN: 0415255112 ISSN: 0021-8529.

[11] S. Dixon, 2007. *Digital performance: a history of new media in theater, dance, performance art, and installation*. MIT Press, 2007 ISBN: 9780262042352.

[12] Fred Forest, David Sugarman, and Joanna Weston, 1988. Communication Esthetics, Interactive Participation and Artistic Systems of Communication and Expression, *Design Issues*, vol. 4, no. 1/2, pp. 97–115. DOI: 10.2307/1511394 ISSN: 07479360.

[13] R. Schechner and S. Brady, 2002. *Performance Studies: An Introduction*. Routledge, 2002 ISBN: 0415502314.

[14] M. Causey, 2006. *Theatre and performance in digital culture: From simulation to embeddedness*. Routledge, 2006. DOI: 10.4324/9780203028223 ISBN: 0203028228 ISSN: 0045-5067.

[15] L. Candy and E. Edmonds, 2002. Interaction in Art and Technology, *Crossings*, vol. 2, no. 1, pp. 1–18. DOI: 10.1007/978-1-4471-0197-0 ISBN: 1852335459 ISSN: 13514180.

[16] S. Broadhurst, Mar. 1999. The (Im)mediate body: A transvaluation of corporeality, *Body and Society*, vol. 5, no. 1, pp. 17–29. DOI: 10.1177/1357034X99005001002 ISSN: 1357034X.

[17] C. Gomes, 2015. *Ciberformance: a performance em ambientes e mundos virtuais*. CECL - Centro de Estudos de Comunicação e Linguagens. Faculdade de Ciências Sociais e Humanas, Universidade Nova de Lisboa, 2015. DOI: http://hdl.handle.net/10362/11409 ISBN: 978-989-98796-1-4.

[18] W. Forsythe, 1999. Improvisation technologies : a tool for the analytical dance eye. ZKM/Zentrum für Kunst und Medientechnologie Karlsruhe, p. 1 CD-ROM, 1999 ISBN: 3-7757-0850-2 ISSN: 1351-0002.

[19] S. Skjulstad, A. Morrison, and A. Aaberge, 2002. Researching performance, performing research: dance, multimedia and learning, *Researching ICTs in Context*, pp. 211–247.

[20] J. Ford, Dec. 2007. Performing in (virtual) spaces : Embodiment and being in virtual environments, *International Journal of Performance Arts and Digital Media*, vol. 3, no. 2, pp. 123–138. DOI: 10.1386/padm.3.2 ISSN: 20400934.

[21] P. Ferreira-Lopes and F. Jensen, . LeinKlang : Novos Instrumentos de Expressão Sonora.

[22] Microsoft, 2010. Kinect, 2010. [Online]. Available: https://pt.wikipedia.org/wiki/Kinect.

[23] Orbbec, . Orbbec – Intelligent computing for everyone everywhere. [Online]. Available: https://orbbec3d.com/. [Accessed: 21-Nov-2018].

[24] INTEL, . Intel®'s RealSense™ | FRAMOS. [Online]. Available: https://www.framos.com/en/intel-realsense. [Accessed: 21-Nov-2018].

[25] Z. Lieberman, A. Castro, and O. Community, 2004. Openframeworks, 2004. [Online]. Available: http://openframeworks.cc.

[26] B. Fry and C. Reas, 2001. Processing.org, *Processing*, 2001. [Online]. Available: https://processing.org/.

[27] G. Bradski, 2000. OpenCV, 2000. [Online]. Available: http://www.opencv.org.

[28] Unity Technologies, . Unity. [Online]. Available: https://unity3d.com/pt. [Accessed: 21-Nov-2018].

[29] OpenCV Community, . OpenCV: Background Subtraction. [Online]. Available: https://docs.opencv.org/3.4/db/d5c/tutorial_py_bg_subtraction.html. [Accessed: 21-Nov-2018].

[30] G. Bradski and A. Kaehler, 2008. *Learning OpenCV: Computer Vision with the OpenCV Library*, vol. 1. O'Reilly, 2008. DOI: 10.1109/MRA.2009.933612 ISBN: 0596516134.

[31] K. Perlin, 1985. An image synthesizer, *ACM SIGGRAPH Computer Graphics*, vol. 19, no. 3, pp. 287–296. DOI: 10.1145/325165.325247 ISBN: 0-89791-166-0 ISSN: 00978930.

[32] A. Bruhn, J. Weickert, and C. Schnörr, Feb. 2005. Lucas/Kanade meets Horn/Schunck: Combining local and global optic flow methods, *International Journal of Computer Vision*, vol. 61, no. 3, pp. 1–21. DOI: 10.1023/B:VISI.0000045324.43199.43 ISBN: 0920-5691 ISSN: 09205691.

[33] J. M. Moura, J. Sousa, P. Branco, and A. F. Marcos, 2008. You move you interact : a full-body dance in-between reality and virtuality, in *ARTECH 2008 : proceedings of the 4th International Conference on Digital Arts*, 2008, pp. 49–54 ISBN: 9789899577633.

[34] L. Loke and T. Robertson, Mar. 2013. Moving and making strange, *ACM Transactions on Computer-Human Interaction*, vol. 20, no. 1, pp. 1–25. DOI: 10.1016/j.anai.2009.11.015 ISSN: 15344436.

[35] D. Brieber, M. Nadal, H. Leder, and R. Rosenberg, Jun. 2014. Art in Time and Space: Context Modulates the Relation between Art Experience and Viewing Time, *PLoS ONE*, vol. 9, no. 6, p. e99019. DOI: 10.1371/journal.pone.0099019 ISSN: 1932-6203.

[36] G. Young and M. Whitty, Aug. 2011. Progressive embodiment within cyberspace: Considering the psychological impact of the supermorphic persona, *Philosophical Psychology*, vol. 24, no. 4, pp. 537–560. DOI: 10.1080/09515089.2011.556606 ISBN: 09515089 ISSN: 09515089.

[37] J. Leach, Oct. 2014. Choreographic Objects, *Journal of Cultural Economy*, vol. 7, no. 4, pp. 458–475. DOI: 10.1080/17530350.2013.858058 ISSN: 1753-0350.

[38] S. Hawksley and S. Biggs, Oct. 2006. Memory maps in interactive dance environments, *International Journal of Performance Arts and Digital Media*, vol. 2, no. 2, pp. 123–137. DOI: 10.1386/padm.2.2.123_1 ISSN: 1479-4713.

[39] S. Smith, Jul. 2018. Dance performance and virtual reality: an investigation of current practice and a suggested tool for analysis, *International Journal of Performance Arts and Digital Media*, vol. 14, no. 2, pp. 199–214. DOI: 10.1080/14794713.2018.1509256 ISSN: 1479-4713.

[40] I. E. Sutherland, 1968. A head-mounted three dimensional display, in *Proceedings of the December 9-11, 1968, fall joint computer conference, part I on - AFIPS '68 (Fall, part I)*, 1968, p. 757. DOI: 10.1145/1476589.1476686 ISBN: 158113052X ISSN: 18770509.

[41] I. E. Sutherland, 1965. The ultimate display, *Proceedings of the Congress of the Internation Federation of Information Processing (IFIP)*, pp. 506–508.

[42] S. M. LaValle, 2017. *Virtual Reality*. Cambridge University Press, 2017.

[43] K. Kilteni, R. Groten, and M. Slater, Nov-2012. The Sense of Embodiment in virtual reality, *Presence: Teleoperators and Virtual Environments*, vol. 21, no. 4. MIT Press, pp. 373–387, Nov-2012. DOI: 10.1162/PRES_a_00124 ISBN: doi: 10.1162/PRES_a_00124 ISSN: 15313263.

[44] R. B. Rusu and S. Cousins, 2011. 3D is here: Point Cloud Library (PCL), in *Proceedings - IEEE International Conference on Robotics and Automation*, 2011, pp. 1–4. DOI: 10.1109/ICRA.2011.5980567 ISBN: 9781612843865 ISSN: 10504729.

[45] T. G. Zimmerman, J. Lanier, C. Blanchard, S. Bryson, and Y. Harvill, 1986. A hand gesture interface device, *ACM SIGCHI Bulletin*, vol. 17, no. SI, pp. 189–192. DOI: 10.1145/30851.275628 ISBN: 0897912136 ISSN: 07366906.

[46] T. Feuchtner and J. Müeller, 2017. Extending the Body for Interaction with Reality, in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17*, 2017, pp. 5145–5157. DOI: 10.1145/3025453.3025689 ISBN: 9781450346559.

[47] S. Wilson, N. (Nicholas) Collins, and D. Cottle, 2011. *The SuperCollider book*. MIT Press, 2011 ISBN: 9780262232692.

[48] D. Wilcox, 2014. ofxPd, a Pure Data addon for OpenFrameworks using libpd, 2014. [Online]. Available: https://github.com/danomatika/ofxPd. [Accessed: 03-Mar-2018].

[49] P. Brinkmann, C. Mccormick, P. Kirn, M. Roth, and R. Lawler, 2011. Embedding Pure Data with libpd, *Proceeding of the Fourth International Pure Data Convention*.

[50] N. Moran, Jun. 2010. Resisting the lure of the screen, *International Journal of Performance Arts & Digital Media*, vol. 6, no. 1, pp. 77–88. DOI: 10.1386/padm.6.1.77_1 ISSN: 1479-4713.

In Search of Holistic Spirituality: A Philosophy of a Physi-Musiking Practice

Irene Eunyoung Lee
Hoseo University / Sonic Arts and Culture
Asan-si, South Korea / Yongin-si, South Korea
irenelee@hoseo.edu / irenelee@sonicart.co

Abstract

Before the digital age, humans spent years in training to gain matured physical fidelity and versatility necessary to become professionals in music, which nowadays is often called *the organization of sound*. As the concept of sound art expands and becomes more diverse and inclusive of various practices and activities made possible through the technological advancements of our era, the organization of sound in artworks no longer necessarily requires time restrictions or physicality. We certainly don't know how expansively this "between categories" genre will develop yet. This essay presents the background thought process, through social and cultural perspectives, behind an in-progress sound art project to create a paean and elegy of human mortality through a self-driven artistic composition. The self-termed *Physi-Musiking* practice led this artist to self-study a musical instrument and yoga movements. The journey of building new craftsmanship, by itself, is part of the experiment in unifying original auditory-visual expressions, somewhat similar to visual music. The multiple-year project was initiated in November of 2017 in Hong Kong with an announcement of the imprecise future schedule of three-tier, evolving stages leading to the final assembly in South Korea.

Introduction

Many historians and scholars have contemplated how arts such as dance, painting, music, drama or theatre might have branched out from holistic human activities, such as religious rituals, carnivals, or everyday life, since ancient times. [1, 2, 3] However, the disjunction among the genres and the specialized institutions have been detailed and significant as the advancement of industrial and capitalistic society required fostered expertise in each discipline. [4] The notion of unified knowledge, such as the consilience, interdisciplinarity, transdisciplinary, or holistic curriculum, arose in the late 20th century among scholars and educationalists. [5, 6, 7] Making reasonable bridges between the branched and specialized study paradigms, establishing the ethos of converged educational formulation, is being researched and experimented with on various academic levels. [7, 8] As a contemporary sound artist who envisions a self-driven creation of fresh unification in auditory-visual artwork, I would like to liberally record some perspectives that arose during the holistic practice, in both social and artistic contexts.

Physi-musiking

I have schooled myself in music performing, sound engineering, music technology, and aesthetic cognition. I've navigated among differentiated specializations within the music/sound terrain seeking a way to express myself in a uniquely artistic and intellectual way. I admit that each disciplinary study helped me to harness constructive and solid knowledge and skillful proficiencies; nonetheless, I repeatedly found myself discontented, not comfortable fitting into any one conventional music and entertainment style. Afterward, during my graduate school years in New York, I discovered that I was more captured by sound art, which allows me to be flexible and unrestrained in expression.

Since 2016, I have been developing the new self-termed art form of Physi-musiking, with an aspiration to create an inventive auditory-visual composition using colorful images driven by body movements that emphasize the purity and narrative of organized sound. This idea was inspired by a memory of self-expression that I freely practiced in my childhood. Through the courses of preparation and preliminary stages of the project thus far, three values in genuineness of holistic spirituality—naturalness, craftsmanship, and mortality—have emerged as vital components of the work.

Naturalness

I remember the first time I exuberantly danced, sang, and acted to tell a story, filled with enthusiasm and without concern. It was on a day in the late 1970s, when I was a small girl who had not yet started school. I danced in my parents' bedroom in front of a large mirror. I did not mimic or try to learn someone else's movements. What mattered most to me at the time was not how well I followed conventional artistic styles, but how fittingly I expressed in sound and movement what was coming to mind at the moment. I acted in a purely improvisational manner, creating a unified expression of various art forms.

To work at physi-musiking, a unified auditory-visual presentation using physical movements, I felt the need to revive the naturalness/rawness of my youthful expressions.

It felt necessary to get away from institutionalized knowledge or technology dependency (even if technology will consciously and subconsciously influence the creation of artworks) as much as possible to be naive like my younger self. At the very preplanning stage, I made a few trial shootings of my free dancing and singing to check how it looked, and I was shocked because it looked awfully unattractive. It was much too hideous-looking to serve as my artistic output; therefore, I decided to work on my muscles to strengthen expressivity and improve the aesthetics of my expression.

Craftsmanship

I decided to improve my stiffened physical body and framed musical judgment by self-training in yoga and free playing of the Kayageum (a traditional Korean 12-string instrument) with the aid of some online tutorial clips. I chose yoga to softly improve flexibility and strength in my body; I chose the Kayageum to go beyond the western style music experience.

For my first physi-musiking prelude presentation to exhibit in Hong Kong in 2017, I created visual presentations of sound poetry using still camera shots of physical movements while wearing vivid silk fabric. On the opening night, I performed a live, original sound poetry with vocalization and self-accompaniment on the Kayageum in collaboration with a contemporary dancer who made movements with adaptation of Ashtanga yoga asanas[1]. What I achieved by mapping the endeavor through a series of bodily practices and sound organizations at the early stage was not a visual music form like animated digital abstract film. I exploited a live performativity of music and sound together with poetic utterances and an emotional expressivity with human body-driven images utilizing textile colors and camera exposures as tools to create a new style of visual music, and I think it matches up to the coordination of earlier visual music. [9]

Mortality

I continue self-practicing Ashtanga vinyasa yoga[2] and kayageum sanjo[3] with anticipation that I will continue physi-musiking until very late in life. It is good enough for me to be mediocre in skill. What is significant in its practicing is the inner-communicative sincerity that can lead into a lifetime-long, holistic spiritual journey within human mortality. The intention of physi-musiking is to venerate beauty and acidity in the progression of the mortality of humans by accentuating both the naturalness and craftsmanship of oneself in accordance with organized sound narratives. By starting ashtanga yoga and kayageum sanjo in my mid-40s, I began to contemplate the implication of belated trainings and the lost holistic human development in today's society. The introspective practice is an experiential journey to self and has a sense of connection on the inside. This is not to entertain others: it is about inner conversation. The progress of inner communication and expansion in physical skills resulting from self-practice will apparently accentuate both the rawness and craftsmanship of an earnest seeker of unknown paths. Practicing and utilizing self-taught, incompetent skills to achieve somewhat different/new aesthetical expressions in the age of specialization can be risky but still worthy of a gallant attempt.

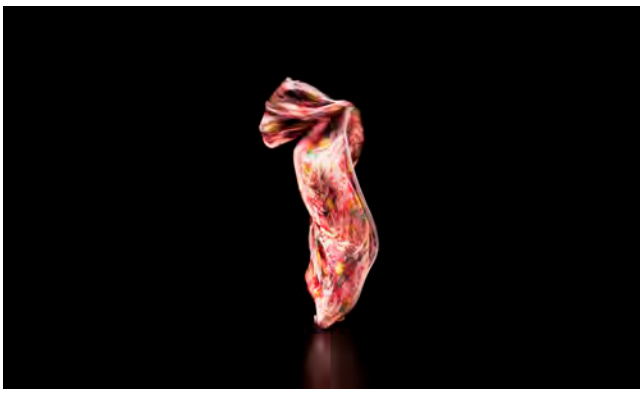


Figure 1. An example of the early stage physi-musiking from the prelude exhibition held in Hong Kong. This still image depicts a section "Alienation from things defined the ego / Barely discern what comes next," in a sound poetry *Tillandsia in the Lost Garden*. © Sonic Arts and Culture.

Progressive Future Plans

My current physi-musiking project is titled *Tillandsia to Nabillera,* and it is expected to reveal its progressive metamorphosis in three chronological development stages leading up to its final completion stage. The multiple-year progressive project is largest in its scale among all my *Sound Diary* artworks, which will be introduced briefly in the next section. The process leading to the end product is very time-consuming, and I am presently confronted with several difficulties in actualizing my idealistic aspiration, because the process involves more than just making novel audio-visual expressions. I envisioned the final assembly of the work to incorporate launching of a sustainable art space of contemporary sound art and physi-musiking in Asan city, in South Korea. After the prelude stage presentation in Hong Kong in November 2017, project evolution has been sluggish because I have not yet been able to resolve some heavy conflicts. One, for example, is a legal battle against an unfair compulsory acquisition attempt by the Asan city administrative office against individual prop-

[1] An archived video of the introductory photo installation & performance of physi-musiking <*Tillandsia in the Lost Garden*> at nakedHub Gallery on Nov. 17, 2017 in Hong Kong is available online. https://vimeo.com/249501106

[2] The eightfold yoga path founded and developed by K. Pattabhi Jois.

[3] Skillful solo-scattered melodies played with a traditional Korean instrument.

erty ownerships. The ambitious project, to some extent, has involved an expected state of complex affairs since I initially conceived and mapped out prospective plans. It is a bold attempt, which almost makes achieving my vision improbable, but I wish to champion the cause of the current downtrodden, the victims of circumstance and injustice in my life and our society. I sincerely desire to accomplish the project in its best possible form despite numerous personal, financial, and administrative obstacles. Still vague in its prospect productions whether it can incorporate high-tech and architectural construction as I loosely mapped out at in early preplanning stages. I will continuously practice, keep dwelling upon, and take effort to bring to fruition as an innovative holistic composition out of all the ambiguity.

Sound Diary Series

The Sound Diary project is an ongoing, serial artistic collection of artworks heightening the sonic medium and semiotic uniqueness of my lifetime sound art practice. Bluntly speaking, it presents works and events produced from unbound creative expressions from chronicles of a true-life existence in the world (i.e., my life), interwoven with music and sound activities. Hence, it naturally exposes various internal, external, and environmental conditions and reflections of my sonic journey of life. These may be considered reasonably unique but rather raw characteristics when compared to some commercial music/sound artworks. The collection in its current state evidently holds demonstration of various creative ventures, struggles, and efforts as an art practitioner and common citizen, and it is expected to exhibit future growth as well. Hence, I entitle its form *Experiential Sound Art*. So far since 2003, I have published five completed official works of the project (Sound Diary No. 1 ~ No. 5), and a broad range of media platforms has been explored (including two audio CDs, three on-site exhibitions, three full-length, large-scale theatre productions, several experimental performances, various writings, audio-visual compositions, music compositions, sound organizations, photographs, and web designs…etc.). It continues and expands into further experiments on the embodiment of sound narratives across media.

Coming from a social background of high cultural conformity in South Korea, I always felt that I have been walking a fine line on the thorny edge of mainstream (popular) culture and the fine art world. I tried not to concede to the commercialization of hyper-capitalism with my talents and productions as a living, practicing sound artist. Such intentions have required a complicated and demanding lifestyle. In our highly conformed society, innovative but unpopular (experimental) sonic/music works are often ephemeral, existing merely during the moment of performance/exhibition. It seems as if they vanish in a sense after the main event. One of the reasons why sound art has been unrecognized and unpopular might be the inherent experimental trait and time-based disposition of the works. However, I intended to uphold a collection that embraces all kinds of its artistic residues – all sorts of texts, music scores, audio and visual resources, and conceptualization traces, so that it can subsequently be revived and be transformed or transcended into re-mediated or reborn presentations when needed. The Sound Diary project has such generative attributes enabled by its conception with the aid of the boundless technology and flexible platform of contemporary art. By continuously practicing the series, I expect to realize experiential sound art, which may eventually accentuate a sense of the spiritual-purificatory role of art. It is a long-term artistic voyage; however, I aspire to let the Sound Diary project overcome the limitations of time and space, and personal and monetary difficulties, so it can be shared and re-lived for a broader audience.

Conclusion

What does “holistic spirituality” mean and how am I searching for it through physi-musiking? Probably my sincere responses for these questions would be best presented within the artworks of the Sound Diary project. However, as an academic scholar, I have an impetus to map its philosophy with deep research and study of related theories, practices, and contemplations. The time is yet premature to fully discuss it in this paper; however, I can briefly illustrate some theorists whose thoughts demonstrate some common core strands with the philosophy of the Sound Diary project. Carl Rogers said, the main motivation of creativity is an individual’s strong tendency for actualizing oneself–the drive to become one’s potentialities. [10] My motivation for creating the Sound Diary project initiated from similar grounds. I’ve been persevering to actualize myself and to overcome improbable circumstances with my potentialities for every artwork. Likewise, my experience of troubles and struggles in sustaining creative practices as an experimental artist in a highly conforming commercial-consumption society could prove some essentials of the cultural contradiction theory of Daniel Bell. He explained culture as a process to maintain identity, and he asserted that cultural contradictions in high-level capitalism were evoked as the society lost its purifiers, the roles of religions and arts before the age of science and technology arrived. [11] I wished to hurdle over the obstacle of cultural contradictions; hence, I have persistently pursued a lifetime goal of holistic spirituality. It is assumed that the incongruity tendency of creative individuals can invite several challenges, such as conflict, struggle, and contempt. [12] I also have been confronted with such heavy conflicts to fight against; therefore, I work to embrace the incongruity tendency as an innate trait of an artistic career. Making both artworks and intellectual records as a practicing artist and scholar even with the uncomfortable edge of conventional aesthetics is a way to balance with core strength for me.

To realize the entire <Tillandsia to Nabillera> project, I will need to keep improving my physi-musiking craftsmanship with resilience for the long-term until the final stage. Undertaking an artistic pilgrimage that challenges me utilizing unskillful, stiffened body and mind in the mid-age is not an undemanding test by itself. Besides, I am aware of the need to cope with the degeneration issue of the human aging process; hence, I presume that this physi-musiking practice might expose more degenerative states in physicality as I age further. Still, I consider it as one possible approach to reinstate innate purity of art in our era of lost holistic spirituality in order to make a beautiful paean and elegy of human mortality and to continue on my long-time endeavoring "experiential sound art" voyage.

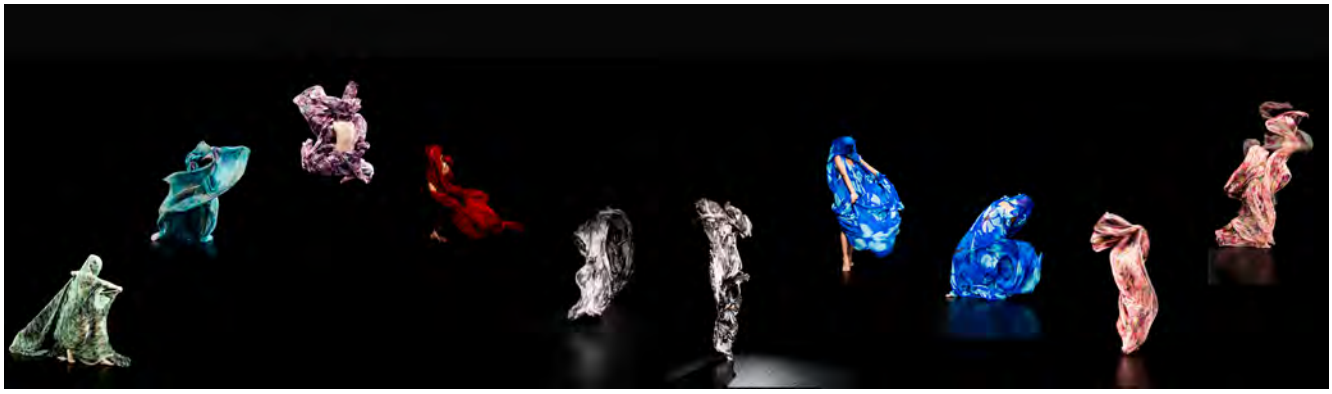


Figure 2. A collective snap shot of physi-musiking images in temporal order of the sound poetry *Tillandsia in the Lost Garden*. © Sonic Arts and Culture.

Acknowledgements

The sound diary artworks and the artist received national and provincial fellowships from the Korea Creative Content Agency (KOCCA), Arts Council Korea (ARKO), Seoul Foundation for Arts and Culture, and ChungNam Arts and Culture Commission. The endowments and support have been financial and moral aids and motivations that helped to transform idealistic artistic visions into real actualized artworks and performances.

References

[1] Jane E. Harrison, "Transition from Ritual to Art (1913)", in *Ancient Art and Ritual* (London and Southhampton: Oxford University Press, 1948), 119–169.

[2] Edward O. Wilson, "The Arts and Their Interpretation (1998)", in *Consilience: The unity of knowledge* (New York: Alfred A. Knopp, 1998), 226–237.

[3] Victor W. Turner, "Acting in Everyday Life and Everyday Life in Acting (1982)", in *From Ritual to Theatre: The human seriousness of play* (New York: Paj Publications, 1982), 102–123.

[4] Victoria D. Alexander, "Art World (2003)", in *Sociology of the Arts: Exploring Fine and Popular Forms* (Seoul: Sallim Publishing, 2010), 147-187.

[5] Allen F. Repko, "Defining Interdisciplinary Studies (2008)" in *Interdisciplinary research: Process and theory*. (Los Angeles and London: Sage, 2008), 3-26.

[6] Edward O. Wilson, "The Great Branches of Learning (1998)", in *Consilience: The unity of knowledge* (New York: Alfred A. Knopp, 1998), 8–13.

[7] Arild Buanes, and Svein Jentoft, "Building bridges: Institutional perspectives on interdisciplinarity," *Futures* 41(7), (2009): 446-454.

[8] John P. Miller, "Implementing and Evaluating the Holistic Curriculum (1988)", in *The Holistic Curriculum* (Toronto: University of Toronto Press, 2007), 190-200.

[9] William Moritz, "Towards an Aesthetics of Visual Music," *ASIFA Canada Bulletin* Vol. 14: 3, December 1986, accessed (via an html copy in the Center for Visual Music website) April 13, 2019,
http://www.centerforvisualmusic.org/TAVM.htm

[10] Carl R. Rogers, "Toward a theory of creativity", *ETC: A review of general semantics* (1954). 251.

[11] Daniel Bell, *The Cultural Contradictions Of Capitalism: 20th Anniversary Edition* (New York, Basic Books, 1996)

[12] Roger. G. Graham, "New music and the con-texts of creativity: Cultural-evolutionary and humanistic perspectives." *Journal of New Music Research* 35(4), (2006): 347-352.

Bibliography

Theodor W. Adorno, *Philosophie der neuen Musik*, (Frankfurt, Suhrkamp, 1975).

Victoria D. Alexander, *Sociology of the arts: exploring fine and popular forms*, (New Jersey, Wiley, 2003).

David Bayles and Ted Orland, *Art & fear: Observations on the perils (and rewards) of artmaking*, (Santa Barbara, Image Continuum Press, 2001).

Carl R. Rogers, "A therapist's view of the good life: The fully functioning person" in *Becoming a person* (New York, Mariner Books, 1961), 183-196.
Robert J. Sternberg and Todd I. Lubart, *Defying the Crowd: Cultivating Creativity in a Culture of Conformity*, (New York, The Free Press, 1995).

Author Biography

The author, Irene Eunyoung Lee, has been acting as a sound artist in South Korea under the pseudonym ARING. Over the course of a wide-ranging career, she has worked as a composer, producer, performer, writer, video artist, cognitive researcher, educator, and photographer. The artist endeavors to accentuate the spiritual-purificatory role of art by taking mundane existential stories of life as general and intellectual states, and maneuvering them into insightful ritualistic art practices through a serial project called the Sound Diary. Her creative, genre-disrupting, unconventional original works integrate a variety of artistic media, including music/sound, dance, movement, lighting, visual images, and texts, through performances and exhibitions. The author uses the components of music and various media formats to portray delicate occurrences in living a life (based on storytelling), being attentive to inner self and others. Behind each work is an extensive process of introspection and exploration, involving sketches of the endeavor through a series of written texts, tangible performances, and free-form sound organizations. For more information about the series, visit the project website (https://www.sonicart.co/sound-diary-project) or the artist's vimeo page (https://vimeo.com/aring).

The Idyosincrasies of Shutter Speed

Yanai Toister
Unit for History and Philosophy, Shenkar College of Engineering, Design & Art
Ramat Gan, Israel
yt@yanaitoister.com

Abstract

The history of photography has produced a fascinating wealth of theoretical narratives. However, a surprising proportion of existing narratives relies on a problematic assumption - the assumption that it is possible and apposite to equate photography and vision. In this article, I demonstrate that the equation depended on certain physical circumstances and particular technical-technological operations dictated by those circumstances, and mediated by various constraints of speed. I intend to dwell on a number of strategic moments in the history of photography in an attempt to make a critical reading of the circumstances, the applications and the interpretations of various types of speed and their relationship to photography. This article concludes with the claim that in recent decades one important type of speed, namely shutter speed, has undergone a transformation that now makes it possible to challenge the ontological model binding together vision and photography. Moreover, the probable disappearance of the shutter in the near future also permits an alternative media history of photography renuncing the traditional hierarchy in which images created by photography (i.e. photographs) are less important than the technological and conceptual systems that produce them.

Keywords

History of Photography; Vision; Speed of Light; Algorithmic Speed; Post-Photography.

Introduction

The history of photography enables a fascinating wealth of theoretical narratives. However, a surprising proportion of existing narratives relies on the unconvincing assumption that it is possible and indeed apposite to equate photography with human vision. This consists of expressions from which one or more of the following interpretations arise: 1. The camera is a type of mechanical eye, or it functions as such; 2. The act of shooting a photograph, in some ways, corresponds to the act of seeing; 3. The viewing of photographs is similar to looking at the world. As I argue in this article, these equations serve the purpose of declaring new categories of experience and veracity, derived, as it were, from 'laws of nature' which had previously been unknown.

In this article, I demonstrate how this equation emerged from technical-technological circumstances and physical operations dictated by those circumstances. I focus primarily on how these are mediated by and represented in various constraints of speed. I argue that this equation, from its very outsets, is mostly manipulative or simply erroneous and can now be challenged successfully. Moreover, the probable disappearance in the near future of familiar speed-based functions of photography (notably shutter-speed and, for that matter, the shutter itself) also permits a renunciation of the longstanding tendency to give precedence to images created by photography (i.e. photographs) over the conceptual systems that produce them. I will sum up by propounding a more complex articulation of the relationship between human vision, technologies of vision, sensing and imaging. I deem this relationship as a post-optical media-history of photography.

Speed and the Speed of Light

Light, it has been repeatedly claimed by photographers, is *the* necessary condition for photography. This traditional claim is but another sign of a conflation between photography and human vision. Other than in a strict etimological sense, it is far from accurate since many light-sensitive surfaces also respond to other frequencies within the electro-magnetic spectrum. It is human vision, and not photography, that truly depends on light and cannot occur in its absence. Ingeborg Bachmann wrote of this, saying: 'There is nothing more beautiful under the sun than being under the sun' (Bachmann, cited in Kittler 1999, 19). Light, in other words, permits human vision and vision–more so than hearing and touch–enables us to distinguish between the static and the variable. This property of vision is independent of spatial constraints and it is available to us almost constantly. Therefore, the sense of sight has often been compared to thought, and since Plato's days has been considered the paramount sense.

However, even when there is sufficient light in a particular situation, human vision can not take place without a fundamental property of light - its incomprehensible speed. By virtue of this speed, we are able to simultaneously observe the world and see it, without any time lapse between the moment when a particular configuration of light rays is reflected from an object in the world (or emitted by it) and the moment when the same configuration of rays strikes the retina. Or so we think.

The term ‘speed’ refers to the rate of change in the location of a specific material or of an energy particle (i.e. a large change in position over a given time period means high speed, a small change over the same period means low speed). According to the Theory of Special Relativity, the highest possible speed is the speed of light, at which only energy or information can travel (matter can not move at the speed of light). However, it should be noted that although the speed of light is the highest speed, it is still not an infinite speed but only a finite velocity. It is because of this that human vision can only be taken as immediate, never simultaneous. Since the light has to cross a certain distance from the object to our eyes, there is always a certain time lapse between the moment the light ‘leaves’ the object and the moment when it ‘reaches’ the retina (at least according to the laws of classical physics).

However, because the speed of light is enormous by any standard, the rays of light usually reach our eyes within a few nanoseconds (a nano-second is a billionth of a second). This time gap is indicernable to us and so we have no reason to suspect that it exists at all. Physical changes in the object, if they occur, will not usually occur during such a short span of time. And so seeing is almost always the most effective way to experience the world and to experience it in real time – to see what is happening in the world ‘at this very moment’. Simply put, the speed of light not only facilitates vision but, more importantly, permits an illusion of the immediacy of vision.

In contrast to other illusions, this illusion is in perfection harmony with our everyday visual operations and, unlike other illusions, is usually innocuous, especially in terms of visual operations occurring on Earth. If, on the other hand, we look at the stars in the sky on a clear night, without assistive equipment, the visual operations facilitated, albeit emerging from largely similar visual experiences, are, principly very different from 'regular' vision. The huge distance between the earth and certain stars, and the great length of time required for light to cross this distance mean that what we see in such cases is not the object (a star) as it exists at the moment we gaze upon it but the object as it may have existed millions of years ago. Even if a star explodes as we are looking at it, we will not be able to notice it. At best, someone might notice the explosion only millions of years later. In the unlikely scenario that we plan a journey to the stars solely on the basis of observations made from Earth today, our journey may end in frustration, since the destination of the journey will not necessarily be in place when we reach it. We should nevertheless note that even in celestial observation, although visual experiences do not enable standard visual operations, because the speed of light speed is finite, fixed and known, it is still theoretically possible to accurately calculate the time lapse between the moment the star exploded and the moment we see the explosion. To the extent that ‘vision’ is to be undersood in terms of of operation(s) made possible, and not just the experience(s) undergone then arguably the term cannot apply to both standard (on earth) and celestial observations. Perhaps only the term ‘sensing’ can apply to both.

Non-constant Speed

Observing stars, in spite of the awe it generates, is an activity less complex than observing photographs. The latter rests, always and inevitably, on a speed that is neither constant or known and therefore cannot be calculated. One may look at a photograph of a man immediately after it is taken, or many days or years later. In many cases, we may never know or care to know when a person lived and when they were photographed. In this regard, even Thomas Ruff’s much celebrated star photographs (series entitled ‘Sterne’, 1989-1992, fig. 1) are like all other photographs – they too represent (distinct) objects in an undistinguishable moment in time.

Fig. 1: Thomas Ruff, *Sterne (16h 30m -50°)*, 1989

Wonderful as they are, that is all they do. Whether these objects exist is of lesser importance. And even if we sometimes are capable of dating photographs, to make the objects in them hypotheticaly more knowable, then this capacity seldom emerges from the photograph itself; It is almost without exception, enabled by other means - either by previous knowledge about the circumstances in the photograph, by a caption for it, or, these days, by way of its metadata.

Shutter Speed

The process of photography is completely different from the process of seeing and depends on different types of speed, all of which are irregular, indeterminate and therefore unknown. If we trace the ways in which these types of speed have changed, I would argue that we can reinterpret the implications of various theoretical definitions that have accompanied photography at different stages of its history. One important type of speed that I will discuss now is shutter speed – a technical variable in photography that determines the length of time during which the photo-sensitive surface (mostly within the camera, be it film or sensor) will be exposed.

The emergence of photography in the mid-19th century was, as Geoffrey Batchen demonstrated (1999), a series of events whose exact magnitude, order and hierarchy, is still controversial. The heart of the dispute lies in the definition of the circumstances and interests to which the very formation of the idea of photography is to be attributed. Since there is no consensus on this, Batchen argued, it is therefore also impossible to point to a single technology responsible for the invention of photography. By the same token, it is difficult to consider photography at that time as a completely homogenous practice. However, all the early forms of photography, whether practiced in England, France, or elsewhere, were associated with the need for a lengthy series of physical operations to produce the photograph. These operations, it should be pointed out, required no little time, a phase which in many cases (certainly before 1840/1) may very well have been longer than the time it took to produce a drawing or an engraving.

One of these operations was, crucially, the exposure of a light-sensitive material to light, whether by placing it outdoors in sunlight (as far as photograms were concerned) or by removing its covering. Of course, in those early years there were no optical lenses intended for use in photography, so when lenses were used, they were lenses without a mechanical shutter. The only ‘shutter’ that was available in those early years was a cap that blocked the lens or the black cloth that covered the camera, both of which had to be manually removed to allow exposure. Thus, in other words, in the earliest days of photography, the pace at which a photograph could be produced was necessarily also a derivative of the speed of movement of a human body (or at least in unison with it - a slowly moving photographer, even with emulsions more sensitive than had been available, still could not shoot quickly).

To clarify - Niépce’s heliographs required exposures of approximately eight hours while Daguerre’s first processes required 15 to 30 minutes. By the early 1840s Daguerre’s process had come down to approximately two minutes and sometimes even less than one. In England, Talbot’s first ‘photogenic drawings’ required 30 to 60 minutes, though with his subsequent invention of the ‘calotype’ process, this was quickly reduced (Eder 1978, 501-06). These early restrictions prevented photographers from describing what they saw. Any type of object, situation, or state of affairs whose components were not perfectly stationary could be depicted in a blur or not depicted at all. For this reason, it is understandable why, from a contemporary perspective, it seems that the various contendors to the title ‘inventor of photography’ produced remarekbly similar photographs. Consider the photographs of shells and fossils made by Louis-Jacques-Mandé Daguerre in France in comparison to the photographs of china and crystal articles made by William Henry Fox Talbot in England. Both of these, I argue, although illustrating a particular cultural world and a clear purpose, attest more than anything else to the technical-technological constraints under which both Daguerre and Talbot worked (fig. 2-3).

In the same regard, consider too the photograph taken by Nicéphore Niépce of his home (the ‘first’ photograph, so it is claimed), in comparison to the photograph of Talbot's country manor (the ‘first’ building ‘to have drawn its own picture’ in Newhall, B. 1980). Without going into the issue of historical primacy, it is clear that one major constraint is common to these two photographs - the pleasure one must take in slow and deliberate work. The same pleasure has continued to characterize photography, and it can also be detected, years later, in the ‘Anonymous Sculpture’ photographs of Bernd and Hilla Becher, even if those do not describe rural estates but water towers, grain silos or steel mills. All are contemplations on the possibility that the seemingly-immobile may also be permanent, and that which is permanent may be 'eternal' (or could be represented as such).

In the same regard, consider too the photograph taken by Nicéphore Niépce of his home (the ‘first’ photograph, so it is claimed), in comparison to the photograph of Talbot's country manor (the ‘first’ building ‘to have drawn its own picture’ in Newhall, B. 1980). Without going into the issue of historical primacy, it is

clear that one major constraint is common to these two photographs - the pleasure one must take in slow and deliberate work. The same pleasure has continued to characterize photography, and it can also be detected, years later, in the 'Anonymous Sculpture' photographs of Bernd and Hilla Becher, even if those do not describe rural estates but water towers, grain silos or steel mills. All are contemplations on the possibility that the seemingly-immobile may also be permanent, and that which is permanent may be 'eternal' (or could be represented as such).

Fig. 2: Louis-Jacques-Mandé Daguerre, *Shells and Fossils*, 1839

Fig. 3: William Henry Fox Talbot, *Articles of Glass* (Plate IV in The Pencil of Nature), 1844

For this reason, it is especially puzzling that Talbot chose to praise the "speed" at which a photographer can perform the work of a draughtsman: 'You make the powers of nature work for you, and no wonder that your work is well and quickly done… There is something in this rapidity and perfection of execution, which is very wonderful' (Talbot, cited in Buckland 1980, 31). Similarly, Daguerre's language is also surprising - his choice of the term "immediacy" to refer to the act of photography (Daguerre, cited in Trachtenberg 1980, 11). How are these statements to be explained? And should they be understood as more than just fashionable rhetoric tropes? Surely, the introduction of railway transport redefined notions of distance and with them concepts of time and speed. Two cities connected by a railway line now needed to synchronize their time management. This allowed for speed to be easily calculable. However, in view of the invention of the telegraph as a means of communication, certainly an operation that takes several minutes ought not to have been considered an 'immediate' operation.

I suggest interpreting these statements as a deliberate and conscious choice on the part of the pioneers of photography. Arguably, this choice served two main aims: On the one hand, it expressed a 'desire' (Batchen) to turn away from early forms of depiction – especially those traditional forms which still demanded skills whose acquisition is a slow and protracted process, as is their implementation. These traditional forms and their constraints, as has often been argued, were consequently changed with the emergence of photography ('In achieving the aims of baroque art, photography has freed the plastic arts from their obsession with likeness. Painting was forced, as it turned out, to offer us illusion and this illusion was reckoned sufficient unto art.' Bazin 1960, 7); On the other hand, it also expressed a desire to present photography as a field in which craftsmanship is of little importance, or none at all (Arago, reprinted in Trachtenberg, 15-26). Nor did it require the photographer to acquire greater physical dexterity. From a contemporary perspective, by the theory of special relativity, we can argue that that which is done "instantaneously" is unfettered by matter. Only that which can be done "directly" is done without human intervention, and presumably without intercession. Alternatively, even that which is still slow, but has the potential for speed, is closer to thought. Ostensibly, photography, like vision, can identify the unchanging, the permanent, the eternal.

It can also be contended that a photograph tethered to a photograph print (the most common form of photography until the 21st century) invites contemplation of the eternal not only because it is "immediate" but also because it itself is ostensibly "eternal" - or, unlike its carrier (Wiesing 2009), is insensitive to changes and is unchangeable. Photographs of objects never change after the object has changed. To illustrate this point with the star example again - if we gaze continuously at the star for millions of years, we will eventually see the explosion that destroyed it. On the other hand, even if we gaze

continuously at the photograph for millions of years, the photograph will not change.[1]

Arguably, similar considerations led Niépce, Daguerre, Talbot and others to adopt the concept of nature as a supplementary term that is also integral to discussions of the phenomenon known as photography. This made it possible to present the photograph as a kind of 'magic' or 'wonder' that is incontestable because it stems, like various natural phenomena, from eternal but abstract principles, principles that we will never be able to grasp and fully understand.[2] It is ironic that this 'nature', which from the outset was only empty, simplistic and metaphysical rhetoric to advance photography, has taken root in our consciousness and overwhelmed it. It is still with us whenever we assume that the privileged mode of access photographs afford is an incontingent one.

Evidence of this way of thinking may be found in the view which comprehends seemingly analogous properties in both the eye and the camera and thus turns them into two parallel systems. According to this view, both the eye and the camera lens are similarly equipped to convey the electromagnetic signals present in nature - configurations of light rays that are reflected from or emitted by actual objects. Later, both the brain and the film or sensor supposedly process the signals in a similar manner.[3] The assumption is used to argue that the photograph shows us (or can show us) what our human eyes would see if we were standing where the camera stood at the time the photograph was taken.

Now that photography can be performed almost at the speed of light (more about this below) it is clear how unreasonable this assumption is. Firstly, there is a wealth of anatomical reasons to reject the comparison between the eye and the camera. Here are some possible reasons. We have two eyes and not one. Our eyes are never fixed and are always in motion (and therefore human vision is more like videography than still photography, if it resembles it at all). Our field of vision is elliptical and not enclosed in a rectangular frame. Our eyes are concave at the centre and therefore our field of vision contains a sharp area only at the centre and not from end to end. Consequently, we cannot see sharply across multiple planes (or in photographic lingo: we are unable to see depth of field.) (Snyder and Allen, 1975). Secondly, and perhaps more importantly, neurological and cognitive capabilities play a significant role in the perception of color, depth, and movement in human vision. The camera does not enjoy processes that parallel these capabilities.

There is no natural balance in which the camera is the embodiment of another natural eye. And even if there is some sort of balance - as Andreas Feininger may be implying in his photograph, 'The Photojournalist' (fig. 4) - it probably demonstrates the exact opposite.

Fig. 4: Andreas Feininger, *The Photojournalist*, 1951

If the architecture of the human eye were the same as the architecture of a camera, the image projected onto the optical nerve would be the same as the image projected onto the film/sensors. One day (which is perhaps

[1] As of yet, there are few exceptions to this rule. One possible exception is light field photography (commobly known by its commercial name 'Lytro'). Light field images are photographic images which can be refocussed after exposure. Other possible exceptions include Gigapixel photographs or HDR exceptions. We might also think of other forms of images wherein a 'photograph' is created with constant recourse to a database.

[2] Talbot: "But after all, what is nature, but one great field of wonders past our comprehension? Those, indeed, which are of everyday occurrence, do not habitually strike us, on account of their familiarity, but they are not the less on that account essential portions of the same wonderful whole." Quoted in: Buckland, Fox Talbot and the Invention of Photography, 31.

[3] Rudolph Arnheim offers expressions allouding to this, as do Andre Bazin, Siegfried Kracauer and even MOMA's photography curator John Szarkowski. (Kracauer 1995, Szarkowski Apr. 13, 1975)

closer than we want to admit) our eyes will indeed be engineered and programmed like cameras, or they will actually be cameras. For that very reason, if we want to use photography as a means to learn about the world around us, there is good reason to reformulate the relationship between vision and photography with rhetorical and logical constructs that do not require the term 'nature'.

The advent of glass plate photography in the late 1840s and early 1850s accelerated exposures by a considerable factor and brought exposure times down to a matter of a few seconds. Even that, however, is achingly long by today's standards. Exposure times of fractions of a second only became available in the 1870s. These were introduced courtesy of Leland Stanford's engineers, who designed for Eadweard Muybridge sophisticated mechanical shutters that were faster than all their predecessors. By these means, Muybridge succeeded in "freezing" photographs of the galloping of Stanford's mare, *Sally Gardner*, at the Palo Alto racetrack. Only in this way could it be demonstrated that certain phases of its gallop did indeed include moments when all four hooves were off the ground (figs 5A-5B).

Fig. 5a: Eadweard Muybridge, *The Horse in Motion*, 1878

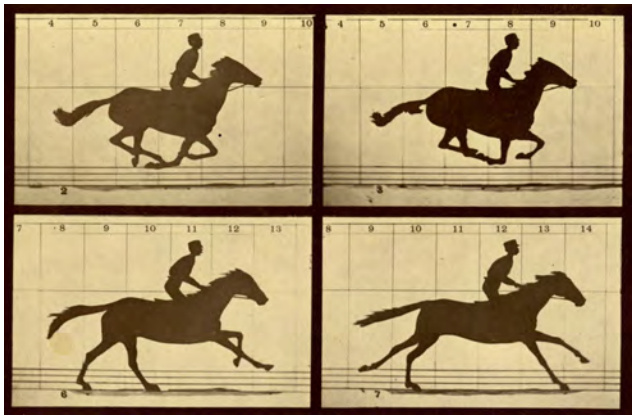


Fig. 5b: Eadweard Muybridge, *The Horse in Motion*, 1878 (detail)

These photographs, received a cool response from artists, other photographers and certainly from the general public. The photographs, it was claimed, were 'unnatural' and even 'unrealistic' (Solnit 2004). This response did not stem from doubts about the reliability of Muybridge's accomplishment or about his personality. It stemmed a justified feeling that the accomplishment not only challenged prevailing standards of portrayal but also approaches to understanding human perception. For even if one believes that horses indeed gallop as in Muybridge's photographs, one has no way of corroborating or refuting this belief, other than through additional photographs.

It was because of these shutter speeds that Muybridge's photographs produced other domains of visibility. These related not only to the matter of hooves or how horses gallop, but mainly to the human eye. This organ, so it transpired, was completely oblivious to numerous phenomena. Access to these is enabled only by and through the camera which, as it were, reveals to us a new 'optical unconscious', argued Walter Benjamin (2008). Thus, if there are natural phenomena to which the eye is indifferent and even blind, then the option of a belief in vision has been shaken once again. From now on the saying should be: *Seeing is not believing*.

To what can the revelation of these domains of visibility be attributed? Certainly not to the common laws of nature that had been known since the 17th century, only to the mechanics of photography instead. Thus shutter speed became an essential feature that the viewer could not ignore. Moreover, in such circumstances, it was reasonable and logical that even earlier photographs, in which no movement was represented, were attributed less to the bounties of vision and more to camera (Snyder and Allen, 156) or, arguably, to the speed of the shutter and to the camera in which the shutter was installed. This may explain how and why photographs would gradually be perceived in our consciousness less as a wonder of nature and more as a product of mechanical action. Because the device that produced the action, that produced the photographs, that produced the veracity was highly engineered and mechanized, it turned out that the device, a mere machine, was the sole source of the photograph's authority. I suggest therefore, that by the end of the 19th century it became apparent that it was not Leon Battista Alberti's perspective construction, the optics of Robert Hooke and Isaac Newton or the chemistry of John Herschel which constituted the great discovery that allowed photography to open new domains of visibility. It was the mechanics of Leland Stanford's anonymous engineers.

Additionally, shutter speed, which came into existence as a result of the mechanics of photography, also allowed us to distinguish between two distinct types of

experience - vision and viewing. This difference stems from what may be called temporal incompatibility, which is necessarily speed dependent (Warburton 1988). By way of clarification - if *Sally Gardner* needed X seconds to run Y meters, it would have taken me X seconds to see her do so, if I had been in Palo Alto, California, in 1878. On the other hand, it is not necessary to spend the same X seconds watching the photograph. In fact, the time I need to look at Muybridge's photograph or, for that matter, any photograph need not be the same time it took to perform the action portrayed in the photograph. This may only be a difference of degree rather than of kind but it is a profound difference notes Henry Bergson (1911, 332). If we ignore the history of photography and film for a moment, and assume that Muybridge not only photographed but also filmed *Sally Gardner* at the gallop, this imaginary film would illustrate the same argument. If this film were 50 seconds long, I could watch it screened at low speed, over 500 seconds, screened at high speed, over 5 seconds, screened in a loop or screened at a negative speed, that is to say, backwards. In this case too, there is no connection between the time it takes me to see the actual event and the time I decide to spend watching it on the screen.

Vision can be plainly defined as a situation wherein similar manners of perception are enabled for most real world events. Viewing, on the other hand, is a situation that allows the time taken by cognitive processes of vision to part company with the time span of real world events. Because photographic technologies always conjure up temporal incompatibility, they also, consequently, allow for a type of viewing which is, inevitably, a non-participatory experience (Wiesing). Any other situation of viewing or observation potentially turns us into participants. Consider, in this context, the audience at an aerobatic display. There have been numerous occasions in which planes crashed down on the spectators of such performances and compelled them to become participants. How many times have airplanes crashed down on people viewing a photograph or a movie? The viewer of the photograph is always removed from the situation, detached from it and protected. The various photographic technologies have always permitted one to observe real events in safety. They allow viewing, not vision.

As the history of photography clearly demonstrates, accelerated shutter speeds permitted the production of cameras that were easier to use, lighter and hence more portable. The subjects of photography thus began to regularly change, even when the objects photographed remained similar. Consider, in this context, Timothy O'Sullivan's *A Harvest of Death* and recall Robert Capa's photo of the death of a soldier in the Spanish Civil War (fig. 6-7).

Fig. 6: Timothy O'sullivan, *A Harvest of Death*, 1863

Fig. 7: Robert Capa, *Loyalist Militiaman at the Moment of Death, Cerro Muriano, 5 September 1936,* 1936

A more disturbing contrast can hardly be imagined. Both photographs are manipulative but in completely different ways - one is epic but restrained, the other is as a Kabuki dance and both allow us to be spectators and spectators alone. From the perspective of our time, it is possible to recognize that faith in the machine did not banish expressions of belief in the laws of nature from the discourse and from thinking about photography, it simply subsumed them and gave rise to a new kind of confidence for the viewer. That confidence came from the knowledge that even if photographs do not show us reality, or aspects of it, as we humans would see it, some other mechanism grants authority to the photograph.

Machine, Sync Speed, Projection Speed and Other Speeds

Assurance always comes at an expensive price. Therefore, if mechanics was the greatest of the achievements that

made photography as we know it possible, it can equally be argued that photography is, and was from the outset, only a playground of the machine. Peter Henry Emerson, for example, would refuse to credit the photographer for his most significant accomplishments because, in his opinion, whatever the photographer's actions, the act of photography does not involve any significant operation other than that of the machine.[4] In a more complex, but not dissimilar, manner, Vilém Flusser would describe photography as an arena of wherein photographers, or 'functionaries' as he sometimes called them (2000, 27) can wrestle with the machine and attempt to override its program. In that arena, there are various operations that an experimental photographer can perform but they are never enough to exhaust the machine. There is no way to defeat 'the apparatus', Flusser thought, but it can be outsmarted by re-engineering (Flusser 2000, Flusser 2011). In his view, only if one tries to intervene in the program of the machine, to re-program it as it were, they may be able to operate it in ways that its designers never imagined.[5]

Best known for his experiments with the multiflash technique and with stroboscopes Harold "Doc" Edgerton, professor of electrical engineering at the Massachusetts Institute of Technology (MIT), redefined various concepts of speed in photography. Inportantly, his iconic images, produced starting in the 1930s, although mostly considered as straight-out stills, are actually the products of hybrid cinematic processes. In the course of his work, Edgerton developed a very fast film camera that was already in the 1930s capable of shooting at up to 15,000 frames per second (i.e. at a rate of over 1/15,000 of a second). With complex electronics, Edgerton hooked up his camera to a sophisticated strobe that was also capable of attaining 15,000 flashes per second and was fully synchronized with the camera. Edgerton also achieved speeds of 1/1,000,000 in the 1960s. Edgerton used to screen his films at a lower rate than the shooting rate, as in Muybridge's zoopraxiscope screenings. These, when screened at the rate of a normal cinema projector (24 frames per second), taught us about the tremendous wealth of reactions and follow-up reactions that occur in the most elusive of events - drops scattered in all directions in a glass of milk or shreds of paper that fly out in a cloud when a bullet bursts through matter. (fig. 8).

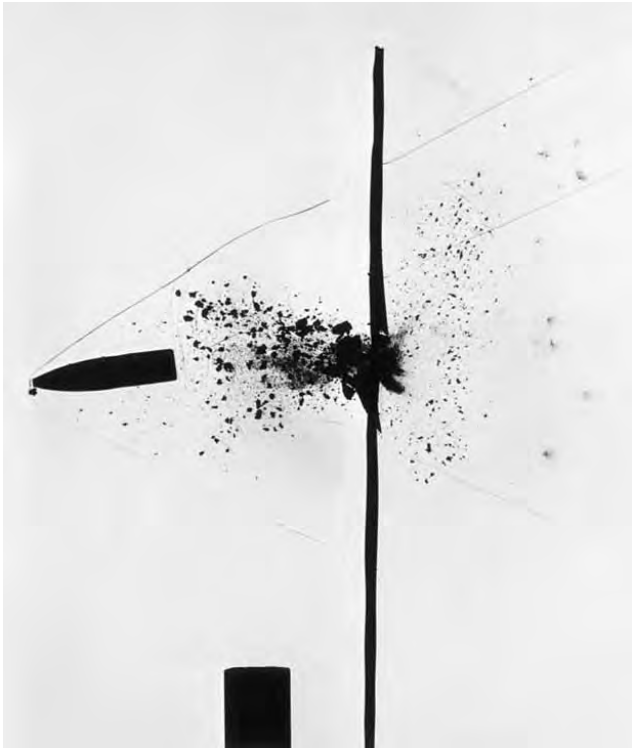


Fig. 8: Harold (Doc) Edgerton, *Bullet through Plexiglass*, 1962

Unlike Muybridge's photographs, Edgerton's photographs can not be reproduced, even today, without refined electronics. Nonetheless, the long journey of photography into the habitus of electrical and software engineering began 80 years ago. Edgerton also played a role in the development of technologies such as underwater photography, aerial photography and time-lapse photography, all of which rely to some extent on extreme synchronization speeds. Less well-known, but no less interesting, are his involvement with other technologies such as Rapatronic photography, which uses a fast electronic shutter, Schlieren photography and sonar.

Rapatronic photography is required when a nuclear explosion must be captured at the very instant of its detonation, which takes place at a tremendous speed. The well-known mushroom photos from Hiroshima and Nagasaki do not depict the explosion itself but the cloud of dust that follows it. Another inherent difficulty in making such a photograph is the fact that, apart from a blinding flare of light from the nuclear explosion, a

[4] "You selected the view: that was art. You arranged it well, focused it well: that was art.... Then you started a machine, and that machine drew the picture for you; you merely fixed its work by chemicals, which is... not art. You selected some ready-made paper, and the sun printed your picture.... That is photography, with an iota of art in the selection of the paper. We find you have not proved... you are an artist, for you can execute nothing.... If you think photography to be an art, you must decide who is the artist in the case of an automatic machine - the penny, the person who drops the penny in the slot, or the automatic machine...". Original publication: Emerson, Peter Henry. "Photography Not Art." The Photographic Quarterly, January 1892. In Newhall, N. 1975, p. 98.

[5] Flusser uses the term 'program' in reference to both hardware and software. Either way, intervention within the program is still a predetermined possibility within the 'meta-program'.

nuclear blast produces tremendous heat that incenerates every human or mechanical body that is found in the vicinity of the blast. To this end, Edgerton teamed up with two other engineers who together developed a photographic shutter without any moving parts - a shutter that opened and closed by turning a magnetic field on and off (Fig. 9). Thus, a nuclear explosion was first photographed in Nevada in 1952 using an exposure of 1/100 millionth of a second. Immediately after the exposure, the metal tower that appears in the photograph melted and the desert sand turned into glass.

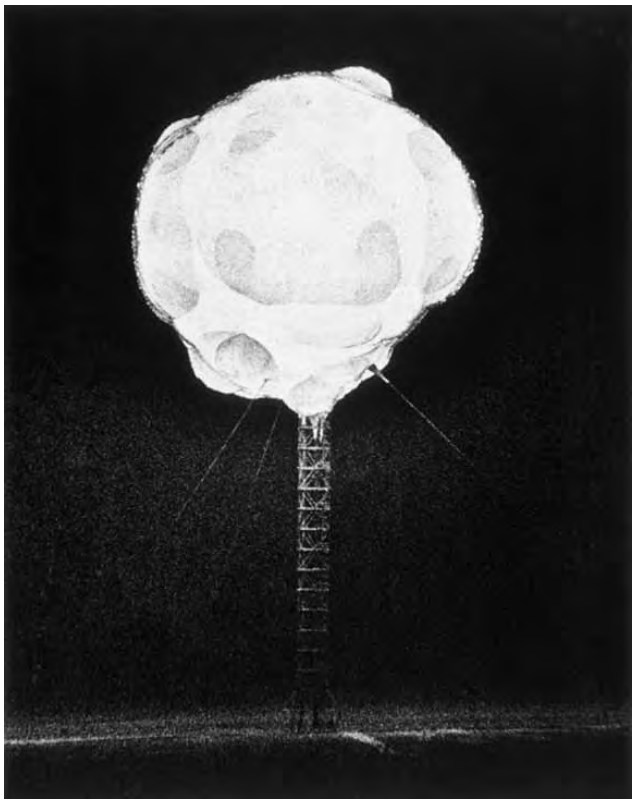


Fig. 9: Harold (Doc) Edgerton, *Atomic Bomb Explosion*, c.1952

Photographs like this one, noted James Elkins, “are exactly as only photographs can be: nearly unbearable, insistently present, perfectly resistant to the pressure of meaning” (2011, 173). Why so? Not for the reasons Elkins himself suggests but arguably because the photographer(s) that took them were not and could not have been ‘eye-witnesses’ to the events depicted in them. They were, arguably for the first time in the history of photography, far removed, safe from the reach of causality, just like their viewers.

Schlieren photography is a technology whose main use is in ballistics and aeronautical engineering. In recent years, it has also been used in advanced types of construction engineering and in architecture. The technique uses deliberate diffraction of a light beam that is recycled within a system of mirrors in order to depict changes in the density of a gas due to the movement of an object or to temperature change. Examples might include photographing air moving around the nose cone of an airplane or the convection currents above a candle flame. Sonar is a better-known technology that uses sound signals to 'see' underwater. These signals are transmitted from a submarine, for example, and are returned from the seafloor, or an enemy submarine, within a fraction of a second. If one knows the velocity of the sound waves and the density of the water, one can calculate the distance from the object that returned the sonar signal and the size and shape of the object, just as a bat does in flight. We could, for the sake of brevity, think of these technologies as quasi-seeing.

The two latter technologies have inspired new photographic technologies that will soon be commercially available. They may either revitalise or endanger photography, but the resulting revolution will dwarf the importance of that brought about by Muybridge's motion pictures. By means of incomprehensible speeds, these technologies not only redefine concepts such as body and movement but also allow for a new interpretation of the concept of the space within which bodies exist and movement occurs. It can be argued that these technologies bring to the world a kind of 'vision' through non-ocular means, a vision that has nothing in common with the human eye.

Laser Speed, Algorithmic Speed

One family of technologies that will become more familiar in the coming years includes technologies such as remote sensing, which is used in space archaeology, LIDAR and time-of-flight cameras. What these technologies have in common is the use of various forms of electromagnetic radiation, some of which are outside the visible light spectrum. These are not only reflected back to the camera but are also sent out by it in order to produce the photograph. They depend on the intergration of activities done at enormous speeds and require, as it were, that we acknowledge the categorical gaps separating between seeing, viewing and sensing. Remote sensing is a growing area of imaging that uses satellites that are able to take high resolution photographs and to produce and project beams of infrared or thermal rays. The rays are projected from a satellite moving through the outer atmosphere and are directed towards specific sites in the subterranean soil that have reasonable potential for archaeological or geological discoveries. Because infrared rays have longer wavelengths than visible light, they can penetrate the surface of the ground before they are returned to the camera by what may be found underground. The “photograph” is then put through a computerized analysis that can determine whether the

density of the soil is anomalous, thus indicating the existence of ancient roads, settlements of ancient cultures or, alternatively, an unusual geological pattern. LIDAR is a technology for remote-sensing where instead of infrared beams, laser beams are fired towards the ground and reflected from it. Laser, it should be recalled, is a type of light produced artificially by chemical reaction and is completely coherent, consisting of rays that all have the same wavelength, as opposed to 'ordinary' types of light that contain varying combinations of rays at different wavelengths. Here, too, the pattern of the returned rays is usually meaningless to the human eye and is therefore passed on for reading and analysis by a computer. Time-of-flight cameras are a class of LIDAR technology where the laser projection operation is performed differently. Instead of scanning only relevant parts of the scene, entire scenes are scanned and analysed by a computer.

Paul Virilio argues that in photography governance through speed is logistics, and that, further, in photography logistics is not only omnidirectional and computerized but also virtual, devoid of direction and devoid of distance (2006, 70). A type of time-of-flight photography developed by MIT researchers at the beginning of this decade is thus particularly relevant to this discussion. This type of photography can depict not only movement of objects in space but also the movement of light, no less, within spaces and within different types of matter. The depiction is empowered by a number of operations that occur at tremendous speeds and are fully synchronized. Thus a laser flash that is fired over one femtosecond (a trillionth of a second), and is only a few millionths of a millimeter wide, is photographed by a camera capable of exposures at a shutter speed extremely close to the speed of light. The laser flash, though it is not completely “frozen” (nor is the horse in the Muybridge photo), can be clearly portrayed by the slow projection of a chain of photographs (exactly as in Edgerton's shots of moving bullets) (Velten et al. 2013).

Moreover, the same camera is capable of an incredible time resolution of up to 2 picoseconds (2 trillionths of a second). Therefore, given that each laser burst that hits an opaque material will break into thousands of 'flash fragments', and since each fragment will ricochet in a different direction, various photographs can be woven together on the computer, each describing a different pattern of reflection from each fragmented laser burst. Thus, by calculating the time difference between the reflection returns of different 'flash fragments', it is possible to produce a mapping of distances within the space into which the laser bursts were projected, even when there might have been interference. In other words, by means of extraordinary shutter speeds, it is possible to photograph around corners, even when the camera is not directed at the photographed object (i.e. there is no line of sight between them).

This technology is already being applied and has been in use in research studies for several years. The MIT researchers predict that in the foreseeable future it might be used for other applications, such as in medicine for body imaging without X-rays or, in disaster situations, for imaging within collapsed buildings to assist the rescue teams. Because of the enormous costs associated with this technology and the commercial interests of the defence and weapons industries, it is likely that before civil applications of femto-photography become available, applications will be developed for military and other enforcement purposes - policing, dispersion of demonstrations and counter-terrorism.

Virilio claimed that history marches forward at the speed of its weapon systems (2006). Friedrich Kittler argued that history advances at the speed of its communications systems (2013). Activists believe that the camera is a weapon, nihalists believe that photography is nothing more than a communications system. One way or the other, ever since the inception of photography, its ability to promote social change or to preserve the established order, and its potential for violence have always been, and will, into the foreseeable future, continue to be a function of speed.

Speed in the Post-Photographic Age

We live in an era of acceleration, miniaturization and acceleration through miniaturization. In this paper I have tried to demonstrate that photography is subject to its own kind of Moore's Law in which accelerating cognitive processes and their expropriation by technology have become commonplace.[6] If only for that reason photography as we know is changing again. In this, I am not only refering to the growing ephemeralization of those material types of photographs that once appeared onmipresent. Huge changes can also expected for the photographic image, pertaining, in particular, to how they come into being. The professional photographer, it is now clear, is now only a congenial functionay of computation which occurs at increasing speeds, if not put completely out to pasture. In his stead now appear a wealth of options, tools and resources. They permit a truly immidiate harvest

[6] Moore’s law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.

of infinite types of image information from various sources. Human photographers, we could say, have become superfluous because their eyes, unlike camera, afford nothing but seeing. Moreover, they operate so slowly that they become an increasing burden on systems such as cameras, computers and optical communication networks whose speed of operation is approaching the speed of light. Do these insights herald the impending disappearance of photography as a distinct cultural tool? What other resources will be integrated with it or replace it? It is dangarous to predict. Doubtless, however, tomorrow's photography will be composed of numerous technologies for which the term “sight” may no longer be appropriate. Whether we are talking about scanning, sensing or computer vision, we humans will probably not need to see anything. Whether mathematical processing technologies are used extensively or exclusively, humans will be able to calculate what they want to see from a safe distance. ‘The violence of speed has become both the location and the law, the world's destiny and its destination’ (Virilio, 167).

REFERENCES

Batchen, Geoffrey. 1999. *Burning with Desire: The Conception of Photography*. Cambridge MA: The MIT Press.

Bazin, André. 1960. "The Ontology of the Photographic Image." *Film Quaterly* 13 (4):4-9.

Benjamin, Walter. 2008. *The Work of Art in the Age of its Technological Reproducibility, and Other Writings on Media*. Translated by Edmund Jephcott, Rodney Livingstone and Howard Eiland. Cambridge, MA: Belknap Press of Harvard Univ. Press.

Bergson, Henri. 1911. *Creative Evolution*. Translated by Arthur Mitchell. London: Macmillan.

Buckland, Gail. 1980. *Fox Talbot and the Invention of Photography*. London: Scolar Press.

Eder, Josef Maria. 1978. *History of photography*. Translated by Edward Epstean. New York: Dover Publications.

Elkins, James. 2011. *What Photography Is*. New York: Routledge.

Farocki, Harun. 2003. War at a Distance.

Flusser, Vilém. 2000. *Towards a Philosophy of Photography*. London: Reaktion.

Flusser, Vilém. 2011. *Into the Universe of Technical Images*. Translated by N.A. Roth. Minneapolis: Univ. of Minnesota Press.

Kittler, Friedrich A. 2010. *Optical Media: Berlin Lectures 1999*. Translated by Anthony Enns. Cambridge, UK: Polity Press.

Kittler, Friedrich A. 2013. *The Truth of the Technological World: Essays on the Genealogy of Presence*. Translated by Erik Butler. Stanford, CA: Stanford Univ. Press.

Kracauer, Siegfried. 1995. *The Mass Ornament: Weimar Essays*. Translated by Thomas Y. Levin. Cambridge, MA: Harvard Univ. Press.

Newhall, Beaumont, ed. 1980. *Photography: Essays & Images: Illustrated Readings in the History of Photography*. New York: The Museum of Modern Art.

Newhall, Nancy. 1975. *P.H. Emerson: The Fight for Photography as a Fine Art*. New York: Aperture.

Ng, Ren. 2006. "Digital Light Field Photography." PhD, Computer Science, Stanford.

Raskar, Ramesh. 2012. "Femto-Photography: Visualizing Photons in Motion at a Trillion Frames Per Second." http://web.media.mit.edu/~raskar/trillionfps/.

Solnit, Rebecca. 2004. *River of Shadows: Eadweard Muybridge and the Technological Wild West*. New York: Penguin Books.

Snyder, Joel, and Neil Walsh Allen. 1975. "Photography, Vision, and Representation." *Critical Inquiry* 2 (1):143-169.

Szarkowski, John. Apr. 13, 1975. "Photography a Different type of Art." *The New York Times Magazine*, 64-68.

Trac Trachtenberg, Alan, ed. 1980. *Classic Essays on Photography*. New Haven: Leete's Island Books.

Velten, Andreas, Thomas Willwacher, Otkrist Gupta, Ashok Veeraraghavan, G. Bawendi Moungi, and Ramesh Raskar. 2012. "Recovering Three-Dimensional Shape Around a Corner Using Ultrafast Time-of-Flight Imaging." *Nature Communications* 3:745-752.

Velten, Andreas, Di Wu, Adrian Jarabo, Belen Masia, Christopher Barsi, Chinmaya Joshi, Everett Lawson, Moungi G. Bawendi, Diego Gutierrez, and Ramesh Raskar. 2013. "Femto-Photography: Capturing and Visualizing the Propagation of Light." *ACM Transactions on Graphics* 32 (4):Article 44.

Virilio, Paul. 2006. *Speed and Politics*. Translated by Mark Polizzotti. New York: Semiotext(e). Original edition, Vitesse et Politique.

Warburton, Nigel. 1988. "Seeing Through 'Seeing Through Photographs'." *Ratio* 1 (1):64-74.

Wiesing, Lambert. 2009. *Artificial Presence*. Translated by Nils F. Schott. Stanford: Stanford Univ. Press.

Cognitive Assemblages in Ecological / Digital Art

Scott Rettberg
Professor of Digital Culture, University of Bergen
Bergen, Norway
scott.rettberg@uib.no

Abstract

This essay considers cognitive assemblages, as represented in several recent works of digital and ecological art, which themselves reflect upon contemporary environmental crises. The investigation is framed by the work of theorists N. Katherine Hayles and Timothy Morton in considering ideas of assemblages of cognition distributed between humans, non-human lifeforms, and machines, and the hyperobjects thematized by the works. The essay explores how these concepts can be read through installation artworks by artists including Phillipe Parreno, Kobie Nel, and Pierre Huyghe. How are digital artworks helping us to think through ecologies of distributed cognition during the contemporary period of planetary crisis in which they operate?

Keywords

cognitive assemblage, distributed cognition, ecological art, ecology, nature, cyber-semiotics, metaphor, installation, immersion, machine learning

Introduction: Immersion in an Uncanny Cognitive Assemblage

The Martin-Gropius-Bau museum in Kreuzberg, Berlin seems a waystation between worlds. The building was originally constructed in 1881 as an Arts and Crafts museum. During World War II, the Nazi SS headquarters were located directly next to the museum, and the building was severely damaged during Allied bombing in 1945. When the Berlin Wall was erected in the early 1960s, it was built directly adjacent to the museum, blocking off its front doors. During the late 1970s the building was reconstructed and restored. One set of windows now overlooks the Topography of Terror documentation center, an archive documenting the atrocities of Nazi Germany during WWII. The Gropius-Bau is constructed in an elegant neo-Renaissance style, and with all of these discordant historical currents flowing through it, the space inside seems somehow out-of-time, an alien in-between place.

Phillipe Parreno's "Immersion—Exhibition 4," [1] exhibited at the Gropius-Bau during the summer of 2018, is an assemblage of different elements which could be discussed as discrete objects and events but are better understood as a collective whole, an immersive ecology.

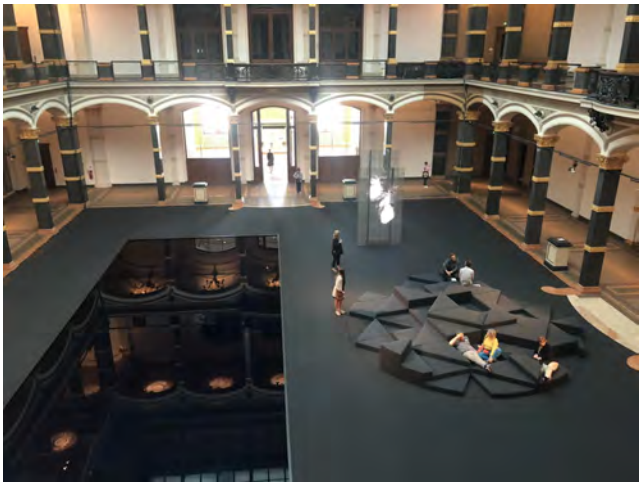


Figure 1. Photo by Scott Rettberg. Atrium space of Phillipe Parreno's Gropius-Bau exhibition, July 2018.

As I entered the imposing open atrium space of the Gropius-Bau, I felt a strange sense of entering another world with uncanny rhythms of its own. A large, rectangular, recessed reflecting pool was laid out directly in front of the entrance. The room was quite still aside from some distant music from off in alcoves all around the central space. In the pool at occasional intervals, barely perceptible bursts of water plopped up from beneath, creating reverberating circles in the water. As they rippled, the reflection of the geometric patterns of the window panes of the glass roof above warped and curved with the movement of water. The documentation of the exhibition explains that these patterns are actually sounds from elsewhere in the exhibition space "transduced into visual patterns of water lilies." On the other side of the pool, a large sculptural cluster of triangular sofa sections rotated slowly on a circular turntable before two black steel grids. After a few moments I heard a sudden surge of raw voltage. The grids lit with electricity, and as they charged, an image seemed to flash briefly in arcing bolts of light. As I settled onto the rotating furniture and watched the grids as they charged up again, I saw that this was indeed a kind of

picture, imprinted as a retinal afterimage when I closed my eyes: an electric insect, a flickering dragonfly.

The other rooms of the exhibition featured both objects, such as drawings of these same dragonflies, framed bits of asemic writing, and aleatory events. Dozens of polystyrene fish balloons floated in one room, driven by small fans that created shifting air currents so that the air above our heads seemed to become a kind of organic stream as a docent with a net struggled to catch some strays moving into other rooms.

Strange videos played in two dark rooms, including one of a crowd of people reacting to some sort of unexplained presence or rapture on an auditorium stage as flashes of light occasionally lit their confused faces as they wandered. The video redirected our attention as an audience not only to the reactions of the people on the screen, reacting to an unseen presence in a darkened room, but to our own reactions to the video and to each other, watching in a similar room. In two other spaces, player pianos stood in the center of the room. In one of these rooms, very little seemed to be happening as I was waiting, but shades covering two high vertical windows moved slowly up and down at intervals. I spent several minutes waiting for something to happen with the piano when I heard a nearly-imperceptible voice coming from an air vent on one side of the room. As I bent my ear to the vent, I could just make out bits of a monologue: a woman whispering about machines and computers, asking whether we were controlling the machines, or if they were controlling us. On the other side of the building, the player piano did in fact occasionally play a tune, but not consistently. Sometimes it would strike only a chord or two, other times it would play a full bar.

Figure 2. Photo by Scott Rettberg. Laboratory space of Phillipe Parreno's Gropius-Bau exhibition, July 2018.

In one of the alcoves off the main atrium, there was a small laboratory enclosed in a plexiglass case including beakers, scientific measurement equipment, and computers. The exhibition brochure described this as a bioreactor "in which micro-organisms multiply, mutate, and adapt to their environment." Monitored and transcoded, the yeast cultures in the beakers are connected to computers that are in fact the engine driving and "orchestrating the contingent events" elsewhere in the exhibition. The documentation claims that over time "these yeast cultures develop a memory—a collective intelligence—that learns the changing rhythms of the show and evolves to anticipate future variations." Parreno describes the micro-organisms' interactions with each other and with the conditions of their environment as "neural circuitry" that "sets a complex non-deterministic, non-linear mise-en-scène in motion through a series of non-periodic cycles."

In her *Unthought: The Power of the Cognitive Nonconscious*, N. Katherine Hayles articulates a relationship between human and non-human cognition that is distributed between three types of actors: human beings engaged in the types of cognitive activity we typically characterize as "thought," non-human life forms (from whales to micro-organisms to plants) that also clearly engage in acts of individual and distributed cognition, and AI and other forms of machine cognition. Hayles argues that it no longer makes sense to consider human thought as a process that occurs in isolation from the cognitive processes of these other cognizers with whom humans co-evolve in various forms of symbiotic and sometimes agonistic relations. Human semiotics must encounter bio-semiotics and cyber-semiotics. Hayles describes the position of homo sapiens within this network of cognitive associations as "…open to and curious about the interpretative capacities of non-human others, including non-biological life forms and technical systems; she respects and interacts with material forces, recognizing them as the foundation from which life springs; most of all, she wants to use her capabilities, conscious and unconscious, to preserve, enhance, and evolve the planetary ecology as it continues to transform, grow, and flourish" [2].

Parreno's exhibition comprises what Hayles has described as a "cognitive assemblage." The exhibition itself is a literal assemblage, composed not only of a variety of types of artistic objects, materials, texts, video, and events, but also an assemblage of different agents cognizing, processing, and influencing each other and the participants' experience of the work. Moving through the exhibition is not so much an experience of "viewing" an artwork as an outside observer, but one of a kind of immersion within a cognitive assemblage. Audience members are not outside of the experience, nor are they simply surrounded by it. Instead, upon entering the exhibition they become an element within a cognitive assemblage in flux, cognizing agents within an assemblage that is itself cognizing. The micro-organisms, the transcoding computers, and the visitors themselves are all feeding into a variable system that produces the collective experience of the work as a gestalt. Numerous feedback loops between different elements of the work process information provided by systems that themselves are processing information provided by the elements they affect. For example, in the laboratory, information transcoded from the

observations of the micro-organisms becomes a variable affecting the rise and fall of the shades over the windows of the room of the laboratory itself. The micro-organisms' exposure to light affects the growth and movements of the micro-organisms in turn. The sounds the visitors to the exhibition make while moving through the space influences the production of the water lily patterns in the water, which might in turn affect the visitors' movements. The affect is that of an unavoidable, immersive ecology.

The visitors to the exhibition also impacted the experience of the other visitors. Because everyone was immersed in the exhibition, the artwork was in effect coterminous with the whole floor of the Gropius-Bau. We watched not only the strange furniture rotating on the turntable, but the movement of the other humans on that furniture. We experienced not only the fish balloons floating in the air currents above us, but the smiles and laughter of the other visitors playing with the fish and redirecting them in the air streams. As we processed, cognized, and reacted to the artwork, we became elements of the artwork itself. The work as a whole presents a cognitive assemblage which is non-anthropocentric in the sense that human agents are not the sole cognizers in the environment. In Hayles's view, "*Cognition is a process that interprets information within contexts that connect it with meaning*." [3] When the growth of the micro-organisms in the lab is registered by the computers, that represents a process of cognition that connects that growth with meaning, which is then interpreted computationally, launching events which are connected with meaning by the humans interpreting the artwork, and their movements and actions within the space further represent interpreted acts of cognition, in a continuous cycle of feedback loops between micro-organism, computation, and human cognition.

A Canary in a Meat Packing Plant: Ecology After the End of the World

Bergen Kjøtt is a curious exhibition venue north of the center of Bergen, Norway. From the 1960s until the early 2000s, the 2000-square-meter, four-floor building was a meat-packing plant. In recent years it has been converted in a cultural venue, including studios occupied by some 300 artists and musicians and a large exhibition space on the first floor—an open space large enough for livestock to be unloaded from trucks and prepared for slaughter. While this space has been thoroughly repurposed and is now a buzzing hive of artistic activity, it remains a clearly post-industrial site, with a different rawness and edge than typical white cube gallery spaces.

In April 2018 I visited Bergen Kjøtt to see the "Apple Puma" exhibition by South African artist, Kobie Nel [4]. Not knowing what to expect, I walked up the stairs to the second-floor exhibition space. Thick plastic curtains hung over the entry. After I pushed through them and entered the space, I jumped, startled, as something brushed by my head. As I turned the corner, I heard the sounds of clouds rumbling in the distance. I heard birdsongs and, as I looked up to the high ceilings, saw that a number of canaries were perched on ropes hanging overhead. Others were flying in the space, nibbling at heaps of birdseed on the floor, strutting across bales of hay, or hopping from dowel to dowel on a custom-made bright green wall. Initially fighting a kind of panic, perhaps borne of my memories of Hitchcock's *The Birds* or a traumatic childhood encounter with a sharp-beaked parrot, I walked further into the space and saw that two armchairs were set amidst a kind of three-dimensional post-industrial tableau. The canaries were artificially bright, brilliantly yellow and flamingo pink-orange. Scattered on the floor were chunks of bricks that looked as if they had been gathered from a site of a recent demolition. A few wine glasses filled with water were perched precariously among the bricks, and the odd dish was scattered here and there. A number of clear plastic two-liter soft drink bottles filled with water and rose blooms of different colors inside them were placed amidst the scene. Some neon light sculptures in abstract patterns that called to mind jellyfish or beetles were mounted on the walls.

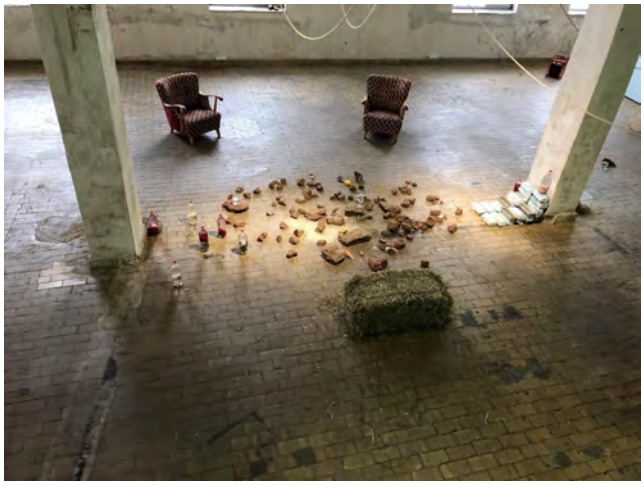


Figure 3. Photo by Scott Rettberg of Kobie Nel's "Apple Puma" installation at Bergen Kjøtt, April 2018.

Several high-resolution photographs hung on the walls of the exhibition: one was of a cactus into which the words "Apple Puma" had been carved, another was a Type-C print of a bright green serpent coiled up on a rope inside a wire mesh cage. The "Apple Puma" images were difficult for me to decode. They represented a process of human inscription on the living tissue of the cactus. Someone (probably the artist) had taken a knife to the cactus, and the cactus, thus scarred, would continue to grow bearing those words (readable only by humans) for the rest of its lifespan. The choice of words was also strange: "Apple" and "Puma" are both words that denote non-human life forms, neither of which have anything in common with cacti or the desert landscape. They are also words that have been appropriated and trademarked as corporate names, one for the world's most-valued computer company, the other for a pair of running shoes The image presented a complex kind of signification. On the one

hand, the plant, this hardy, spiny life form in the desert, had been appropriated, carved into, literally branded with symbols that represented ideas of nature that had also been appropriated by corporate brands. On the other hand, the plant would continue to grow in its environment in spite of the carving. Modified and changed, it would adapt to the scars and continue to develop around them.

Figure 4. "Apple Puma" © 2018 by Kobie Nel.

The pattern of the wire mesh in the photo of the serpent was similar to the pattern of the scales on the snake's skin. The title of the photo "Marpat" suggests the connection between the two patterns. Marpat is short for "Marine patterning"—a multi-scale camouflage pattern formed of rectangular pixels of color that is also known as "digital camou." The pattern match between the wire mesh and the snake's skin in the image were indeed so close that at first, I thought the image must have been modified. Because the resolution was so high and the colors of the print so bright, the image took on an almost three-dimensional character. As I looked at the image, it was impossible for me to distinguish what was "real" and what was the product of a digital process. The ambiguity in the image highlighted one of the themes of the exhibition as a whole: is there ultimately any difference between a serpent in the garden and our invention of a serpent in the garden? The serpent, like climate change, remains regardless of whether or not we created it.

I settled into one of the armchairs and tried to process the scene of which I was now a part. Alone in this space with perhaps two or three dozen birds, I felt that I was no longer the observer. My sensation was not similar to that of a man looking into a bird cage, nor was it that of walking into one of the immersive rainforest exhibits you sometimes find in zoos—this was not a meticulously detailed rendering of a natural environment. This was not the canaries' "natural" environment. And yet, as the canaries chirped and nibbled and hopped and flitted across the factory floor, offering the me the occasional sideways glance, it felt much more like I was the creature under bemused observation than the canaries were. It would be too much to say that I had stepped inside a bird cage, or that I had come to take the place of the bird, but the exhibition represented a clear disruption in "the order of things" and in our presumptions of "nature." The human was not at the center of things here, but an aspect of an ecology of an environment after the human.

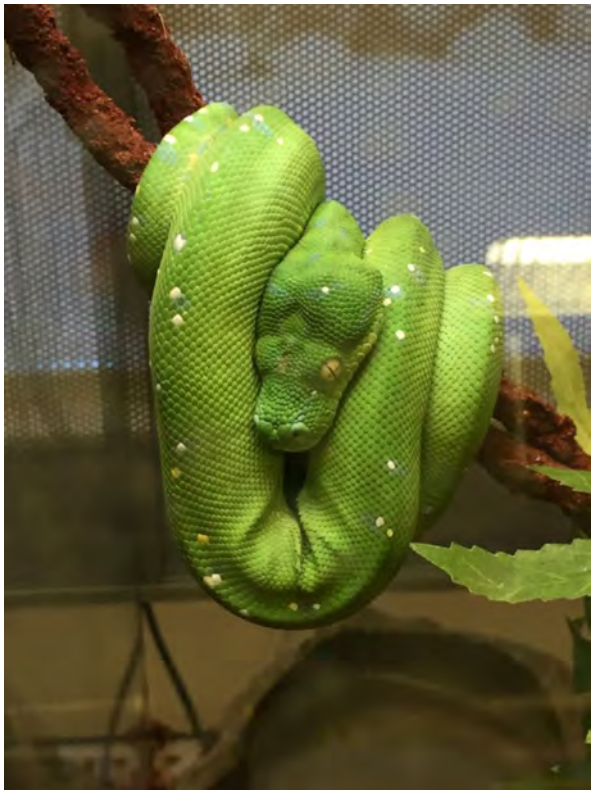


Figure 5. "Marpat" © 2018 by Kobie Nel.

The canaries in the room were not colored in the hues they were born with. The "true color" of the canary is white, but its color can be modified by dietary additives in a process known as 'colour feeding'—the colored birds fetch more at the market than plain white ones [5]. Although this strange space, this former slaughterhouse, had in some sense been temporarily given over to the birds, the birds themselves had been modified in a process of Anthropocene intervention. The birds and I were coequal parts of an ecology, as Timothy Morton has described, "after the end of the world" [6].

Morton highlights the fact that the concept of "the world," in fact the whole practice of "worlding" poses problems for the situation of the human within a planetary ecology. Following Heideggerian phenomenology, Morton explains that "different sentient life forms have different experiences of their surroundings, and hence phenomenologically […] different worlds" [7]. When we speak of "the world" we inevitably speak of "our world" because our process of

understanding the world is inevitably based our phenomenological experience of it. As soon as we begin to imagine a world, we therefore situate the human in its center. We could imagine that there are other worlds operating at any given time: the worlds of the dog or the cat, the worlds of the canaries or the serpent. It is difficult to think in terms of both my world and those other worlds simultaneously, as my world is the only one that I have direct experiential access to. Morton identifies the "fundamental problem with worlds: they do not exist" [8]. A world is always a construct, and when the world that I construct is in conflict with your world or the worlds of the serpent or canary, we have no basis for shared understanding. Yet we must base any proactive approach to the environment on the presupposition that a shared objective reality exists. By placing the human observer within a space that could no more be said to be the domain of human that it could be said to be the domain of the canary, Nel highlights this fact that any conception of a world centered exclusively on the human is an artificial construct.

The discourse of nature has always been a discourse of distancing. When we speak of "getting back to nature" or "natural ingredients" or "nature preserves" we do so by positing nature as something at some distance from the human, or outside of ordinary human experience. Because this positions nature as outside of "our world," it also enables us to think of nature as something that can acted upon without personal consequence. To think of nature is therefore always also to think of nature as "natural resources." Nature might be the source of a pastoral idyll, but it is also a repository, for example, of fossil fuels. Nature is alternatively posited as an ideal (an Edenic state before the fall) or as a threat (that which is in conflict with the human, e.g. Jack London trying to build a fire in the snow). Nature is a construct in the sense that we posit it as something a priori to and distant from the human. The trouble with the concept of nature is that "Just when it brings us into proximity with the nonhuman 'other,' nature reestablishes a comfortable distance between 'us' and 'them'" [9]. In this sense nature is a dangerous concept, as in distancing the human from a wider ecology of life forms we also posit a state in which we are apart from nature or can somehow exist without it. Morton argues that one consequence of the Anthropocene is that we no longer make such assertions. We can no longer imagine a nature apart from us. The environment that surrounds us is always already impacted by our presence in it.

There is no point in imagining the white canaries in their natural environment when I am surrounded by brightly colored canaries in a meat packing plant. The room in which the exhibition took place was not the only part of it that was post-industrial. All the lifeforms within it, human and bird, were post-industrial as well.

Morton argues for a form of "deep ecology" that would entail a shift from our view of "anthropocentrism to ecocentrism" [8]. There is nothing inherently anti-human about this perspective, but it does entail a realization that the planet is not a "world" uniquely shaped by human needs and human perspectives, but a complex ecology shaped by many forces, and we can further say by many different types of cognizers. In Morton's view, the understanding of the human as the steward of nature is at the core of the catastrophe of anthropocentrism that has already occurred. The catastrophe calls for a conception of the human that is not to be understood as a steward of that which it has already altered and damaged, but an element within it. Morton asserts that "what is called human is more like a clump or assemblage of things that are not strictly humans—without human DNA for instance—and things that are—things that do have human DNA. Humans did it [climate change], not jellyfish and not computers. But humans did it with the aid of beings that they treated as prostheses: nonhumans such as engines, factories, cows, and computers […] The reduction of lifeforms to prosthesis and the machination of agricultural logistics is hubristic, and tragedy […] is at least the initial mode of ecological awareness" [10].

The artworks discussed here share in common the element of reiterating this fundamental point: the type of ecological awareness that is necessary to mitigate the effects of climate change will require an understanding of the human as a cognitive assemblage that is enmeshed within a broader cognitive assemblage that humans impact continuously and are continuously impacted by. The fact that machine learning systems are playing and will play an increasingly omnipresent role in shaping human culture and society is only one of the more obvious ways in which we are part of a distributed cognitive ecology. And we must acknowledge our participation in this ecology as if our lives depended upon it, because they do.

Machine Learning in the Realm of the Flies: Pierre Huyghe's "Uumwelt"

The Serpentine Gallery in London is housed in a former tea pavilion built in 1933 and nestled on the banks of the Thames. In November 2018, I visited Pierre Huyghe's "Uumwelt" exhibition there [11].

Just as in the Kobie Nel exhibition, I had to enter the space by pushing through plastic curtains (a feature which I now anticipate indicates the presence of non-human lifeforms). There are two central elements to "Uumwelt": a series of large screens flashing rapidly sequenced videos of machine-learning-generated imagery in separate rooms of the gallery space, and a colony of flies buzzing around the room. The images were generated by a neural network that uses human brain activity measured by fMRI data. The images produced are the result of a "reconstruction algorithm" developed at Yukiyasi Kamitani's lab at Kyoto University [12]. Pierre Huyghes describes the process as follows: "They [Kamitani Lab / Kyoto University and ATR] are doing an MRI of someone who is thinking about an image and they take a brain wave at the moment that person is thinking about the image and this wave becomes a pattern and this pattern goes through multi-neural networks which have a databank of millions of images. To me is was fascinating that in a lazy, poetic way I could say 'I just need to think and it prints." [13] The neural network had been

trained on images of animals such as birds, owls, and dogs and a corresponding set of patterns of fMRI data from humans who had looked at these images previously. The images shown in the exhibition were generated by the neural net in response to new observations of fMRI data from human participants who looked at the same set of images. The images the system generates are the best guess of its predictive algorithm of the shape and features of the animal the human was thinking of. The system is not showing the images it was trained on but the new images it struggles to produce in a live response to the human subject's thoughts. The results, like many neural-net-generated images, are uncanny forms of almost-parrots and pig-dogs that shift into almost-human skulls.

Figure 6. Photo by Scott Rettberg of Pierre Huyghe's "Uumwelt" installation at the Serpentine Gallery, November 2018.

The flickering imagery was extremely liminal in nature. As I watched it, I had the feeling that I was watching *something* think, almost forming an image, grappling to give a thought material form, but I could not say whether I was watching a neural network cognize or watching a human think. The images are of course simultaneously a representation of both human and non-human cognition and of the tenuous space in between. The fact that the images almost taking form were images of animals added another layer to the experience. The images of the neural net that (I think) was trained on pictures of dogs were particularly striking; in addition to the struggles of human and machine cognition represented, I was also witnessing animals trying to emerge, to surface, to be seen. Eyes struggling to take form in hollow sockets: a kind of pathetic and uncanny process that I could neither turn away from nor refuse to feel a sense of identification with.

"Uumwelt" is the German word for "environment" with an extra U. Like many aspects of this piece, we could speculate about what the extra U means: is it meant to suggest a personal "you" inseparable from the environment? Is it intended to suggest a negation, an "un-environment"? The artist does not explain this, nor to what extent Huyghe modified the imagery vs. simply appropriating imagery provided by the research lab.

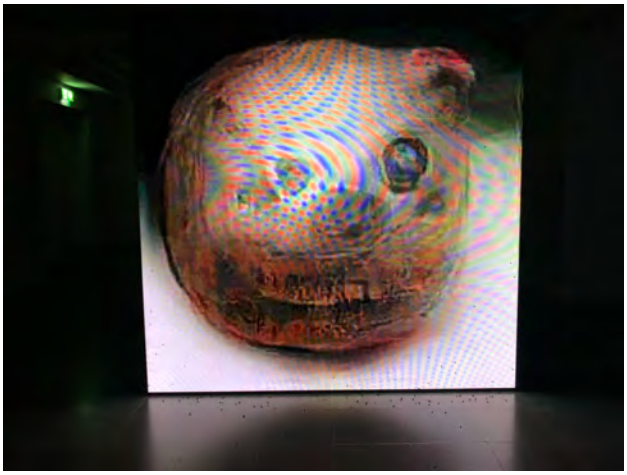


Figure 7. Photo by Scott Rettberg of Pierre Huyghe's "Uumwelt" installation at the Serpentine Gallery, November 2018.

The flies in the space played an important role in my experience of the piece, though the extent of their impact on the technical production of the work was unclear. While I was in the space the docent explained that the movement of the flies in the space was somehow filtering or modifying the presentation of the piece. She did not know how precisely, but there were sensors within the gallery space. The movement of the insects or their infrared concentration were somehow affecting the way that the images were presented: my guess is via the speed at which the system moved through the image-set, though it was difficult to tell.

The more important effect of the flies in the space was metaphorical. These flies were specifically bred from a strain of a species common in the park outside of the gallery space. The lifespan of the flies was a matter of perhaps fifteen to twenty days. The flies were nourished by feeders placed in a circle the ceiling at the center of the Serpentine Gallery. The paint on the walls of this room had been partially stripped, revealing layers of paint from previous exhibitions stretching back to the 1970s, and reiterating a sense of environmental memory.

All of the flies had been born in this gallery and would die in this gallery. Because they were all well-fed and because they were attracted to the bright screens that dominated each room of the gallery, the flies, if initially unsettling, were not particularly bothersome to the human visitors. They seemed not pests, but a kind of co-existent being.

In addition to the flies in the air, the floor was littered with the bodies of the flies that had died that day in the space. You had to walk carefully to avoid crunching their bodies underfoot. Every night the bodies of these dead flies were swept from the floors of the gallery, even as new flies were born to take their place.

Figure 8. Photo by Scott Rettberg of Pierre Huyghe's "Uumwelt" installation at the Serpentine Gallery, November 2018.

I was forced to contemplate the nature of these flies' existence: their entire world consisted of this strange gallery environment, surrounded by images representing machines trying to represent human thoughts about animals. Although I rarely think about the thoughts of flies, in this situation I could not help but wonder about fly cognition. In a way it might seem cruel to breed creatures only for this purpose: to buzz around a dark gallery space and to crawl across flashing screens. The world of the gallery was their world-as-such, they would never know any other. They were literally created for these rooms alone. Yet in that moment in the room they were a co-equal part of a cognitive assemblage, a cognizing element of an enclosed system from which they would never escape. Their situation was not so different, in a way, from that of the human within the planetary ecology. The difference, of course, is that with consciousness and efforts, humans might at least be able to recognize their situation within this ecology and confront the hyperobjects, like climate change, which are difficult to comprehend discretely because they operate on a different time scale than, for instance, weather does, or even than our lifetime does, but might potentially be better understood and somehow mitigated over cycles of generations.

References

[1] Philippe Parreno, Exhibition brochure for "Immersion – 4" Groupius-Bau, Summer 2018.

[2] N. Katherine Hayles, *Unthought: The Power of the Cognitive Unconscious* (Chicago and London: The University of Chicago Press, 2017), 64.

[3] Ibid, 23

[4] Kobie Nel. "Works: Kobie Nel." http://www.kobienel.com/

[5] Dan Miller. "The Sentinel and the Species" (Catalogue essay for Kobie Nel's "Apple Puma"). Bergen Contemporary Art Project, 2018. https://danmiller.website/text/downloads/danmiller_the_sentinel_and_the_species_2018.pdf

[6] Timothy Morton, *Hyperobjects: Philosophy and Ecology After the End of the World* (Minneapolis: University of Minnesota Press, 2013).

[7] Timothy Morton. "Coexistence and Coexistent: Ecology Without a World" in *Ecocritical Theory: New European Approaches*, ed. Axel Goodbody and Kate Rigby (Charlottesville and London: University of Virginia Press, 2011), 168.

[8] Timothy Morton. *Ecology Without Nature: Rethinking Environmental Aesthetics* (Cambridge: Harvard University Press, 2007), 19.

[9] Ibid, 2.

[10] Timothy Morton. *Dark Ecology: For a Logic of Future Coexistence* (New York: Columbia University Press, 2016), 201.

[11] Pierre Huyghe. "Uumwelt," the Serpentine Gallery, London. https://www.serpentinegalleries.org/exhibitions-events/pierre-huyghe-uumwelt

[12] Kamitani Lab, Kyoto University. http://kamitani-lab.ist.i.kyoto-u.ac.jp/

[13] Pierre Huyghe and Rebecca Lewin. "Pierre Huyghe: UUmwelt" (Video interview), Oct. 30, 2018. https://youtu.be/enxvyWn7UU

Author Biography

Scott Rettberg is a professor of digital culture in the department of linguistic, literary, and aesthetic studies at the University of Bergen, Norway. Rettberg is the author and coauthor of novel-length works of electronic literature such as *The Unknown*, *Kind of Blue*, and *Implementation* and combinatory films such as *Toxi•City: A Climate Change Narrative* and *Penelope*. His work has been exhibited both online and at art venues such the Venice Biennale, Beall Center in Irvine California, The Chemical Heritage Foundation Museum, Arts Santa Mònica, the Slought Foundation in Philadelphia, and The Krannert Art Museum. Rettberg is the cofounder and served as the first executive director of the nonprofit Electronic Literature Organization. Rettberg and his coauthors were winners of the 2016 Robert Coover Award for a Work of Electronic Literature for *Hearts and Minds, The Interrogations Project*. He recently published the book *Electronic Literature* (Polity, 2019), a comprehensive introduction to the history of genres of electronic literature.

Underwater Sound and Oceanic States of Mind

Yolande Harris
Digital Arts and New Media, University of California Santa Cruz (UCSC)
Santa Cruz, California, USA
yharris@ucsc.edu

Abstract

Underwater sound is brought closer to everyday experience by a series of artworks that use deep ocean recordings in site-specific sound walks along the edge of the ocean. Using a practice of embodied experience the sound walks explore notions of listening and connectedness to the uninhabitable ocean. Sound is considered as engaging a sense of relatedness that allows participants to imaginatively dive beneath the visual surface of the ocean, encouraging a sense of presence and connectedness to arise from these encounters. The artist-author recounts her creative process, as well as exploring responses of participants, to elaborate a multi-faceted field of artistic research around sound, environment and sonic consciousness.

Keywords

Underwater sound, sonic consciousness, marine mammals, sound walks, listening, deep listening, environmental art, embodied knowing.

Sonic Consciousness

"The möbius strip of expanding awareness moves out from one's own body to immediate place, to other phenomena, on to remote environments and back to the self in Yolande Harris' rich body of thought and art… The sense of interdependence which they evoke and encourage is vital to our transformation into good stewards of our environmental neighborhoods." [1]

How can our conscious listening affect the world around us? How can learning to listen to underwater sounds transform us, and transform our relationship to the environment? Listening to underwater sounds helps us to understand ecological interconnectedness even in such remote environments as the deep ocean, where sound is crucial to ocean life. Environmental degradation of the ocean includes the specific problem of uncontrolled anthropogenic sound, and one of the tasks of learning to listen is to hear these human sounds in the context of the acoustic interdependence of ocean life. How can we relate as land-dwelling humans to the deep ocean, can we experience a sense of presence? The technological advances that enable us to hear underwater with our feet on the earth, encourage us to re-embody our sonic sense and our sonic intelligence towards the goal of a more conscious awareness of the remote, inaccessible environments of this planet.

Sound and Environment as Artistic Practice

"Shifts in time and space, and undulations in daily perception, are active elements within the work of artist Yolande Harris, and brought forward through a deep curiosity for the world. A gap or fissure seems to appear, to break in – between seeing and believing, between material fact and poetical imagining, and between the near and the far, along with the ineffable and animate threads that may also connect and therefore disrupt such dichotomies. The gap, and the threads that traverse and link, and which invite us to enter their subsequent web of associations and slippages, disorienting layers and close-ups, and from which new perspectives are generated." [2]

My process of making art draws on the coexistence of multiple ways of knowing, and moments of heightened awareness that arise in everyday experience. I collect and listen to underwater sounds, and create works that emphasize not only the sounds themselves but also the context in which I find them. I am curious about the many ways we listen and the different motivations listeners have. Through my work I aim to balance knowledge and insights about the ocean from the disparate fields of science, culture, the arts and psychology.

Part of my research is learning to incorporate forms of knowing that happen beyond my rational intellect, such as those generated and stored in my body, and my intuition, allowing my mind to recognize and integrate these forms of knowledge. My creative process combines many hours of close listening, the rigorous analysis of those sounds, and freely following intuitive threads of ideas in the moment of making. For someone experiencing my work, I aim to provoke a sense of wonder in my audience, inviting their imagination to actively make sense of the experience.

The projects discussed here activate the senses, drawing the participant back to the body as the central vehicle with which we interface with the world around us. There is a moment when the individual opens to receive these sounds into their system, in a way that is beyond information. When imagination, investigation and the senses are combined, an expanded form of presence can arise. And when something is given presence, it can no longer be ignored. I

am particularly interested in how sound and listening can help facilitate this presence in the context of the ocean.

Over the past ten years my research has focused on sound in the submarine environment, with numerous works focusing on the dislocation between visually seeing surface and sonically experiencing depth. Sound activates relationships between humans, animals and our shared environments and it is these relationships my work strives to reactivate and renew. I situate sound within a broader sensory context, recognizing the interdependence of the bodies own systems with the environment it is in. My performances, installations, workshops, walks, lectures and writings combine deep listening, field recordings, live performance and sound technology with images, video projections and other sensory materials such as braided jute, to explore remote places of the environment and the mind. My goal is to develop what I call 'sonic consciousness', a deepening of awareness through an attentiveness to sound, and 'techno-intuition', combining technological and intuitive ways of knowing and being in the world.

A range of underwater listening experiences

The following offers a series of examples from my own underwater listening experiences, presenting a wide range of places, interactions, technological interventions and ideas.

I lower a hydrophone, an underwater microphone, through the surface of the water. I pull it up and let it down again, listening to the change in sound as my extended ear crosses between air and water.

I tune in to live streams from hydrophones from deep ocean observatories around the world. [3] Most of the time there is the ocean hiss of white noise, faint or loud hums from distant boat engines, and the occasional voice of a whale or dolphin.

I am in the lab of a university oceanographer, listening to the first sound recordings of a sea-glider collecting data in the Pacific Ocean. [4] We hear constant machine sound from the glider, occasional bubbles and faint whale call.

Later I ask the same oceanographer which species were brought into harbor by the whaling fleets of Dundee in Scotland. My ears open up when she sends me a soundscape full of bowhead whales, bearded seals, beluga whales and narwhals, sounding in the creaking and squeaking of the artic ice caps. [5]

In a local natural history museum on the coast of the Monterey Bay in California, I set up a hydrophone for visitors to listen in the touch pool. [6] I watch as they move the hydrophone around, carefully exploring the acoustic spaces where the anemones live, mostly sonic shadows created by rocks that hide the ongoing reverberation of the pump.

I go whale watching and we come close to humpback whales feeding in the Monterey Bay. The engine is shut off, people on the boat gradually grow calm, the chattering stops, and as a whale dives deep showing its fluke, I hear a collective gasp and sigh from the crowd.

I listen to an interview with a 'dolphin ambassador' and participate in her guided meditation of dolphin sounds. I sense a change in the energy of the room. [7]

I am watching the spectrogram of recorded sounds that I've been given by a scientist working with a hydrophone deep in the Monterey Bay and I see the shapes of sounds well outside my hearing range. [8] I listen in detail over and over, zoom into specific features, sometimes I recognize sounds. I shift sample rate, change speed, filter, remove ocean hiss, replace ocean hiss, equalize so I only hear certain bandwidths, check how sounds correspond to each other. I am getting to know the material and sonic space from many angles.

Gradually the deeper ocean, while still out of my reach in so many fundamental ways, comes closer, or rather, I come closer to it. I begin to melt into it**.**

Listening to Arctic marine mammals in Dundee Harbor, Scotland

"In Whale … visitors are invited to walk, letting the sounds of whales envelop them in their watery, deep murmuring. These sounds are at once distant from our earthly territory, our terrestrial senses, while they in turn immerse us within their sudden proximity: the immensity of the sounds – the great depth and dimension of their sonority – are brought right up against our skin, delivering all this depth and resonance into our listening." [9]

In 2017 I was commissioned to make a project in Scotland focusing on Dundee's history as a whaling port. [10] The resulting piece, *Whale (Dundee)*, is a thirty-minute sound walk using custom-made, open-ear headphones with an audio player, situated along the historic harbor walls of the city and on the historic ship, RRS Discovery. Dundee has an interwoven history of whaling and jute production, whale oil was used in the production of jute, and jute ropes rigged the whaling ships. Using a traditional Celtic braiding technique – a sixteen strand hollow braid that enables a solid core to be wrapped in rope – I wove Dundee jute around the headphones for the sound walk. The rough feel of jute in one's hands, along with the braided pattern in two colors, provided a material physical reference to Dundee's whaling history that participants experience when they touch the headphones. The ongoing entwining of the cultural lives of these species - human and cetacean - fascinates me. [11] The braided headphones are a way of acknowledging the complexity of these cultural references in both the cetacean and human communities.

In response to my inquiry about the species of whales hunted by Scottish whaling ships, University of Washington oceanographer Kate Stafford, sent me sound recordings that she had made under the arctic ice in the vicinity of whaling areas Fram Strait and Davis Strait close to Green-

land. In addition to hunting bowhead whales, bearded seals and beluga whales, Stafford suggested that Scottish whalers also hunted narwhals. Her recordings of the animals in their arctic habitat are extraordinary to listen to. Bearded seals make long downward wavering whistles of pure tones that fall endlessly at differing speeds, some fast, some slow, some starting at a very high pitch, others at a low pitch, with no apparent 'breath' to break the sound. The sounds are rich with reverberation and appear to go on into an indefinite background. The bowhead whale has a squeezing multiphonic vocal sound, in repeating phrases alternating high and low, that have a compressing and decompressing effect on my body when I listen to them. The artic ice is irregularly creating a background of squeaks, creaks and loud bass cracks that fill the sound field. These recordings induce in me an uncanny sense of connection with the direct physicality of another body making sound. I feel as though I could reproduce these sounds and as I try, I realize that they require me to have internal pressure inside my body, more like bodily resonations than our open mouthed projections.

When I work with these sounds I go through a period of deep immersion in them, through repeated listening often for hours at a stretch. The high quality of the recordings enables me to work with them to reveal qualities I might not otherwise hear, by changing the speed and shifting the frequency into my hearing range. I also work with the visualization of the sounds in spectrograms both to help me listen, and to edit, at times zooming in on certain frequencies to get more clarity in my mind as to what this sonic environment consists of. After this immersion, my editing process consists largely of selecting portions of the recordings. I listen for clear calls and sounds and sections where many voices call together or appear to interact, as well as the background contextual sounds. I am listening for passages that clearly reveal the array of sounds happening simultaneously, and the sonic context within which they occur, rather than for one perfect voice. I present the sound environment in a way that is minimally edited while maintaining the listeners interest.

When listening to the headphones on the historic walls of Dundee harbor, to these oceanic voices – bowhead and beluga whales, bearded seals and narwhals – we can imagine them speaking directly into our ears from arctic waters. They become the agents, the guides, the voices of knowledge beyond our immediate experience. *Whale (Dundee)* creates a resonance with the past and our changing relationships to the ocean and the animals that inhabit it, while preserving a sense of wonder and inspiring a greater sense of empathy.

People who participated in this walk were invited to share their reactions in a guest book. Many of the comments point to the sound experience in combination with the site as revelatory or transformative:

"A moment to reflect on this history in the landscape.
Beautiful and meditative, left a lot of space for thoughts to wander and [be] still.
Really thought provoking.
Was aware of smells and feet walking. Was very emotional, quite upsetting toward the middle and then calmed down at the end. Otherworldly and floaty.
Who would think all those sounds came from the sea!
Haunting sounds, feels like heaven, thank you.
Sublime, altered perception of the waterfront.
Haunting. Made you reflect about our relationship with animals and think about the future and our role in preserving their environments.
Beautiful sounds of the ocean! Sometimes I felt like I was on another planet! Closed off from my surroundings and transported into the deep and wild oceans.
I've joined the whales. Send a note to my family…
Want to buy the headphones."

Sound, Body and Oceanic States of Mind

These are not unusual reactions to my work. Words like *meditative, aware, haunting, heaven, sublime, altered perception, another planet, transported* are commonly used to describe a state of mind that is activated through the listening experiences I create. In my desire to build on the knowledge that I receive through these interactions, I look for answers in complementary forms of experience, bodily systems of knowledge that are a step removed from theory, a step closer to directly being in the world. Again, the questions arise: *How can our conscious listening affect the world around us? How can learning to listen to underwater sounds transform us, and transform our relationship to the environment?*

Composer Pauline Oliveros challenges us with her mantra "listen to everything, all the time and remind yourself when you are not listening" [12]. Listening to other beings, other phenomena, other machines, strengthens relationships between us and our environment. Listening focuses our attentiveness to other beings, and calls into question distinctions between human and nonhuman, sentient and insentient. Sound asks for and requires us to pay attention, it creates a relationship with us. Oliveros theorizes that sonic attention is both focused and diffuse at the same time, and so it has the effect of situating us within a field of relationships, a field of varying qualities. [13] This practice helps shift our state of awareness from one consumed with *doing*, to one attuned to *being*. I use the term "sonic consciousness" to describe such a heightened awareness of sounds around us and of the materiality of sound. [14]

With Oliveros as inspiration, I explore different sonic experiences and ways of listening, particularly in relation to immersion and oceanic states of mind. In her Deep Listening practice, Oliveros draws inspiration and techniques from her lifelong study of meditation and her work can be considered as a form of sound healing. During one of Oliveros' Deep Listening Retreats, I was first introduced to the Taoist practice of Tai Chi and the healing art of Qi

Gong. I found these practices to be deeply complementary to my sound art practice and I have continued to study them. 'Chi', which is roughly translated as 'life energy', moves through the body and extends beyond the surface of our skin, which, although a physical threshold, is not the limit of the body's energy. I notice parallels between such a practice of energy flow through the body and the way sound behaves in space, moving through boundaries such as walls. This is a much more sonic than visual way of experiencing one's body, offering an awareness of oneself that is not bounded by the surface of the skin.

This more expanded 'sonic' notion of the body informs my understanding of echolocation by animals underwater. Cetaceans use echolocation to make sense of their environment. There are anecdotes of sperm whales and dolphins 'scanning' the bodies of human divers where the sound conveys information, not only of their outside shapes as would a visual scanning, but of the interior of the body as the sound reflects differently depending on density. [15] This ability could give them a conscious awareness of the interior as well as the exterior of other bodies. Where we *see* their physical body shape, they may have a more expanded perception of themselves or others. Such a sonic awareness of bodies deemphasizes the apparent impermeability of surface, and in doing so reduces a lot of the power of human visually centered thinking limited to external surface appearances. And in addition, much as sound can travel through walls behind which we cannot see, the visual surface of skin or ocean need not limit us in our relationship and understanding. As a result of our visual dominance and suppressed sonic perception, we tend to 'see' only the surface of the body and skin. A sonic sense would 'hear' or create mental maps or images that aren't limited by surface.

So how does sound affect the body and one's sense of relating to the world around us? Can sound and listening be considered a form of healing as Oliveros' work suggests? Sound healing therapy takes many different forms, but all relate to a notion of how sonic vibrations affect the energetic patterns of the body. In sound immersions or sound baths, the participant is a passive receiver (unlike Oliveros' active listening) of dense layers of continuous sound, created live, usually with bowls, gongs, bells, chimes, voice and sometimes electronic sound. These sound baths aim to immerse one in an 'ocean of sound'; the vibrations of the sound-field directly affecting the vibrations within ones fluid body, and thus shifting blockages and patterns in ways that allow the energy to flow more healthfully. This experience is not so much a question of listening, as of allowing the physicality of the sound to work on one's body. Such sound-healing events have become enormously popular. I have been in a large space with nearly a hundred people calmly lying on the ground while the sound healers create waves and washes of sounds and vibrations. Afterwards my body and mind became acutely sensitized and aware of my environment. I noticed the clear light and shadow of moonlight far more intensely than usual, the pace of footsteps passing me, my own impact on the ground, moving in a heightened mental state induced by sound.

Moving beyond the surface, whether the skin of the body, the surface of the ocean, or the conscious mind, depends on the experience of 'energy exchange'. In Jungian psychology, the vastness of the subconscious is comparable to a submerged iceberg, where the iceberg tip visible above water level is comparable to the conscious mind. Clarissa Pinkola Estés, a Jungian psychoanalyst and traditional storyteller, links the imaginative journey into the underwater world, with a dive into the subconscious. She interprets the Scottish mythological beings of the Selkies, seals that can become human and return to being seals, as an example of this ancient psychological pull. She refers to the notion of a 'medial woman' outlined by Antonia Wolff, [16] a psychoanalyst who worked closely with Jung, as one "who stands between the worlds of consensual reality and the mystical unconscious and mediates between them". [17] In her interpretation, "the seal-woman, soul-self, passes thoughts, ideas, feelings, and impulses up from the water to the medial self, which in turn lifts those things out onto land and consciousness in the outer world. The structure also works conversely." [18] In my own work I draw parallels between making conscious the unconscious through dream work (inspired in part by Oliveros' Deep Listening collaborator, Ione, the Dream-Keeper), and making audible the inaudible using technological means, drawing the sounds up from underwater into our waking consciousness. Such a manifestation of the subconscious in a conscious or material form, is like listening to the remote deep ocean on land. Listening to this material when one's imagination is engaged and free flowing is an enriching experience. As Oliveros writes, "Listening involves a reciprocity of energy flow, and exchange of energy, sympathetic vibration: tuning into the web of mutually supportive interconnected thoughts, feelings, dreams, and vital forces comprising our lives." [19]

Melt Me Into The Ocean: Santa Cruz and the Monterey Bay, California

What pulls us to the ocean? And when we arrive at its edge, what do we experience? *Melt Me Into The Ocean* (2018) imagines a deeper dive at the point where land and sea meet, bringing sounds up from under the surface, filling our air space with liquid motion from beneath the ocean. And while we look out at the surface of the ocean, feet on the land, ears underwater, how does our sense of place expand to integrate the submarine world into the presence of our imagination?

Santa Cruz lies on the edge of a vast marine sanctuary, a submarine canyon deeper than the Grand Canyon, filled with life, resident and migrating through. When I look out at the ocean surface I try to visualize in my mind the sheer

depth of that canyon, the amount of space filled with ocean, and the proximity of vastness to this small city. I remember the first time I reached the edge of a desert canyon overlook in Utah, my stomach caved in as if punched hard and I burst into tears. I couldn't process that sudden vastness of scale dropping away beneath me. Now I imagine the darkness of the three dimensional space underwater, and the sounds that flow through it, five times faster than sound moves in air and reaching greater distances, sounds above and below my hearing range. I imagine my body orienting itself in this cold, liquid, pressurized, sonic world. And then I feel my feet on the ground, in this place, looking out.

I listen through my body, I learn through my body, and sound helps to open up a sensitivity and vocabulary for integrating my bodily sensations with a sense of place and a sense of identity. Memory is stored in the body, sound acts on the body. Energy flows through and out of the body, and many times gets blocked in it. Healing is associated with allowing the energy to flow again.

Leaning over the edge of the wharf I'm listening to a hydrophone I've lowered like the people fishing around me lower their lines. I can see it shining in a thick shoal of glistening anchovies hugging the wharf posts that are coated in muscles, barnacles, kelp and giant star fish, red, orange and pink. I hear these creatures clicking and snapping and I can hear sea lions barking underwater. Somehow I'm surprised that they can make these sounds underwater as I've seen them on the jetty throw their heads back and open their mouths showing big pink tongues and yellow teeth. I find myself thinking of their bodies in relation to mine, and whether I could make sounds underwater in the same way, without breathing or drowning. And then a sea lion comes darting through the anchovies chasing a larger fish, and all is flow and energy exchange.

What do I mean by the ocean as energy exchange? I link it to the flow of sound, the flow of energy in and through the body, the flow of energy within the liquid ocean, and the flow of energy from ocean to climate systems worldwide. If I think of the ocean not as filled with objects, but as a flow of energy exchanges, I come closer to it and enable it to move over me on land. Its influence in a coastal zone is always present, particularly in the air, in moisture, in smell, in sound. The coastal redwood forests thrive on the foggy moisture from the ocean system. Everything is softer, skin more supple, temperature steady. The coastal band absorbs the energy of the ocean by its proximity. The ocean has influence well beyond its surface, much as the energy of a human body has influence well beyond the surface of its skin. It makes me remember that our visual sense identifies surfaces as solid boundaries, as beginning and ends of objects, as identities and influence bound and contained by surface. In contrast our sonic sense hears beyond surface, it recognizes what's beneath and outside of skin and ocean and beyond the walls of a room. Our sonic sense recognizes energy exchange and flow; it recognizes the ocean in ways that eludes our visual sense. Such a state of sonic consciousness brought about by listening to underwater sound, brings us closer to that awareness of *being* rather than *doing*.

Melt me into the Ocean explores these ideas. To date, it has included an evening installation in the Santa Cruz Museum of Natural History (SCMNH), and a day-long festival which included a sound walk along the harbor jetty to Walton Lighthouse, and a sunset performance at Ocean View Park, which overlooks where the San Lorenzo River joins the Pacific Ocean. [20] Siting the works in these public places, open to spontaneous passers-by, I am engaging a public dialogue around a deeper awareness of the presence of the ocean environment through sound.

These works use sound from the Monterey Bay Aquarium Research Institute (MBARI) hydrophone, a high-resolution underwater microphone, placed on a ridge 900 feet down in the Monterey Canyon, and linked by high speed cable to the shore. [21] Unlike most recorded whale or dolphin sounds that are publicly available, which are carefully edited to highlight just cetacean sounds, listening directly to the ocean environment is a more complex experience. The sounds emerge from the distance, blend with each other, echo off canyon walls, and are submerged in a loud ambient ocean hiss created by waves or rain on the surface. The distinct 'songs' of humpback whales repeat in long patterns, multiple overlapping echolocation clicks of perhaps dolphins, and even the lowest bass of the blue whale, which rumbles at the very edge of our hearing range, are all contextualized in the ambient sonic space of these recordings.

For the SCMNH installation I combined these sounds with video I recorded of humpback whales in the same location, projected in an atrium above our heads, inviting visitors to dive beneath the sea and hear the sound world of these and other animals via headphones. This technological extension of our ears asks us to learn to listen to a place we can't directly experience. What are these sounds and how do they interact with each other? What do they teach us about this environment and how can this help transform our relationship to the ocean and its inhabitants? When I recorded the video of humpback whales in the Monterey Bay I was fascinated by the rhythmic punctuation of breathing, particularly the 'fluke dives' where the whale dives deep to feed for some minutes before returning to the surface. So the video remains on the surface, in intensified colors, leaving our imagination to dive with the whales and listen to the depths of their sonic environment.

The sound walk to the lighthouse used the same headphones as *Whale (Dundee)* but with a soundscape that I created from my own hydrophone recordings combined with the MBARI recordings of the Monterey Bay. Walking out to the lighthouse along the harbor jetty the listener becomes increasingly submerged in the deep ocean sounds. The open-ear headphones allow sound of the immediate environment to blend with the ocean sounds, (waves, voic-

es, footsteps, boats) creating a sense of expanded presence of one place with another.

The evening sunset performance at the park combined these sounds with my videos of a dreaming sea lion, ocean waves, and humpback whales, projected onto boulders in the park. The performance began with videos almost imperceptible because of the daylight. As the light diminished and sky colors transformed, the images started to appear while the sounds blended with the ambient sounds of the location. The audience that gathered was quiet and absorbed in being with this moment of changing transition from day to night, the emergence of the city lights, the sounds and lights from the distant roller-coaster, and the emerging planets and stars in the darkening sky overhead. The experience attuned us to being in the present moment, and in the presence of the nearby ocean through its sounds. This interweaving of direct bodily subjective experience with the remote submarine spaces through sound brings me back to Annea Lockwood's comment, "*The möbius strip of expanding awareness moves out from one's own body to immediate place, to other phenomena, on to remote environments and back to the self.*" [22]

Sound as the Harbinger of a Renewed Relatedness

We began by considering the need for creating a space for the presence of the ocean within our land-bound lives. While many mechanisms are in place, from entertainment and tourism, to science, to spirituality, it is through sound – sonic consciousness – that a profound sense of presence can be experienced. I create the possibility for people to be in their bodies, in their location, in a way that enables them to extend their experience of the submarine spaces through their imagination, provoked by sound. An understanding of body-knowledge, imagination and relatedness to environments needs to be embraced and practiced for the kind of empathetic knowledge to emerge towards an uninhabitable environment like the deep ocean. Through these projects sound is the harbinger of such a renewed relatedness. The technological advances that enable us to hear underwater with our feet on the earth, encourage us to re-embody our sonic sense and our sonic intelligence towards the goal of a more conscious awareness of the remote, inaccessible environments of this planet. It is my hope, as an artist creating these opportunities for experiencing ocean presence, that what leads out from such an expanded sonic imagination, contributes to healing and re-balancing human relationships to our environments.

References

[1] Annea Lockwood, "Integrated Circuits" catalogue essay in *Yolande Harris: Listening to the Distance*, Woodbury Art Museum, 2015.

[2] Brandon LaBelle, 'Yolande Harris, Aesthetics of Intensity', catalogue essay in *Yolande Harris: Listening to the Distance*, Woodbury Art Museum, 2015.

[3] For examples see: Listening to the Deep Ocean Environment (LIDO), Michel André, Univeristat Politecnica de Catalunya at www.listentodeep.com (accessed August 2018); Salish Sea Hydrophone Network / Orca Sound, San Juan Islands, Washington www.orcasound.net (accessed August 2018).

[4] Lab visit with Kate Stafford, Principle Oceanographer in the Applied Physics Department, University of Washington, Seattle, 2014

[5] Email correspondence with Kate Stafford, 2017

[6] Installed during special event 'Sensation: an evening of Sensory Science Exploration' at the Santa Cruz Museum of Natural History, 10 February 2018

[7] Linda Shay, accompanying CD to book *Dolphin Love: From Sea to Land* (Dancing Seas Media, 2012)

[8] John Ryan, Senior Research Specialist at Monterey Bay Aquarium Research Institute (MBARI), see https://www.mbari.org/technology/solving-challenges/persistent-presence/mars-hydrophone/ (accessed August 2018)

[9] Brandon LaBelle, 'Yolande Harris, Aesthetics of Intensity', catalogue essay in *Yolande Harris: Listening to the Distance*, Woodbury Art Museum, 2015.

[10] Commissioned by Sarah Cook, North East of North Digital Arts (NEoN) for the Ignite Festival, Dundee, 2017

[11] That cetaceans are cultural animals is extensively reviewed in Hal Whitehead and Luke Rendell and *The Cultural Lives of Whales and Dolphins* (University of Chicago Press, 2014)

[12] Pauline Oliveros, "Quantum Listening: From Practice to Theory (to Practise Practice) *Music Works* (Spring 2000): 38.

[13] For a more in depth discussion on this point, see Edward Shanken and Yolande Harris, "A Sounding Happens: Pauline Oliveros, Expanded Consciousness, and Healing" in *Soundscape: the Journal of Acoustic Ecology*, (Vol.16, 2017).

[14] Yolande Harris, "Scorescapes: On Sound, Environment and Sonic Consciousness" Doctoral Dissertation, Leiden University, 2011.

[15] Lecutre by Philip Hoare, author of *Leviathan,* Rhode Island School of Design, 2015

[16] Antonia Wolff, *Structural Forms of the Feminine Psyche* (C.J.Jung Institute, Zurich 1956)

[17] Clarissa Pinkola Estes, *Women Who Run With The Wolves: Myths And Stories Of The Wild Woman Archetype* (New York: Ballantine Books, 1992): 288

[18] Ibid. 289

[19] Pauline Oliveros, "Quantum Listening", in Music Works, Spring 2000: 45

[20] Commissioned and curated by Madison Heying of Santa Cruz experimental music platform Indexical, https://www.indexical.org/events/2018-08-11-melt-me-into-the-ocean (accessed August 2018)

[21] Made available to me for this project by lead researcher John Ryan, Monterey Bay Aquarium Research Institute MBARI.

[22] Annea Lockwood, "Integrated Circuits" catalogue essay in *Yolande Harris: Listening to the Distance*, Woodbury Art Museum, 2015.

Privacy in the age of Mobile XR

Alejandro Rodriguez
Independent researcher
Hong Kong
alejandro@dogrush.com

Tomas Laurenzo
School of Creative Media – City University of Hong Kong
Hong Kong
tomas@laurenzo.net

Abstract

Surveillance capitalism [1] is a model based on the commoditization of customers' information, with the consequent impact on their privacy, and opening the door to large-scale social manipulation. This has brought the weaponization of social media [2], where invisible actors can harm the public interest using personal information, profiling and exposing groups or individuals, and manipulating the social narrative in sophisticated manners.
XR (mixed or extended reality) is a group of technologies including Virtual Reality, Augmented Reality and Telepresence, among others. These technologies rely on a growing number of sensors that allow for an extreme deepening of the existing surveillance.
This paper analyzes the potential social impact of XR, as well as proposing strategies aiming at safeguarding users' privacy.

Keywords

XR, Mixed reality, surveillance, privacy, biometrics, altered reality, mediated reality, virtual reality.

Introduction

Concerns of personal and social privacy are as old as human history. Once a civilization adopts the concepts of 'inner' and 'outer,' "it becomes impossible to avoid the idea of privacy by whatever name it may be called" [3], with Socrates and other Greek philosophers explicitly discussing privacy. The first recorded legal case related to privacy dated from 1361 when "the Justices of Peace Act in England provided for the arrest of peeping toms and eavesdroppers" [4].

Information technology has a defining impact on privacy, both in our understanding of what constitutes the private space and on the development of tools that drill on this space. In effect, with the introduction of the mechanical press, in 1891, a new discourse on privacy was built, with American lawyers like Samuel Warren and Louis Brandeis publishing the first article on "the right to be let alone [5]."

In the 1960s Alan Westin wrote "privacy is the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others. Viewed in terms of the relation of the individual to social participation, privacy is the voluntary and temporary withdrawal of a person from the general society through physical or psychological means, either in a state of solitude or small-group intimacy or, when among larger groups, in a condition of anonymity or reserve" According to John Holvast "Since 1967, there has almost not been a publication on this subject in which this definition is not presented."
"The development of philosophical notions of inalienable rights of the individual was heavily influenced by the experience of many countries both during the Second World War and under post-war Central and Eastern European governments where (generally) manually operated filing systems tracked dissident citizens and members of minorities." … "Two decades later, with the commercialization of large mainframe computers, the first laws to protect "personal data" about individuals were drafted, based upon an internationally agreed framework but with a local interpretation [6]."

By 1976 - 1979 the 3rd Party Doctrine was established in the US with the ruling over Smith v Maryland, stating that "a person has no legitimate expectation of privacy in information he voluntarily turns over to third parties [7]."

The European Union (OECD in that time) passed the Data Protection Directive in 1980 with specific guidelines to protect the privacy of individuals within Europe. All its members enacted it by the end of the '90s. In 2012 the GDPR (General Data Protection Regulation) was commissioned and approved in 2016, and finally implemented in May 2018. The legal implications of the GDPR and its practical consequences are recent and yet to be seen in its full potential [8]. Technical analysts have already pinpointed some loopholes and big problems [9].

American regulations, however, do not have a similar framework like GDPR, but the territorial range of GDPR can affect American companies, especially if those companies have any presence in Europe. The international scope of the GDPR is still part of an extensive discussion [10].
Beyond the evolution of the legislation, the issue of privacy is not solved just by the application of a law. There are many other technical and practical factors that add complexity to the problem.

Online privacy breaches produce several problems for the individual [11], like inadvertent disclosure of personal information, damage of reputation, rumors, and gossip, cyberbullying, unwanted contact or harassment, political or social persecution, and fraud in many forms.
The social consequences of privacy breaches are also relevant, for example, the harsh repression during the Bahrein uprising crackdown [12], or the controversial meddling in

politics in many countries by Cambridge Analytica to mention some.

Digital privacy

"*If you are not paying for it, you're not the customer; you're the product being sold"* [13] - Metafilter user "blue_beetle"
As previously stated, a big part of privacy problems with online business models is related to Surveillance Capitalism [14], where private information is commoditized and used as the primary source of revenue for corporations.

Some companies have a tradition of compulsory data mining [15] of personal information stored for further analysis, with key "always on" features by default, and complex privacy settings.

The commercialization of user information that shares their data has been expanded even to the social contacts of a user. This means that certain data of individuals that don't authorize their data to be shared publically has been accessed and used via friends or contacts. The case of Facebook selling this kind of information was exposed in the Cambridge Analytica scandal [16].

From the user's perspective, uninformed decisions towards terms of service (ToS) make people accept whatever rules are presented for enabling the use of a popular service [17]. The rules stated in some ToS would often be rejected by users that have the chance to customize their privacy. When people get more informed, their online footprint and their identifiable information are minimized. Public awareness of privacy issues in different social networks is growing with time, and online behavior continues to shift [18].

Even when some legislation like the GDPR protects information when linked to a person's ID, methods exist to deanonymize social network information, rendering these regulations useless [19].

Several problems arise in the social area, derived from individual surveillance applied to big groups of people, or societies. Examples like political meddling [20], activists or social actors profiling [21], political prosecution [22], restrictions to free speech, blacklisting and exposure of vulnerable minorities [23] show the consequences of these practices on a social scale.

The problems produced by privacy breaches that exist in the modern information age have not been solved. Societies and governments are waking to the implications of the state of affairs. The expansion of information that can be gathered using advanced XR devices will add a new dimension for this issue with unimaginable consequences.

XR

XR is an umbrella category that includes technologies such as Virtual Reality (VR), Augmented Reality (AR) and others that exist in Milgram's "Reality-Virtual Reality continuum [24]." Originally the term "MR" (mixed reality) was used in place of XR. Industry and modern manufacturers, however, have favored the term "XR" where "X" stands for current or future technologies. The Khronos Group, a consortium of the largest companies operating on the field, is actively developing OpenXR [25], a standardized framework, and API, aiming at the interconnection and unification of the currently fragmented AR and VR ecosystems. According to Kronos, the API will continually grow to include new technological developments, like haptics or new devices.

There are three main groups of XR technologies with somewhat different characteristics, mobile AR, Augmented reality Headsets and Virtual Reality headsets. The trend is that the lines differentiating the media are blurring and mixing.

Mobile AR has quickly reached the mass consumer market, while head-mounted AR (ARHMD) exists only in experimental devices or developer kits (Microsoft HoloLens, Magic Leap, and others), and VR headsets are already mature and robust consumer grade products.

AR-enabled phones usually use Google's ARCore or Apple's ARkit. Both systems have a strong interaction with biometric data [26] and sensing or scanning real environments.

In ARHMD devices, the trend has been to integrate a comprehensive array of sensors, that include eye tracking, spatial awareness sensors like 3D scanners or speech recognition. Some problems with the current devices like issues with highly illuminated environments, narrow fields of view, relatively low graphical quality, and unreliable background occlusion and geometric coherence [27], don't allow for very accurate and meaningful user spatial interactions. Besides, given the reduced user base these devices have, there are not many applications [28]. The tools are still considered experimental.

In the area of VR, the functionality has improved dramatically lately, and some new features are being developed by different manufacturers. Those include facial motion capture or real-time lip-sync for animating characters (oculus lip-sync SDK). Some add-ons can be attached to the VR headsets include electromyography [29] for facial tracking [30], eye tracking and galvanic response [31] to measure emotions, or 3D scanning devices like the leap motion.
In the mixed arena of consumer electronics, lots of devices now include physiological sensors and technologies akin to those used in the medical field. Those devices can connect to XR capable devices like mobile phones, and the information generated with those physiological sensors are also biometric signatures.

XR biometrics

Any measurement technique that allows the identification of a person is considered biometrics. This includes biological factors, behavioral patterns like writing and speech structure [32] among other makers.

The granularity of information available in XR devices allows identifying users through the combination of sensors. The information gathered can result in robust combined statistical analysis.

The adoption of biometrics in devices with fingerprint detection or face recognition has increased, thanks to their

positive impact on usability (and, surprisingly, not due to other aspects like privacy and trust) [33].

Beyond the direct measurements for identification purposes, the biometric information is used to enhance user experiences. For example, the depth camera used in iPhones "face ID" is also used to create AR video. Apple shares abstract information of the face recognition systems with third-party developers making it available for them to capture, broadcast and store for further use [34].

Other problems with XR are the scanning of other potentially identifying pieces of information (as many new XR devices have range imaging 3D cameras) as well as the scanning of private places, often without explicit consent. Examples like Roomba vacuum cleaner show the risks already present in consumer grade appliances [35].

Machine Learning algorithms also contribute to the mining of users' intimacy, inferring information about private spaces, objects, and other people around those devices. Experiments with the first commercial Google smart glass showed how it was possible to guess the location of users by their gazing at landmarks [36].

Manufacturers of new hardware and frameworks for XR include AI architectures and algorithms. That is the case of Qualcomm Snapdragon XR1 platform that provides for advanced vision processing like AR, Inertial Odometry, Audio Assistants and visual Artificial Intelligence [37]. The platform allows on-device AI for object classification, pose prediction, natural language understanding, and speaker recognition.

The exposure of biometrics to third-party programmers is a relevant issue, and as biometric information cannot be reissued when exposed (like a password, or a stolen credit card), it represents a higher risk.

The corporate practices and ToS in VR, AR and other XR services, software, and devices are not usually transparent enough, and their information practices lack accountability [38].

Due to the technical complexity and the growing range of sensors, it is difficult to pinpoint which kind of data is vulnerable. Mixed techniques like VIO (visual inertial odometry) [39] allow to calculate with a high level of precision 6DOF, but those calculations are only possible through the mixture of different sensors like cameras and IMUS that work at the same time to drive a result. That example can explain the complexity that can arise when combining a multitude of sensors working at the same time to measure many other things, not foreseeable just by analyzing sensors individually. Some of the malicious attacks using multi-sensors and predictive approaches are for example the hacking of passwords techniques, (accelerometer side channel exploit), that allows predicting the password because of the motion of the phone while the user is entering the password [40].

Many biometric signatures are vulnerable to side-channel timing attacks, so the idea of creating purely anonymous embodied information is challenging.

Even if the information is not read and archived by a provider of software or hardware, the act of broadcasting information to a virtual environment potentially opens the door to an automatic agent that's measuring the user's biometric signatures.

Some of the foreseeable externalities of XR technologies include behavioral profiling and prediction, private space and human relationship data mining. Emotional and psychological profiling and its commercial, legal or social exploitation.

A better future is possible

There are different strategies and regulations that can help to alleviate the risks introduced by XR, including new settings on the devices, new regulations, and informing and education of users. However, it is important to bear in mind that these are not enough and constant monitoring and introduction of new safeguards are necessary.

Regulations

The following is a list of settings that should be enforced in XR.

- The default settings for XR devices regarding privacy should be clear and easy to understand.
- The default settings should allow to "opt-in" instead of opting out for biometric sensing.
- Clarity of the propose of biometric data to be collected.
- No punitive impact for the user when opting out from biometric data collection.
- In case the device needs biometric data, or 3d scanning to perform specific functions, the data should be processed locally when possible and avoid broadcasting personal data to be handled elsewhere.
- There is a need for accountability of the information gathered by a provider. (where the data goes and why).
- Vulnerable populations need special safe wards against the exposure of relevant information through XR: minorities, religious, cultural, sexual orientation.
- The recollection of data for further use should not be allowed. In the case that the recollected information would be used differently, a new consent from the individual should be required.
- Determination of the shared ownership of the data mined by XR devices, and the possibility to audit and delete such data by the users.
- The legal framework needs to be preemptive instead of reactive due to the permanent and not modifiable nature of biometric information (it can't be reissued once compromised)

Technical suggestions for manufacturers

- Implement end to end encryption of all data.

- Reduce to the minimum the storage of biometric data.
- Limit the time for data to be stored.

Self-regulation strategies for the industry

- Creation of a standard like PEGI related to privacy.
- Industry association discussions.
- Best practice services and guidelines.
- Industry awards for privacy excellence.
- Privacy certification.
- Institutional boards or industrial association boards.

Education and desirable social behavior

- Inform of the consequences of privacy breaches by XR and biometrical devices
- Implications of the acceptance of invasive technologies according to the technology and use of it.
- Social condemnation of invasive corporate practices.
- Social banning of specific devices from private or personal spaces.
- Promoting and participating in Boycott against unethical corporate behavior.

Conclusions

XR is a new, rapidly growing field that threatens not only to translate but also worsen the social impacts of data-based capitalism, by integrating biometric and contextual information.

The granularity of the information produced by multisensory systems allows for the relatively easy profiling identification of the users, often granting access to intimate information.

There are, however, several strategies that users, companies, and governments can systematically apply to alleviate the social impact of these new technologies.

On top of this, regulations will play a defining role in the protection of privacy within XR. However, XR also deepens the impact of existing legal loopholes while introducing new vulnerabilities. Therefore, new regulatory frameworks need to be developed to tackle problems that will rise from this growing field.

References

1 Zuboff, Shoshana. "Big Other: Surveillance Capitalism and the Prospects of an Information Civilization." Journal of Information Technology 30, no. 1 (2015): 75-89

2 Singer, Peter Warren, and Emerson T. Brooking. Likewar the Weaponization of Social Media. Boston: Eamon Dolan/Houghton Mifflin Harcourt, 2018.

3 Konvitz, Milton R. "Privacy and the Law: A Philosophical Prelude." Law and Contemporary Problems 31, no. 2 (1966): 272. doi:10.2307/1190671.

4 Holvast, Jan. "History of Privacy." The Future of Identity in the Information Society IFIP Advances in Information and Communication Technology, 2009, 13-42. doi:10.1007/978-3-642-03315-5_2.

5 Warren, Samuel D., and Louis D. Brandeis. "The Right to Privacy [the Implicit Made Explicit]." Philosophical Dimensions of Privacy: 75-103. doi:10.1017/cbo9780511625138.005.

6 Rejman-Greene, Marek. "Privacy Issues in the Application of Biometrics: A European Perspective." Biometric Systems: 335-59. doi:10.1007/1-84628-064-8_12.

7 Orin S. Kerr, "The Case for the Third-Party Doctrine," Mich. L. Rev. 107 (2008): 561.

8 F. Moos, "The Troubling Reach of the GDPR Right to Data Portability," *E-Comm Law Policy* 18, no. 2 (2016): 9–10.

9 Tal Z. Zarsky, "Incompatible: The GDPR in the Age of Big Data," Seton Hall L. Rev. 47 (2016): 995.

10 Brendan Van Alsenoy, "Reconciling the (Extra) Territorial Reach of the GDPR with Public International Law," 2017.

11 Bernhard Debatin et al., "Facebook and Online Privacy: Attitudes, Behaviors, and Unintended Consequences," Journal of Computer-Mediated Communication 15, no. 1 (October 1, 2009): 83–108, doi:10.1111/j.1083-6101.2009.01494.x.

12 Singer, Peter Warren, and Emerson T. Brooking. Likewar the Weaponization of Social Media. Boston: Eamon Dolan/Houghton Mifflin Harcourt, 2018.

13 "You're Not the Customer; You're the Product – Quote Investigator," accessed December 19, 2018, https://quoteinvestigator.com/2017/07/16/product/.

14 Zuboff, "Big Other."

15 Helen Kennedy, *Post, Mine, Repeat: Social Media Data Mining Becomes Ordinary* (Springer, 2016).

16 Carole Cadwalladr and Emma Graham-Harrison, "Revealed: 50 Million Facebook Profiles Harvested for Cambridge Analytica in Major Data Breach," *The Guardian*, March 17, 2018, sec. News, https://www.theguardian.com/news/2018/mar/17/cambridge-analytica-facebook-influence-us-election.

17 Thomas J. Maronick, "Do Consumers Read Terms of Service Agreements When Installing Software?–A Two-Study Empirical Analysis–," *International Journal of Business and Social Research* 4, no. 6 (2014): 137–145.

18 Mary Madden, "Privacy Management on Social Media Sites," *Pew Internet Report*, 2012, 1–20.

19 Arvind Narayanan and Vitaly Shmatikov, "De-Anonymizing Social Networks," in *Security and Privacy, 2009 30th IEEE Symposium On* (IEEE, 2009), 173–187.

20 Carmen Reinhart and Kenneth Rogoff, "Regulation Should Be International," *Financial Times* 18 (2008).

21 Eytan Bakshy, Solomon Messing, and Lada A. Adamic, "Exposure to Ideologically Diverse News and Opinion on Facebook," *Science* 348, no. 6239 (2015): 1130–1132.

22 Seva Gunitsky, "Corrupting the Cyber-Commons: Social Media as a Tool of Autocratic Stability," *Perspectives on Politics* 13, no. 1 (2015): 42–54.

23 Kath Browne, "Snowball Sampling: Using Social Networks to Research Non-Heterosexual Women," *International Journal of Social Research Methodology* 8, no. 1 (2005): 47–60.

24 Paul Milgram and Fumio Kishino, "A Taxonomy of Mixed Reality Visual Displays," *IEICE TRANSACTIONS on Information and Systems* 77, no. 12 (1994): 1321–1329.

25 "OpenXR -," *The Khronos Group*, December 6, 2016, https://www.khronos.org/openxr/.

26 Alexander De Luca et al., "I Feel like I'm Taking Selfies All Day!: Towards Understanding Biometric Authentication on Smartphones," in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (ACM, 2015), 1411–1414.

27 D. W. F. Van Krevelen and Ronald Poelman, "A Survey of Augmented Reality Technologies, Applications and Limitations," *International Journal of Virtual Reality* 9, no. 2 (2010): 1.
28 "Microsoft HoloLens Sales Figures Revealed – VRFocus," accessed December 11, 2018, https://www.vrfocus.com/2018/05/microsoft-hololens-sales-figures-revealed/.
29 "Frequently Asked Questions," *Emteq*, accessed December 17, 2018, https://emteq.net/faq/.
30 "Home," *FOVE Eye Tracking Virtual Reality Headset*, accessed December 17, 2018, https://www.getfove.com/.
31 Doron Friedman, Kana Suji, and Mel Slater, "SuperDreamCity: An Immersive Virtual Reality Experience That Responds to Electrodermal Activity," in *International Conference on Affective Computing and Intelligent Interaction* (Springer, 2007), 570–581.
32 H. Saevanee and P. Bhatarakosol, "User Authentication Using Combination of Behavioral Biometrics over the Touchpad Acting Like Touch Screen of Mobile Device," in *2008 International Conference on Computer and Electrical Engineering*, 2008, 82–86, doi:10.1109/ICCEE.2008.157.
33 De Luca et al., "I Feel like I'm Taking Selfies All Day!"
34 https://www.facebook.com/geoffreyfowler, "Analysis | Apple Is Sharing Your Face with Apps. That's a New Privacy Worry.," *Washington Post*, accessed December 19, 2018, https://www.washingtonpost.com/news/the-switch/wp/2017/11/30/apple-is-sharing-your-face-with-apps-thats-a-new-privacy-worry/.
35 Maggie Astor, "Your Roomba May Be Mapping Your Home, Collecting Data That Could Be Shared," *The New York Times*, January 20, 2018, sec. Technology, https://www.nytimes.com/2017/07/25/technology/roomba-irobot-data-privacy.html.
36 Hani Altwaijry, Mohammad Moghimi, and Serge Belongie, "Recognizing Locations with Google Glass: A Case Study," in *2014 IEEE Winter Conference on Applications of Computer Vision (WACV)* (IEEE, 2014), 167–174.
37 "Qualcomm Reveals the World's First Dedicated XR Platform," *Qualcomm*, May 29, 2018, https://www.qualcomm.com/news/releases/2018/05/29/qualcomm-reveals-worlds-first-dedicated-xr-platform.
38 Devon Adams et al., "Ethics Emerging: The Story of Privacy and Security Perceptions in Virtual Reality," 2018.
39 Michael Bloesch et al., "Robust Visual Inertial Odometry Using a Direct EKF-Based Approach," in *Intelligent Robots and Systems (IROS), 2015 IEEE/RSJ International Conference On* (IEEE, 2015), 298–304.
40 Hwajeong Seo et al., "Open Sesame! Hacking the Password," in *International Workshop on Information Security Applications* (Springer, 2015), 215–226.

Acknowledgements

The work described in this paper was fully supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. CityU 11674416).

Author Biographies

Alejandro Rodriguez is an architect and designer. With a vast experience in virtual reality, software production, and rapid fabrication, Alejandro also has an unparalleled trajectory planning and directing massive live shows involving cutting-edge technology, including spatial augmented reality, control, and robotics.

Tomas Laurenzo, PhD, is an artist, computer scientist, and academic working with both physical and digital media. His work explores the artistic construction of meaning and its relation with power and politics. Laurenzo's production spans across different practices, including installation, interactive art, music, live cinema, creative machine learning, and digital lutherie. His artworks and performances have been shown globally. He is Assistant Professor at the School of Creative Media, City University of Hong Kong and has published extensively in the areas of New Media Art, and HCI

The Public Sphere Engendered by Media Technology: Masaki Fujihata's *Light on the Net* (1996)

Yasuko Imura[1], Shigeru Matsui[2]
[12]Institute of Advanced Media Arts and Sciences, 4-1-7 Kagano, Ogaki-shi, Gifu 503-0006 JAPAN
Email: imura@iamas.ac.jp, ma@iamas.ac.jp

Abstract

In media art, how do we articulate the identity of a work after the media awareness and environment that connected artist to audience at the time of its presentation has been lost? This article contributes to the discussion related to the reproduction of Masaki Fujihata's *Light on the Net* (1996), first presented as the internet came into widespread use.

It was Gifu Ogaki Biennale 2017 that first brought us such awareness. We co-curated the exhibition and a series of symposiums, which examined the expression of how computers and humans relate to one another in terms of art, music, and engineering through works of 3 artists. I tried to find out the significance of existence in the process of re-creation of work and the transition of evaluation through the display of materials rather than works.

The most important element of *Light on the Net* is that this work questioned the community the Internet is about to bring radically. That should be analyzed from the perspectives of sociology, the history of technology, and aesthetics in the future.

Keywords
Internet Art, Media archeology, Audience theory, Archives of media art, Reproduction of media art

1. he Re-performance, Reproduction, and Re-exhibition of Media Art

The Gifu Ogaki Biennale has been held seven times since it began in 1994. Last year, IAMAS' 21st Anniversary, my co-worker Shigeru Matsui and I held an exhibition of documents [Fig.1] and a six-day symposium [Fog.2] under the title of "the New Era: the Beginning of Media Art."

We considered the identity of works that had been presented 10 or more years ago through emulation and various materials. In other words, I wanted to consider how to determine the identity of these works and how to convey them to future generations after the media consciousness and environment that linked their creators to their viewers at the time of their presentation has been lost. Specifically, we addressed the issue of how the works of Akihiro Kubota, whose background is in engineering, and Masahiro Miwa, whose background is in music, and Masaki Fujihata, whose background is in art and design, could be described, recorded, and preserved.

Fig.1

Fig.2

2. ngineering･Music･Art: Various Perspectives

First, through our discussion with Akihiro Kubota, the idea of changing the concept of the work came to light. Kubota exhibited a work made with program code in which poetry, image [Fig.3], and music unfolded on three displays. The concept of this work was the program's "executive value," by means of which the work was generated in response to the immediate environment. So it was exhibited on a wall-mounted screen in the library, where the flow of people were changing during a day.

Kubota positions this work as a prototype. He made its code open to the public on the software development platform Github. There he performs not only version control but also has the code available for reference. In other words, for him, the work is something that is produced and changed in each case. He emphasizes that the essence of the work is in the code, and that code is available for reference by others. This way of thinking can be read as a proposal to broadly reinterpret the uniqueness of a work and the mark of its creator, ideas that are taken for granted in the conventional conceptualization of art. By that same token, perhaps at some time in the future we should question the aesthetics

of the uniqueness of code. In response to this way of thinking, we introduced attempts to take code, sound, documentary photographs, and documentary videos of Kubota's live-coding pieces made from 2005 to 2009 and incorporate them into existing archive software. Conventionally, this software is used to archive paper documents [Fig.4]

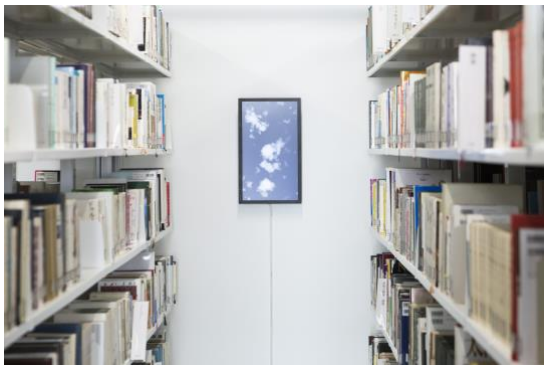


Fig.3

Fig.4

Next, regarding Masahiro Miwa's work: re-performing music is not uncommon. Musical scores from hundreds of years ago can be performed today, and it is only natural that viewing and research is centered on this interpretation. In spite of this, one reason that Miwa's work incites discussion is the fact that it is a music piece that includes devices. Many people may be familiar with the label "live electronic music."

Fig.5

This time, a single harpist performed two versions of Trödelmarkt der Träume – Vorspiel und Lied (1990)[Fig.5]. One version used the same system configuration as the original performance, and the second version was the same as a 2009 performance using emulation. For the performance, the harpist sang while playing a real harp, a computer generated performance data for two harps in real time, and a computer program played sample sounds from day-to-day life, including street noise and children's voices. For the electronic system, the original performance used an ATARI ST computer and an AKAI S1000 sampler. For the 2009 version, the system was changed to use STEEM, an emulator for Windows, and the sampler software Kontakt. The original goal of using emulation was to make a performance like the first after the old equipment had broken or become hard to acquire. However, this interpretation took on its own identity as a piece.

For example, due to the nature of the software, the sound varies slightly from the original equipment. There was some debate as to whether or not this change was acceptable as part of an interpretation. From a musical perspective, this sort of change is not considered to be a problem by the standards of classical interpretation and performance. On the other hand, the meaning of the contingency produced by the computer incorporated into the original piece at the time it was composed must have had the same significance as the "otherness" that is anticipated from modern AI. That otherness may give the performer and air of tension, and may make for a richer performance. I think that this interpretation is what was most significant about the original performance, and must be captured through the imagination of the person interpreting it.

Last of all, we talked with Masaki Fujihata about his Light on the Net (1996), a piece that was exhibited on the first floor of the building now being used as part of the IAMAS campus. Fujihata already created a book called "Anarchive," published by a French publisher in 2016 at the invitation of Anne-Marie Duget. This book is not only a research essay about works in the early 80's, but is also an attempt to re-experience various works spatially using AR. This book is a valuable document that allows us to know the systems of pieces that we could not directly experience. However, we planned our exhibition to have no moving pieces at all but proposed considering and reconfiguring Light on the Net using documentation alone.

3. The Public Sphere of Media Art Seen from Light on the Net

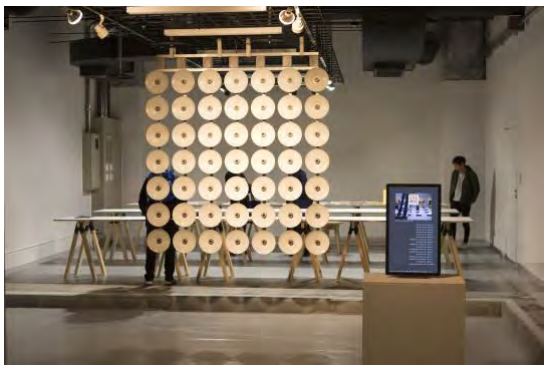


Fig.6

Light on the Net was a work of collaborative research between the Keio University Masaki Fujihata Lab. and the Softopia Japan foundation [Fig.6]. The piece was composed of a casing installed in the entrance of Softopia Japan's center building and a website. Viewers could access the website (light.softpia.pref.gifu.jp) to see an image of lightbulbs arranged in a 7 by 7 grid in Softopia Japan's Center Building. If viewers moved their cursor over the light bulb, an icon in the shape of a hand would appear, and the viewer could turn the bulb on. Conversely, the viewer could turn off a lit bulb by touching it. However, the streaming technology that we have today did not exist at that time. When the viewer selected to light a bulb, the bulb was lit, a picture was taken, and this picture was sent to the viewer. This operation took 4 seconds to process, and because the internet was not as speedy as it is today, it took 10 to 15 seconds in total. This mechanism was reflected in the casing that had been installed in Softopia Japan's Central Building, at people at the site could see the lights switching on and off.

Interestingly, while this piece could be viewed in person, it was essentially based on web communication [Fig.7]. Here you can see the access logs of ten people. It displays who lit which bulb where using their IP addresses and domain names. Fujihata used the images and access log preserved on the server and played back the changes users made to the bulbs at 120 times speed. He did this in order to show what kind of communication occurred when a space was created allowing users from all over the word to turn to turn the bulbs on and off while looking at the same image.

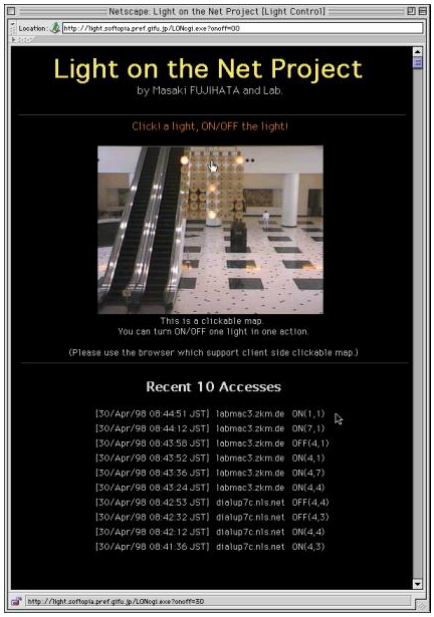


Fig.7

What can be read from these videos was a very primitive form of internet communication. At one time, someone would set the lights into the shape of a heart every morning. Just after this, someone would arrange the lights to spell "HI." It is unknown whether or not these people were cooperating, but the first person would try to return "HI." Then, another person would come in and try to break the letters to bits. Finally, someone else would turn off all the bulbs and be satisfied. The people who met in that space could do things like feel one another's presence, and build consensus.

What kind of communication occurred here? First, tuning on and off the lights to create numbers or letters was a form of communication limited to simple shapes and words. Secondly, as I said before, it took 0 to 15 seconds for a light to turn on once it was selected. If multiple people accessed the site at the same time, a user would put in the next directions for the lights while feeling another's presence. Users tried to use the functions of the extremely limited space they were given to the greatest extent possible.

As we well know, after this, communication services like blogs, message boards, and social media were created and have permeated our lives. However, I think we should take note of the fact that Light on the Net was on a different course from all of that.

When thinking about the collective that the internet brought about, we may be able to remember its first ideal form, the "global village" of Marshall McLuhan. McLuhan predicted that national borders and tribal groupings would become insignificant, and the earth would become a universal collective, as if it were a single village. However, like the "long distance nationalism" that benedict Anderson described in the latter half of the 1990s, it is a fact that internet communication continued to give rise to a new kind of nationalism. When recalling the issues that Light on the Net raised in light of that background, I think that it directly questioned viewers and users about the state of the public sphere as something that is not a simple utopia.

I suspect that through the re-creation of media art, we see an interrogation into the public sphere that media art makes possible. In other words, I think that the issue is the question of how this shape the imagination about others who have not yet seen the art. I believe that an important perspective about "Art of the Information Age" is the way of thinking that asks, how we design our relationship with others.

AIBO: An Emotionally Intelligent Artificial Intelligence Brainwave Opera - Proof of Concept

Ellen Pearlman
RISEBA University/Parsons New School
Riga, Latvia/New York USA
Ellen.pearlman@riseba.lv/pearlme@newschool.edu

Abstract

Analytic cloud- based speech-to-text engines like the Google API and IBM Watson function through semantic analysis of speech. This is accomplished by assigning weighted values based on the force of an emotional statement, or its magnitude, and an emotional analysis of its score, meaning if the sentence is positive, negative, or neutral. These same analytic qualifiers can be deployed by speech-to-text or text-to-speech chatbots, and developed into analytic engines that are tasked with critical decision making power about customer service, healthcare, jurisprudence, social sorting, employment, and migration, among others. Private corporations like Facebook's Building 8 and the U.S. Military's DARPA Agency [1] [2] are funding research to develop semantic analysis of thoughts in the brain capable of interacting directly with computers. AIBO, a work-in-progress emotionally intelligent artificial intelligence brain opera presents a rapid prototype of a built feedback loop between EEG signals from a human brain and an emotionally intelligent artificial intelligence entity driven by machine learning. It explores the hegemony of algorithmic decisions vs. a human being's messy emotions, both as a performer's brainwaves are displayed on their body as flashes of varicolored light, and through the projection of a colored graphic indicating a semantic analysis in a connected feedback loop.

Keywords

emotionally intelligent artificial intelligence, brain computer interfaces, human computer interaction, performance

Proof of Concept As Rapid Prototype

Over the course of four Saturdays using Art-A-Hack™ methodology, [3] a proof of concept was prototyped in a collaborative workspace to develop a functional model of an emotionally intelligent artificial intelligence entity interacting with a performer wearing an EEG wireless brain computer interface. The reason for this prototype was to show that a feedback loop could be assembled between a human brainwave and the semantic analysis of that brainwave. By brainwave I refer to the simple Alpha and Beta signals available on a NeuroSky consumer grade EEG headset. These two measured states translate to simple states of meditation and attention.

The AIBO prototype used Python software to translate a performer's speech into text. That text was then analyzed for emotional semantic meaning using the Google Cloud API [4], which returns values of magnitude and score. Speech-to-text was analyzed in a sentence to figure out the most powerful emotion either positive, negative or neutral. Sentiment analysis does not delineate differences like those between 'annoyed' and 'furious'. Both emotional states are determined to be 'negative' emotions. Neutral scores are texts with 'low' emotion, or conflicted emotions that cancel out their weighted values for a reading of '0'. Magnitude is defined as the strength of an emotion, positive or negative, between 0.0 and +infinity that is not normalized. A word or phrase like 'very' registers a strong magnitude and 'not much' registers a low magnitude score. Score is determined as the overall emotion of a statement, positive or negative. The performer's EEG brainwaves displayed as light corresponding to those sentiment analysis weighted values, both as a necklace of light and a graphic projection.

Figure 1. AIBO Proof of Concept 2018. Brainwave headset/LED bodysuit performance demonstration the relationship between the brainwave of attention and positive emotional sentiment analysis.

Proof Of Concept

A subject wore a NeuroSky brainwave headset that wirelessly communicated through an Arduino hook up with an LED display of an oversized necklace or chest plate (Figure 1). Simple questions were then asked to the performer about her feelings such as "What is something you hate?" or "What is something you love?" As the performer verbally responded, the necklace lit up with the color aqua for the

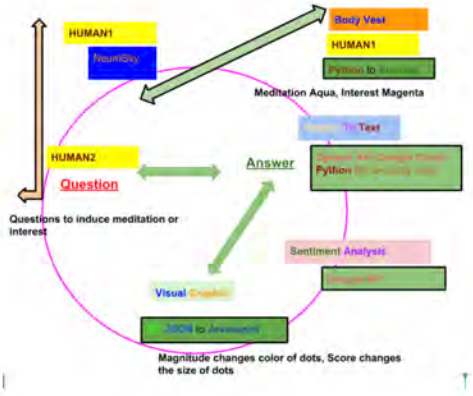


Figure 2. AIBO Proof of Concept Flowchart 2018. Brainwave headset/LED bodysuit performance flowchart showing the relationship between the performer, the questioner, the brainwaves, emotional sentiment analysis, and the colors and graphic displays

brainwave of meditation, and magenta for the brainwave of attention. At the same time the speech-to-text semantic analysis function of the Google Cloud API analyzed the performer's reply, which was projected as a java script graphic corresponding to a live time connection to their brainwaves (Figure 2).

The projected graphic display depicted attention as a magenta and meditation as an aqua lattice graphic. The size of the graphic would change according to the emotional score of the subject's response. A positive response would display a large circular lattice. A negative score would display a small lattice. This change in brainwaves and weighting of emotional scoring occurred with a processing lag of between a few seconds to approximately 10 seconds. This meant the brainwave states displayed on the necklace, and the projected semantic analysis graphic did not always synch up. This was due to the amount of time it took for the Google Cloud API to return a value, an issue that will be investigated in further iterations.

This initial prototype shows the viability of developing AIBO, an artificially intelligent emotionally intelligent brain opera between a human beings and an algorithmic machine learning entity.

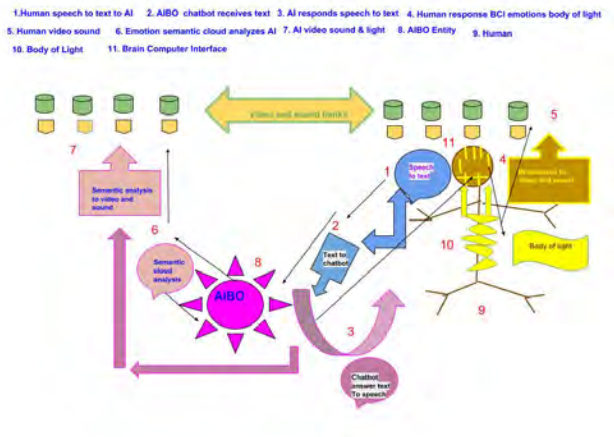


Figure 3. A rough example of the anticipated information flow between the performer wearing a body of light, the AIBO entity working with semantic analysis in the cloud, and their respective databases of videos and sound

It also shows conclusively that a robust further build out is possible. This would include a feedback loop between various EEG brainwave states, an artificial body of light connected to those brainwave states, a speech-to-text and text-to-speech customized repository, and an AI analysis in the computing cloud of a customized AI database of a human performer and an AI entity. Both human and non-human performers could launch databanks of visuals and sound (Figure 3).

Conclusion

In just four Saturdays over the course of approximately one month a proof-of-concept rapid prototype was built demonstrating a clear but time-delayed relationship between a subjects brainwaves measuring either attention and meditation, and an emotionally intelligent artificial intelligence analysis of a verbal statement from speech-to-text using a NeuroSky headset, an LED necklace and the Google cloud based API. It is expected in further iterations the time-delay will be shortened. This implies that an eventual relationship and correlation between a human brain wave and the analysis of human sentiment by an AI entity is possible now, and certainly for the future.

.

Acknowledgements

This prototype was made with the assistance of programmers Sarah Ing, Doori Rose, Danni Liu, and LED necklace builder Cynthia O'Neil, and the sponsorship of Art-A-Hack™ and ThoughtWorks New York.

References

[1] Eliza Strickland, “Director of Typing-by-Brain Project Discusses How Facebook Will Get Inside Your Head, website accessed April 1 2018, *IEEE Spectrum:* https://spectrum.ieee.org/the-human-os/biomedical/bionics/facebooks-director-of-typing-by-brain-project-discusses-the-plan
[2] National Research Council, Emerging Cognitive Neuroscience and Related Technologies, website accessed June 8, 2017 https://www.nap.edu/catalog/12177/emerging-cognitive-neuroscience-and-related-technologies
[3] Art-A-Hack, “Special Edition 2018” website accessed August 18, 2018, https://artahack.io/projects/sentimental-feeling-second-skin/
[4] Google, “Natural Language”, website accessed July 8, 2018 https://cloud.google.com/natural-language/docs/basics.

Author Biography

Ellen Pearlman is a new media artist, curator and critic. She is on faculty at Parsons/New School New York, and an Assistant Professor Senior Researcher at RISEBA University in Riga, Latvia. A Fulbright World Learning Specialist, she was awarded an EU 2019 Vertigo STARTS Residency. She is also Director of ThoughtWorks Arts in New York City.

Lightening the Hiatuses of Story: A Discussion on Intervals in Storytelling of Interactive Documentary

Chanjun Mu
School of Creative Media, City University of Hong Kong
Chanjunmu2-c@my.cityu.edu.hk

Abstract

The conception of interval refers to an approach to narrative experimentation: the use of empty gaps that are regarded as unimportant to the plot [1], which is extensively practiced in the narrative of traditional painting, architecture, literature and cinema art. Interactive documentary, as a new genre that narrates the real and enables audience interact with reality through interactive digital technologies, its physical interactivity and non-linear narrative form generates inevitable pause, gap and intervention of storytelling. These intervals in storytelling of interactive documentary become significant reason of the contradiction between immersion and interaction. Through the investigation and two selected cases studies: *Prison Valley (2009), The Space We Hold (2017)*, this paper aims to address following questions: 1) What's the specific manifestation and effect of intervals in interactive documentary storytelling? 2). Can interval become a promising technique to solve the contradiction between immersion and interacti and evolve non-linear storytelling somehow?

Keywords

Intervals; Interactive storytelling; Interactive documentary

Introduction

Interactive documentary is a new type between film and interaction [2]. Traditional cinema creates a conventional rite that audience should obey the rules to sit in their seats and follow the plot offered by directors. But interactive documentary's non-linear storytelling gives audience new right to change the plot, calling for audience's physical participation. Every time when audience encounter the interactive unit designed by director, they have to leave the story-world and come back the real time and space to conduct their physical movement and interactivity. In this circumstance, unavoidable interruptions occur and recompose the rhythm of storytelling. This kind of disassociation and separation leads to intervals in storytelling, reducing the immersion of storytelling unavoidably. So far, there are plenty of studies focusing on the storytelling content of interactive documentary. They concentrate on the following aspects: time and space of digital media storytelling; structure types like tree structure, net structure, layer structure, etc.; storytelling features; new identities of authors and readers and their relationship. Some scholars such as Janet Murray and Marie-Laurie Ryan have noticed and discussed the relationship of immersion and interactivity in interactive storytelling. However, current studies lose the sight of the invisible content: interval and its potential in balancing the contradiction of interactive storytelling. This research seeks to remedy these gap by analyzing the existed theories and apply to more samples and in enough situations, giving some insight into how the intervals' manifestation and function in storytelling of interactive documentary. As Interactive documentary has grown in light of both the recent digital media market and digital media studies. It indicates a need to understand the various perceptions of the interactive documentary narrative not only for its theoretical value but also for practical instruction.

Interaction and Immersion

There are two most prominent characteristics in digital media narrative: interaction and immersion, which are almost permeated in all the elements of digital media narrative. Ever since human beings began to tell stories, the narrative is interactive [3]. In digital media narrative, interaction is not only the feature of digital media technology -"an inherent ability of two-way communication media brought by the computer", "a key additional value of new media technology" [4][5], but also the characteristic of the user. The user plays the role of an agency in digital media works, just like the agent of a certain character or action in the narrative. Different behavior and languages can lead to different results [6]. Ryan summed up four main types of interaction: internal interaction, external interaction, explanatory interaction and ontological interaction. Immersion is derived from our "fantasy" brought by digital media narrative. Whatever the fantasy is, the personal experience of the simulation is pleasant. The experience is called "immersion" [7]. Ascott defined "immersion" as "entering a whole to dispel the subject and background" [8]. Staffan Bjork and Jussi Holopainen classify immersion into the following types: sense-muscle movement immersion; epistemic immersion; emotional immersion; space immersion and mental immersion [9]. Immersion and interaction are contradictory while closely connected features.

A user study about NFB's interactive documentary Bear 71 gives further proof of the audience's reaction to this contradiction: while on one level the linear narrative provides the documentary with a degree of coherence, many respondents (13 people) described experiencing a degree of tension between the two with the result that they privileged either the narrative (nine people) or interaction (four people). [10] Although many scholars have conducted profound research of interaction and immersion, in the interactive digital storytelling area, especially in different interactive narrative forms, it's still urgent and important to discuss how to avoid interaction weakening the continuity and immersion of the narrative.

Intervals in Interactive Storytelling

Wolfgang Iser's reception theory figures out that literary texts provide graphic frames for readers, which have many "blanks" in every side and need readers to fill and rich in their reading process. [11] In traditional cinema, by utilizing the concept of intervals in narratives, an innovative dimension of storytelling emerges. It relies on emotional factors of images, music and sound; it is based on a self-reflective experience of the film, relocating the purpose of the story into a sophisticated interactivity of the audience with what is not depicted or told. [12] The creation of interactive documentary also need set blanks to gain audience participation, arrange plots and structure and generate more dimensions of storytelling.

In interactive documentary, intervals are normally embedded in the structure of storytelling instead of in content. Audience will be encouraged to do diversified physical participation and interactivity in each pre-designed turning point where an interactive interface with some controllers are inserted. This type of interactive interface usually employs multiple media materials like text, sound, photo, animation and video. Through the participation and interactivity with the interface, the following plots will be provided successively. The interactive points build the structure of the whole interactive storytelling. They are necessary part of story, meanwhile, they bring intervals into the interactive storytelling: the story will never be told coherently any more. Audience have to stop at interactive points and consider about the interactivity and choices, then they have freedom to return to story-world and skip any part, repeatedly enter some segment deliberately or occasionally. In this situation, the time and space of storytelling are totally switched. Leaving from the narrative time and space in the story-word, audience revisit the time and space of real world when they are conducting their physical participation and interactivity. The reversing leads to the hiatuses in time and space, likewise in the storytelling. On the one hand, it influences the feeling of immersion and the rhythm of storytelling; on the other hand, it breaks the traditional narrative universe and enables interactive storytelling explore a new "cyber space".

Thus, in order to tell story in a better way, authors should not only focus on the visible content of story, but also on the invisible gaps. Based on the multiple media materials, including new technologies such as VR and AR, there is great potential in the creation of interactive points. Correspondingly, intervals in the interactive storytelling contain vast space to be explored as well. It indicates a need to find out what features of intervals make various effects on the richness, completeness and coherence of story. Chinese ancient philosophy "creation from nothing", the blank stands for numerous possibilities. The intervals involve practical, critical, aesthetic, philosophical connotations, which indicates the prospect of a new dimension for creation of interactive storytelling.

Case Study: *The Space We Hold*

The Space We Hold, A co-production between Cult Leader and the National Film Board of Canada, is a interactive web documentary about three former "comfort women" who were forced into military sexual slavery by the Imperial Japanese Army during World War II. In a world where rape continues to be used as a weapon of war, *The Space We Hold* provides a unique window into the challenges of reconciliation and what it means to bear witness to testimonies of sexual violence in a digital age. [13] Built from the ground up using WebGL, this interactive documentary intermixes full-screen video, scrolling content, user input and data visualization to enable audience experience characters' stories as witness and to collect audience responses.

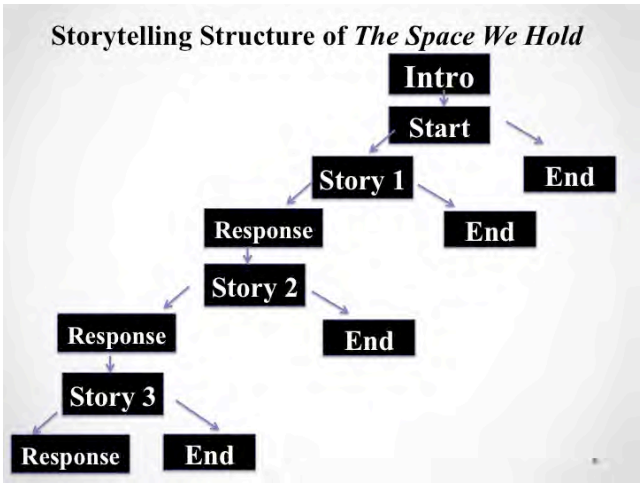


Fig.1. Storytelling Structure of *The Space We Hold* @Author of This Paper

The narrative of *The Space We Hold* presents a tree structure. In this type of structure, storytelling continues to diverge, and there is neither navigation nor retrogression in the whole process. Audience experience the interactive documentary from the third person perspective, mainly in three ways of physical participation: 1) Holding down and releasing spacebar to control video play; 2) Clicking on the mouse to select movement of stop, continue or skip; 3) Inputting text response through a dialogue box. The art-

work consists of three stories, that is, three interactive units as well. The storytelling structure, logic and interaction among them are identical. On the whole, the storytelling structure and interaction mode are relatively single, involving small amount of interaction points with light information contained in each interaction point. But the problem with this structure is that when the audience chooses a path or a conversation they have no opportunity to correct their choice. Therefore it becomes very difficult if they want to review the previous part of the content again.

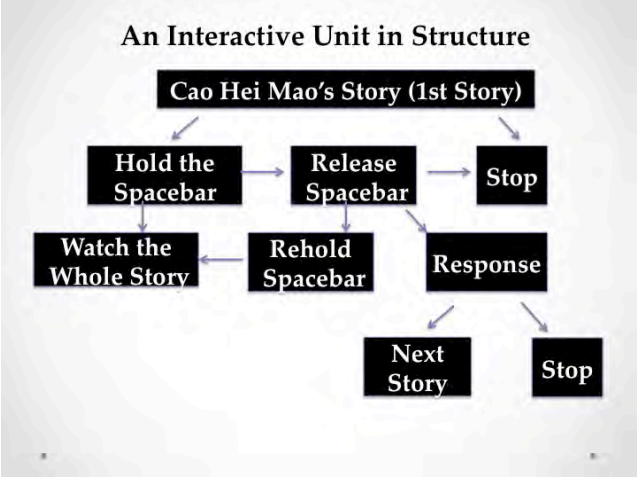


Fig.2. An Interactive Unit in Storytelling Structure of *The Space We Hold* @Author of This Paper

As the figure shows, this is one of the interactive units in which the largest interval is generated in the user's response section. The response section after each story is completely isolated from the plots, it does not belong to the previous plot, nor does it link up with the next plot. In this part, the narrative pauses completely and we can no longer learn anything about the protagonist of the story. This part uses AI technology to bring together all the response left over from the audience to create a three-dimensional starry effect, which is very impressive, and it also be regarded as an innovation.

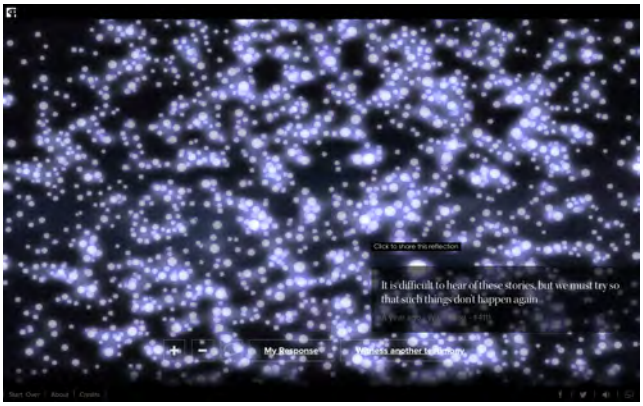


Fig.3. Screenshot of all audience's response collection in *The Space We Hold* @ Cult Leader & NFB

By clicking on each flash, viewers can read comments and thoughts left by other users, such as "may one day we become a better society" and "It is difficult to hear of these stories, but we must try so that such things do not happen again". Numerous response and narrative themes form a mirror reflection. In fact, the audience's point of view, is precisely the gist that this interactive documentary wants to express and appeal. The subject matter of this artwork has a deep historical and social connotation. The purpose of the author is to arouse deep thinking and extensive discussion, to let the public know, face up to and rethink profoundly this tragedy of history. Accordingly, the intervals caused by response part inspire the audience to think about the theme of the film and generate new sub-content in the interactive documentary. Although it is not in the narrative structure, it helps to convey the narrative content further and achieve a very clever narrative design.

Case Study: *Prison Valley*

Prison Valley is a first-person perspective web documentary that creates a unique journey for audience to explore the heart of America's prison industry: Fremont County, Colorado. After checking into a room at the Riviera Motel, visitors can explore the area and meet various characters, including a sheriff, a journalist, and a prison guard. At key moments, all the site's visitors and those affiliated with the industry can join in live online debates and exchange emails with characters on the issues raised in the story. [14] At the beginning of the artwork, there is an introduction for audience, indicating background and their roles in this interactive documentary, which build a stable knowledge foundation for the whole storytelling:

"Welcome to Cañon City, Colorado. A town in the middle of nowhere with 36,000 souls and 13 prisons, one of which is Supermax, the new 'Alcatraz' of America. A prison town where even those living on the outside live on the inside. A journey into what the future might hold." [15]

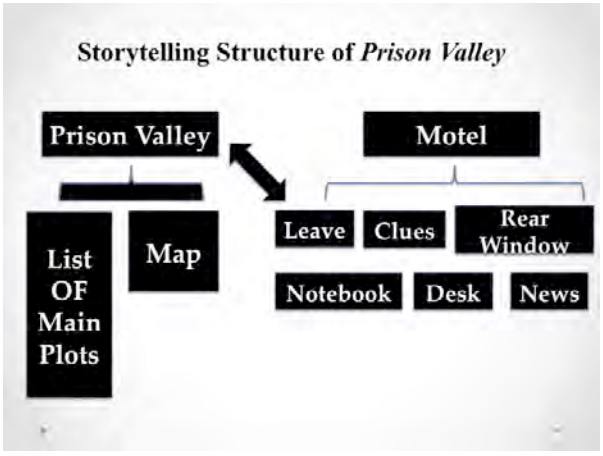


Fig.4. Storytelling Structure of *Prison Valley* @Author of This Paper

Two main sections constitute the storytelling: a motel full of clues and a map of Colorado with a navigator. In the motel, there are six interactive points: rear window, clues (documents and souvenirs), notebook, desk, news, and a door connected to the map of Colorado. Like in TAKAGISM, audience need click the buttons of each clue and collect all the hints in the room of motel to reveal hided plots, patching up the pieces of plots for a complete story of the city Colorado. To some extent, excluding the background information, the whole story is totally blank for viewers. The amount of content viewers can get depends on the degree of their participation and interactivity.

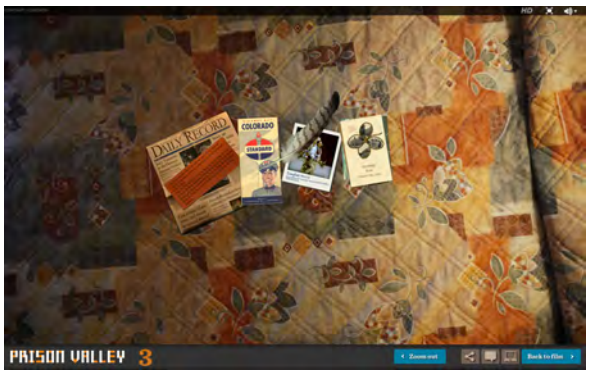


Fig.5. Screenshot of the clues in *Prison Valley*@ Arte & Upian

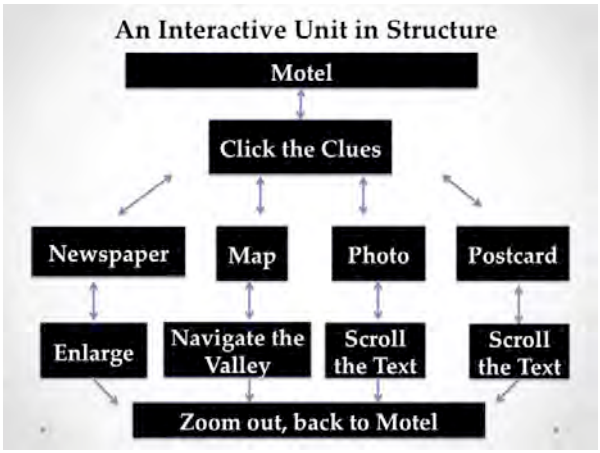


Fig.6. An Interactive Unit in Storytelling Structure of *Prison Valley* @Author of This Paper

As figure 5 shows, this is an interactive unit selected from the storytelling structure, where most physical participation happens. Every interactive point acts as an hinter in this interactive documentary, because audience are informed with the background only, the rest content are empty and waiting for exploring by means of interaction. Therefore interaction including large amount, high frequency and complicated structure becomes obvious texture of the storytelling. However, the way of interaction is pretty simple and repeat: they are completely realized by click and scroll of mouse. Hence, audience need to stop several times to wonder through the jungles of plot pieces and repeat the same movement by mouse. It is clear that even though all of the interactivities construct a formative loop for audience's exploration, the unavoidable will intervals fulfill the structure. Above circumstances probably mislead viewer re-enter the same plot or miss some plot, weakening the coherence and logic of storytelling.

Nonetheless, all intervals are surrounded by abundant media materials: the sustained sound track of the cacophony from prison, exquisite pictures and icons, encompassing information relevant to the story. And the strategy to gain information in this interactive documentary is designed into a TAKAGISM way. The feeling of suspense motivates audience to seek constantly. Through the view of first-person, every time when audience come across the intervals, these media materials generate a tension that makes them feel they are still in the story. Therefore in the empty part of story, the designs above can still bring about immersion and inspire imagination. As Olover Grau notes: "The media strategy aims at producing a high-grade feeling of immersion, of presence (an impression suggestive of 'being there')", which can be enhanced further through interaction with apparently 'living' environments in 'real time'." [16]

Besides, differed from The Space We Hold, an inserted navigator in Prison Valley makes the interaction more flexible. Audience can switch among the clues and comprehend the logic and structure of unknown plots, which reorganizes the intervals and composes a higher quality of immersion. Confusing the navigation of a virtual environment with that of a real environment is akin to equating a documentary image to seeing the real thing. [17]

Conclusion

The contradiction of interaction and immersion should not be ignored in the research or practice of interactive documentary. Overcoming this problem is of great significance to the handle the regulars and to improve the quality of interactive documentary creation. One of the biggest causes of this contradiction, intervals, will be a potential research direction and solution. The chart below shows my discussion of the main factors of intervals and their possible influence on storytelling, and further user studies and discussion will be needed to examine and refine it.

Factors of Intervals	Influence on Storytelling
Frequency	In general, the higher frequency of intervals, the more destruction in continuity of the storytelling. Unless the distribution of intervals can compose a rational rhythm in storytelling somehow, there might be some surprising effect.
Information Content	Information content in the interactive unit where the intervals appear, like text, sound, picture and video, should be well designed.

	Hollow information content will lose the interest and attention of audience, but superfluous information content will distract the attention on the storytelling either.
Logic	The relationship among every interval and storytelling constitute the logic, which is influenced by the effectiveness of every interactive unit. Audience often face the problem that they repeatedly entry the same plot or unintentionally exit the story, because they are unaware of the logic of storyline. Navigators and clues in the interactive unit are effective strategies to solve this situation.
Intensity	The intensity of interval such as the duration and displacement of audience's physical interactivity will influence continuity of storytelling
Perspective	The first person and third person perspective cause different feeling of intervals storytelling. Specific effect depends on the theme of story.

Just as in the traditional storytelling, authors deliber-ately design empty space in the content to stimulate the audience's imagination and thinking, thus sublimating the text content and enriching the text dimension. In interac-tive storytelling, as long as we make use of the frequency, information, logic and other factors involved in the design of interval, these hiatuses in narrative can be lightened and enrich the dimension and implication of the interaction, as well as the possibility of creation.

References

[1] Cedric Van Eenoo, "Storytelling and Intervals Storytelling and Intervals," n.d.

[2] Andre Almeida, Heitor Alvelos, "An Interactive Documentary Manifesto", *Lecture Notes in Computer Science*, Vol. 6432, 2010, 123-128, accessed October 1, 2018.

[3] Eku Wand, Tom Morrison Trans, "Interactive Storytelling: The Renaissance of Narration", in *Chapter of The New Media: Cinema/Art/Narrative* (London: British Film Institute & ZKM, 2002), 164.

[4] Everett Rogers M., *Communication Technology: The New Media in Society* (New York: The Free press, 1987), 56-60.

[5] Martin Lister, Dovey John, Seth Giddings, Grent Lain, Kelly Kieran, *New Media: A Critical Introduction* (London: Routledge, 2003), 20.

[6] Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (Massachusetts: The MIT Press, 1998), 116.

[7] Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (Massachusetts: The MIT Press, 1998), 98.

[8] Roy Ascott, Telematic Embrace : Vsionary Theories of Art, Technology, and Consciousness, Edited and with an essay by Edward A. Shanken, (LA: University of California Press, 2007), 80-81.

[9] Staffan Bjork, Jussi Holopainen, *Patterns in Game Design*, (Boston: Charles River Media, 2004), 423.

[10] Kate Nash, "Strategies of interaction, questions of meaning: an audience study of the NFBs Bear 71"， *Study in Documentary Film*, Volume 8, 2014, accessed October 1, 2018.

[11] Jiyao Lin, *Contemporary Foreign Aesthetics Introduction.* Nanjing: Nanjing University Press, 1991, 348

[12] Cedric van Eenoo, "Empty Space and Silence", *Arts and Design Studies*, Vol.15, 2013, accessed October 1, 2018.

[13] "The Space We Hold", *Website of National Film Board of Canada*, accessed 21 November 2018, www.nfb.ca/interactive/the_space_we_hold_en/?interactive–hp_en=feature_4&feature_type=w_interactive&banner_id=77674

[14] David Dufresne, Philippe Brault, "Prison Valley", *ARTE TV*, accessed 23 November 2018.http://prisonvalley.arte.tv.

[15] David Dufresne, Philippe Brault, "Prison Valley", *ARTE TV*, accessed 23 November 2018.http://prisonvalley.arte.tv.

[16] Oliver Grau, *Virtual Art: From illusion to Immersion*, (Mas-sachu- setts: the MIT Press, 2003), 7.

[17] Cindy Poremba, 2013."Performative Inquiry and the Sublime in Escape from Woomera." In "Strategies of interaction, questions of meaning: an audience study of the NFBs Bear 71", Kate Nash, Study in Documentary Film, Volume 8, 2014

Transformation and Regeneration of the Chinese Traditional Oiled-Paper Umbrella in Contemporary New Media Art

Jing Han
College of Fine Arts and Design, Tianjin Normal University
Tianjin，China
Email: 565291324@qq.com

Abstract

This study explores the aesthetic value and its new media-mediated pronunciation of Chinese traditional oiled-paper umbrella. As a traditional Chinese household item, the oiled-paper umbrella has a long history and combines practical and aesthetic functions. It is rich in aesthetic, spatial and decorative beauties. It has rich historical and cultural connotation and aesthetic values crystallizing the Chinese wisdom. At present, under the impact of the machinery industry, the traditional oiled-paper umbrella is gradually replaced by the steel frame umbrella or the new material and new technology, and is gradually withdrawn from people's lives. As a new art form that combines technology and art, new media art is an effective medium for transforming and regenerating the traditional techniques and cultures, enabling the life of traditional oiled-paper umbrellas to be activated and regenerated, so that traditional techniques and cultures can be activated, inherited and developed in the new era.

Keywords

New media art, Chinese oiled-paper umbrella, Traditional skills, Regeneration

Introduction

Chinese oiled-paper umbrellas is one of the handcrafted forms that unique charm possessing the fame of “beautiful texture and ingenious skills” [1]. Also, it played an important role in people’s lives. But the traditional handicrafts have been impacted by the machinery industry with the advent of modern industrial revolution.

Meantime, the traditional oiled-paper umbrellas have been replaced by folding umbrellas that made of steel frame gradually which as if was withdrawn from the daily life of the masses. They are struggling to maintain for existing under the protection of the intangible cultural heritage. In contemporary, the new media art which relies on the technology and art together, which is not only art carrier but also a medium. As the famous communication scientist Marshall McLuhan said, “The medium is a message” “The medium is an extension of the human,” [2] “The new media art is the extension of the traditional art form.” [3] Exploring a way by a new media for the transformation and regeneration of oiled-paper umbrella to people’s daily life is the main subject of this study.

Chinese traditional oiled-paper umbrella

Chinese traditional oiled-paper umbrellas have a history of thousands of years. As early as the eleventh century BC., umbrellas made of silk appeared. Mugong Qin, who first recorded in the Spring and Autumn Period （770-476 BC）, used a yellow “Hua Gai” umbrella that showed the ruler's majesty. In the Eastern Han Dynasty （25-220 AD）, after Lun Cai’s transformation of papermaking, there appeared a paper umbrella coated into tung oil. Entering the Tang Dynasty（618-907 AD）, oiled-paper umbrellas are widely used among the people. After the rice paper appeared, oiled-paper umbrellas with drawings on the surface appeared. In the Song Dynasty（960-1279 AD）, the famous painting “The Riverside Scene at Qingming Festival” showed the oiled-paper umbrella that was visible everywhere in the city. In the Yuan Dynasty （1206-1368 AD）, due to the invention of cotton, there were oiled-cotton umbrellas. During the Ming and Qing Dynasties（1368-1912 AD）, oiled-paper umbrellas and oiled-cotton umbrellas were widely used among the people. until the 1970s, oiled-paper umbrellas have been the main rain gear in Chinese social life.

After the 1970s, oiled-paper umbrellas were gradually replaced by folding umbrellas with convenient and inexpensive steel frame ribs, It almost quit people's daily lives. Traditional oiled-paper umbrellas have been reduced in production, and there are fewer and fewer craftsmen that know the traditional craftsmanship. The traditional oiled-paper umbrella, which is a combination of practical and aesthetic functions, can only exist as a traditional handicraft with aesthetic value, and no longer has practical value of life. How to protect and develop Chinese oiled-paper umbrella skills is an urgent problem to be solved.

Chinese oiled-paper umbrellas run through the Chinese people’s wisdom and elegant and refined artistic spirit.

They integrate nature, art, technology and function, and have unique aesthetic characteristics:

Shape beauty: The oiled-paper umbrella is made of hand-cut bamboo strips, and there are twenty or thirty skeletons in one circle. The ribs possess fabulous beauty of rhythm. An oiled-paper umbrella opens like a stretch of slim lotus leaves. When the umbrella is rotated around the hand, the shape is smooth and light.

Space beauty: The shape of the oiled-paper umbrella structure is inspired by the lotus leaf shape of nature, and the space structure is similar to Chinese traditional architecture pavilion. The umbrella is folded into line, and can be opened to a surface, and the space surrounding the umbrella surface is the body. The space between the opening and closing of the umbrella is converted from one-dimensional to two-dimensional and three-dimensional, creating a space beauty that is private and intimate.

Decorative beauty: The round umbrella surface of the oiled-paper umbrella is usually drawn with various landscapes, figures, flowers and birds, etc. The color is either fresh or rich, given a strong decorative beauty.

Meaning beauty: The shape of the umbrella is round, it has a perfect meaning. Because "paper" is the homophonic word of "child" in Chinese, so the oiled-paper umbrella has the meaning of "giving an early birth". The ancient Chinese character "傘（umbrella）" contains five characters of "人（man）", indicating "multiple sons and grandchildren".

Figure 1. Copyright by http://www.sohu.com/a/84743691_422188

The practice of new media art on Chinese traditional oiled-paper umbrella

Broadly speaking, "new media art refers to works of art created using new media technologies, including digital art, computer graphics, computer animation, virtual art, internet art, interactive art, video games, computer robots, 3D printing, robotics, art and biotechnology, etc." [4] New media art, as a new art discipline with science and technology as its basic language, is being integrated into all fields of contemporary art, through the comprehensive application of visual, tactile, auditory and other medium, with people involved, Interprets and presents a brand-new visual dimension and personalized artistic experience.

Using the new media art to explore the aesthetic value of Chinese traditional oiled-paper umbrella art, and spread it through the various media fusion of technology and art, in order to achieve its transformation and regeneration.

The new media interactive artwork is that *Instant*, (Figure 2) which uses the new media technology to present the traditional oiled-paper umbrella as a visual symbol and combines with digital human-computer interaction design. Inspired by the opening and closing function of the oiled-paper umbrella, the work puts hundreds of small white paper umbrellas that can be opened and closed in a pixel background on a wooden wall of a non-reflective black curtain. Scan the QR code and enter the text message on the phone. The text message will be displayed through the opening of the array of paper umbrellas on the device. The image will only stay for a few seconds, and then the oiled-paper umbrella will be closed, ending the text graphic information, so that the viewer controlled the mobile phone has his or her own instant moment.

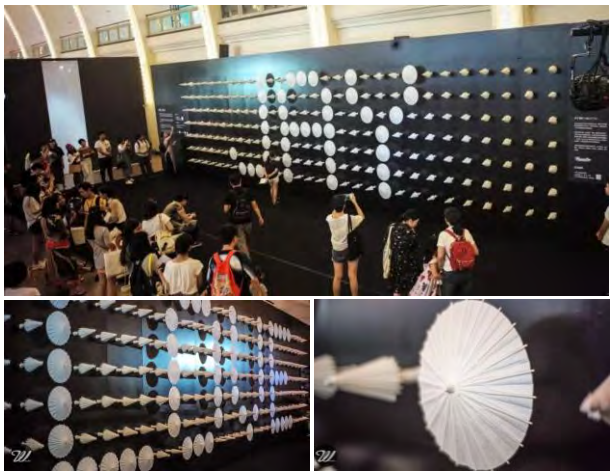


Figure 2. *Instant*, Copyright by Wonderlabs studio.

When the pure white oiled-paper umbrella begins to open and close, the rhythm of the oiled-paper umbrella array can be felt from any position of the viewer, which is elegant and modern. Traditional oiled-paper umbrellas are presented with a strong visual aesthetic, through human-computer interaction of new media art.

The esthetician, Bolev believes that "the reading symbol requires revealing and recognizing the object of the symbol (the object meaning of the symbol) and the meaning (the meaning of the connotation of the symbol)." [5], The traditional umbrellas are arrayed as representation symbols. They are converted into new presentation that is alphabet in English by computer processing. and are presented in international alphabetic symbols as Figure 2. Of which the symbolic transformation is abstracted, and the traditional cultural semantics of the oiled-paper umbrella itself is deconstructed as symbols. The coding becomes the

ideographic representation of people's short-lived inner feelings. The oiled-paper umbrella has been given a new visual cognition and experience by human-computer interaction art of the new media art, allowing viewers to re-recognize the traditional oiled-paper umbrella and rethink it's the new visual significance and aesthetic value umbrella in the contemporary era.

The new media artwork *Rain Lane* (Figure 3) combines the opening and closing space created by the traditional oiled-paper umbrella, with the modern new media art to show the space art and time art. The space created by the umbrella is used as the element and symbol of the new time and space art, and give new meaning. Taking the poet Wangshu Dai's *Rain Lane* as the source of the text, a precise 3D digital dynamic projection is carried out on a translucent Chinese traditional oiled-paper umbrella with a pattern, extending from one-dimensional space to two-dimensional space and three-dimensional space. Through the traditional media oiled-paper umbrella into the modern medium to create the image transformation of time and space. From the real world to the traditional ancient alleys, the oiled-paper umbrella creates a dreamlike space like a kaleidoscope, showing the architectural beauty of the traditional ancient alley. As an original aesthetic, the ancient alley is replaced by digital abstract graphics created by modern media sound and light technology, creating a time-space-like visual illusion that allows viewers to gain a satisfaction with immersive aesthetic experience in a fantastic space full of imagination, just as "the space that is grasped by imagination is no longer the indifferent space under the control of measurement work and geometric thinking. It is the space that people experience. It is not experienced in an empirical perspective, It is experienced in all the particularities of imagination." [6]

The oiled-paper umbrella, as a traditional medium, through the new media 3D projection technology, the visualized spatial imagination is presented, allows the viewer to gain a new cognition and aesthetic expansion of the contemporary cultural connotation of the oiled-paper umbrella.

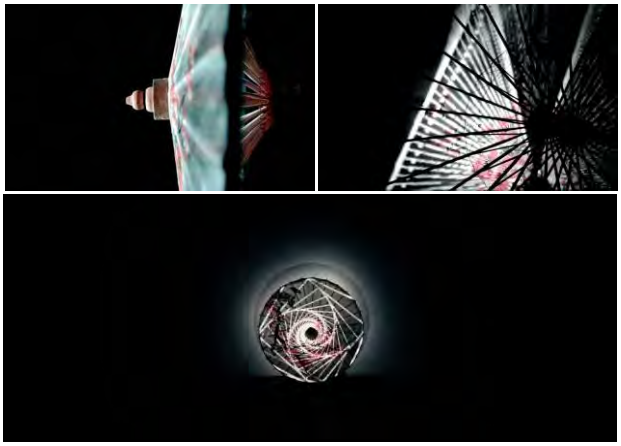


Figure 3. *Rain Lane*, Copyright by PINGIC Creative Media Lab.

The new media interactive artwork *Source* (Figure 4) combines the traditional oiled-paper umbrella with Chinese traditional music art, and uses the umbrella surface as a platform for expressing sound art, re-giving the formal beauty of the oiled-paper umbrella and the aesthetic sense of decorative art of traditional painting.

Through the combination of oiled-paper umbrella art and music art, the audience can play the classical instrument zither and touch the sensing device, which in turn drives the different transformation pictures presented by the oiled-paper umbrella surface on the back screen.

When the audience pluck the strings from slow to fast, the white spots of the umbrella surface gradually begin to converge into line, and these flowing lines are gathered into a surface, so that the three umbrella surfaces are covered as if it all changed into white. Performance music can soothe people's complex and changing emotions, and get a relaxed feeling. The circular plane of the oiled-paper umbrella is used as the artistic carrier to convey the music. Accompanied by the decorative pattern of dynamic lines of the umbrella surface, the rhythm of the music is visually presented, and the tactile and auditory art of the human being are used. It was combined by diversified and intermediary art on vision, acoustically and feeling, which uses modern media technology to bring the beauty of visual decoration of traditional oiled-paper umbrella to the audience, give the new physical and mental experience to them.

Figure 4. *Source*, Copyright by Xiaoyan Jiang and Yulu Liu from the School of Digital Media Arts, Shanghai Conservatory of Music.

The significance of contemporary new media art to the transformation and regeneration of traditional techniques

The above three cases demonstrate that the new media art has fully excavated the aesthetic characteristics of Chinese traditional oiled-paper umbrella, such as shape beauty, space beauty and decorative beauty. Through the advantage of multidimensional media integration of new media, it shows the rich culture of Chinese traditional oiled-paper umbrella. The artistic connotation affects the aesthetic appeal to contemporary people, reflects contemporary values, and then effectively spreads Chinese traditional skills among the people.

Moreover, new media art can be also explored and used to activate and regenerate the life of various traditional art,

toward to the protection and inheritance of traditional skills. As a product of the perfect combination of high technology and art, new media art is an efficient medium, linking people with forgotten traditional skills, and prompting people to rethink. The way that contemporary new media art reforms and regenerates traditional skills is to make full use of the advantages of new media art, use the internet technology, virtual reality technology, digital image technology, mobile media technology and so on, fully tap the characteristics of traditional skills, and use new media art to magnify and present it. Better let the traditional skills be better interpreted and disseminated.

Traditional techniques as cultural and emotional memories carried by human beings might be surely be extended and reborn through contemporary new media art.

References

[1] *Translation and Annotation of Kao Gong Ji* , trans. Renjun Wen (Shanghai Classics Publishing House Press, 2008),4.
[2] Marshall McLuhan, *Understanding Media*， trans. Daokuan He (Commercial Press, 2003), 33.
[3] Zhibo Xu, Dalei Fang and Yan Da, "Sound Media Interaction Design in Musical New Media Art," *Journal* of *Fudan University* (*Natural Science*) 57,(2018) : 320.
[4] New media art , March 21, 2018, https://en.wikipedia.org/wiki/New media art.
[5] Bolev, *Aesthetics* (China Federation of Literary Publishing Company Press, 1986), 376.
[6] Gaston Bachelard, *Space Poetics* (Shanghai Translation Publishing House Press, 2009), 8 .

Bibliography

Daoyi Zhang , *The Art of Creation* (Fujian Fine Arts Publishing House Press ,1989) .
Lushen Pan, " Protection, Inheritance , Innovation, Derivation :Traditional Process Protection and Development Path," *Journal of Nanjing Arts Institute(Fine Arts & Design)* 2,(2018) : 46-52.
Ling Yuan, "The inheritance of Chinese traditional handicrafts in the perspective of intangible culture , " *Art Education Research Journal* 24, (2017)39.
Minmin Guo and Mingming Xu, " Rethinking traditional craftsmanship: thinking caused by contemporary art design," *Arts Criticism Journal* 7, (2015) : 112-115.
Xiaoxiang Ma, *New Media Installation Art* (Nanjing University Press, 2013) .
Xuan Pei, "the construction of spatial aesthetics and its post-modern cultural representation practice， "*Journal of Zhengzhou University(Philosophy and Social Sciences Edition)* 2, (2014): 100-109 .
Yu Fu, " The Enlightenment of Traditional Craftsmanship on Postmodern Design, " *Journal* 3, (2015):26-28.
Yuzu Li, *The beauty of creation*: *the art and culture of product design* (Renmin University of China Press, 2000).
Zongyue Liu, *Craft Culture* (Guangxi Normal University Press, 2006).
Zhi Wang, "Visual Research on Experimental Image Art," (Ph.D. diss., Beijing Film Academy, 2017.)

Author Biography

Jing Han, lecturer of Digital Media Teaching and Research Department, College of Fine Arts and Design, Tianjin Normal University, teaching Digital Media Series Courses. The main direction of academic research are computer animation and theoretical research. Focus on the combination of computer animation and Chinese traditional culture, and published a number of professional papers in domestic core journals.

Imitation - Classification - Construction
Vessels of Vanitas and the Changing Meaning of Ornament

Tobias Klein & Harald Kraemer
School of Creative Media, City University of Hong Kong
Hong Kong, S.A.R.
ktobias@cityu.edu.hk, h.kraemer@cityu.edu.hk

Abstract

This text analyses the ornamental engravings of Rococo, *Art Forms of Nature* by Ernst Haeckel, and the digital paintings of Robert Lettner. Together, they create forms, applications and methods of the ornament as contemporary catalyst reflected in the artwork *Vessels of Vanitas.* The following observations of the works, their differences and similarities, allow a speculation on emerging synergies between method, media and context of the ornament and what each can learn from the other. All these works and objects were brought together in one exhibition, constructing the guiding principle of a *Wunderkammer*. As a result, a better understanding of the multi-layered concept of ornament as a naturalistic imitation, a classification tool, and as an algorithmically generated construct has been achieved.

Keywords

Algorithmic Art, Ornament, 3D Printing, Rococo, Symmetry, Asymmetry, Landscape, Wunderkammer

Wunderkammer.
Model for Synergetic Interplay

The exhibition *New Wunderkammer of Rococo* shown between March 25th and April 3rd 2017 on the 9th floor of the Run Run Shaw Centre for Creative Media in Hong Kong marks the starting point of this investigation. It equally marked the end point of the term and was a platform to bring together the results of several courses and research projects. As for a starting point – for the first time, the results were comparatively put up for discussion in a larger context of the Wunderkammer. Organized by the students of the MA Program *Curating Art & Media*, the exhibition showcased several readings and directions of historical and contemporary handling of the concept of ornament [1]. Subjects of the exhibition were on the one hand replica's of high resolution scans of original ornament prints of the Rococo period by the Museum of Applied Arts in Vienna and a reprint of Ernst Haeckel's publication *Kunstformen der Natur*, which influenced in many ways early 20th century art, architecture and design. These classics of ornamental design were brought into a tense constellation with algorithmically composed ornamental paintings of Austrian artist Robert Lettner (1946–2012), and the synthetic ornament in the 3D printed work *Vessels of Vanitas* made by Tobias Klein. The exhibition included as well a series of 3D printed works by post-graduate students who were given the task to redesign fragments of the Rococo ornament prints as 3D printed artefacts. The exhibition showcased the relationships between the works, their dichotomies and resulting emerging synergetic interplays in a didactic formed discussion surrounding ornament as timeless construct in art.

The creation date of the exhibits covered a period of over 300 years. The tools of making them ranged from the etching of a copper plate to 3D printing using laser light to harden resin. The motives and underlying geometric rules derived from natural imitation, interplay of convex and concave curves to computational applied algorithms and non-invasive diagnosis technologies in medical imaging. In order to interlock these different objects and to bring them into a stimulating interplay, the Wunderkammer was chosen as the overarching model.

The early Wunderkammer or cabinet of curiosities such as the *Musei Wormiani Historia* by Ole Worm, or Ferrante Imperato's *Dell'Historia Naturale* were constructs acting as reference systems and collections of knowledge of the owner [2]. They were at the same time subject of investigation as well as a self-referential micro universe. Their totality made it possible to connect the individual items, independently of their origin and conclude relationships and research based on the ecosystem of related specimens. The symbol of the Wunderkammer, a classification space, would make it possible to compare the exhibited ornamental forms without pre-classification and to examine the rich diversity of an extended concept of ornament.

Rococo.
Imitation, Asymmetries, and Landscapes

The Rococo is characterized by asymmetric floral-vegetal design. Sadly, little is build and most exist only in the form of the ornamental engravings. In place of the baroque pathetic, the female Rocaille constitutes a new lead form, characterized by light, delicate, sinuous lines and tendril-shaped borders. From this playful treatment of convex and concave forms a changed view of nature. The motif of the ornament prints ranged from simple imitation to the idea of the landscape as a stage to the fusion of architecture and landscape as an asymmetrical

Figure 1. Image collage of the exhibition *New Wunderkammer of Rococo*. Left: A series of 3D printed student works / Center: Robert Lettner *About the Dialectic of the Flimsiness*, No. 5, 2000.
To the right: 3D print *Yi Nian* by student LIU Yuquian / Right: *Vessels of Vanitas* casting a shadow on Robert Lettner *About the Dialectic of the Flimsiness*, No. 10, 2000 (© Robert Lettner, LIU Yuquian, Tobias Klein. Photos: Tobias Klein, Harald Kraemer)

design language. These imaginary constructed landscape became the context of the 3D printed artefacts in the exhibition. The MAK - Austrian Museum of Applied Arts in Vienna supported the project by providing high-resolution scans of some of her ornamental-collection works.

Taken the constructed landscape as reference and site, the 3D printed artefacts discuss a changing relationship between form and composition, architectural elements and nature. This can be seen most clearly in the works of the Augsburg artist Johan Esaias Nilson (1721–1788) [3]. In his engravings from the series *Cartouches Modernes avec des différentes Figures*, (Fig. 2 - left side), the two dominant cartouche elements are formed by convex and concave elements. They are decoration, design elements of pictorial space, frames and pictorial motifs at the same time. This ambiguity creates a pseudo-architecture in an artificial nature. In contrast, in the second etching with the title *Naturae miracula* (Fig 2 - right side), nature itself mutates into an ornament. Here, the convex and concave elements serve to emphasize a supposed naturalness in the artificially created environment. With his 1753 published work *The Analysis of Beauty*, William Hogarth provided the art-theoretical basis for understanding this unusual formal language of Rococo [4].

Art Forms of Nature.
Ornament as a Classification System

Ernst Haeckel (1834–1919) was not only an outstanding zoologist, but also an excellent draftsman and someone who knew how to use the laws of symmetry for his influential work *Kunstformen der Natur* (*Art Forms of Nature*) [5]. According to Breidbach, Haeckel deliberately used symmetrical composition to categorize and classify his objects. Haeckel thus followed the language of scientific visualization already developed by Owen Jones in his *Grammar of Ornament*, in which the ornament was understood as a structural principle of order and not as a single decor [6]. The topics were selected by Haeckel to fully illustrate them, while the illustrations were arranged to have the greatest possible visual impact. Plate 71 *Stephoida* and Plate 88 *Discomedusae* (fig.3) show quite well, the symmetrical design language used by Haeckel in support of his classifications. While the 13 individually designed *Stephoida* of the left illustration optimally structure and fill the existing space, the *Discomedusae* already seem like an ornament per se because of their structure and symmetrical arrangement. The individual forms also follow strict symmetrical laws, so that Haeckel's reputation as a meticulous specialist in marine biology was not least due to the high quality and attention to detail of his drawings.

Pictures of Magical Geometry.
Ornaments as Algorithmic Constructs

The trend towards ornamentation at the begin of the 20th century, as anticipated by Henry van de Velde, Wassily Kandinsky and Wilhelm Worringer, is to be regarded as an essential aspect of abstract painting of the 20th century, and the artistic engagement herewith continues to be continuous[7]. This was supported by the exhibition *Ornament and Abstraction*, which took place in 2001 at Fondation Beyeler, presented impressively [8]. Using illustrative examples, the attempt was made here to establish ornament as an essential guideline for the development of modern abstract art of the 20th century; a thesis that Markus Brüderlin has already championed in his dissertation [9].

Figure 2. Johannes Esaias Nilson (design, publisher, and engraver). Left: *Cartouches modernes avec des diferentes Figures*, print no. 2, Inv. No. KI 1-482-2 / Right: *Naturae miracula*, Inv. No. KI 1-484-24
(© MAK - Austrian Museum of Applied Arts, Vienna, Library and Works on Paper Collection)

The Austrian painter Robert Lettner (1943–2012) was one of the pioneers of digital painting whose occupation with the *Pictures of Magical Geometry*, as his exhibition in the Vienna Secession 1998 was called, goes back to the late 1960ies [10]. In his works, Lettner questions the significance of the auratic original in times of digital reproduction technologies and deals with the notion of ornament as a structural order structure of coming image worlds. It was the ability to use computer algorithms to make the computer a quasi-employee of the artist, leading to the current positions. Lettner is primarily concerned with forms that can be embodied as structures ordered by the ornament. They are, so to speak, pictorial principles of order, which represent ornaments and lead to an ornamental consciousness. By contrasting his symmetrically designed rug patterns with a white Arabesque as an asymmetrical void, Lettner somehow resorts to the shape of the Rococo Rocaille. The Arabesque created by him, the forked leaf tendril, from which sprout buds and blossoms in infinite sequence, refers to the construction of the world as a symbol.

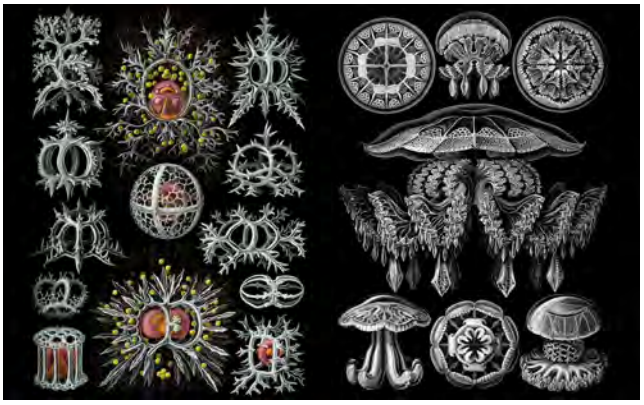


Figure 3. Two illustrations by Ernst Haeckel in *Kunstformen der Natur* (1904). Left: plate 71: *Stephoida*, Right: plate 88: *Discomedusae Scheibenqualle* (© Kurt Stueber, www.BioLib.de)

By calling the series of knots *About the Dialectics of the Flimsiness* (2000), the circle closes with Alois Riegl. With the Arabesque emerges again that original form of ornamental design, which was one of the focal points in Riegl's 1893 published book *Stilfragen. Grundlegungen zu einer Geschichte der Ornamentik* [11].

Figure 4. Robert Lettner, *About the Dialectic of the Flimsiness, No 7*, 2000, Digital print, 200 cm x 200 cm (© Robert Lettner Archive, Vienna)

Figure 5. Tobias Klein, *Vessels of Vanitas,* 2017*,* 3D print using Stereolithography (SLA), 70 x 45 x 40 cm,
(© Tobias Klein, Photo: Tobias Klein)

Vessels of Vanitas.
New Synthetic Ornaments

Set between the imitation of natural forms in the Rococo, the symmetric arrangement of the scientific illustration of Haeckel and the use of computational tools to distort symmetry juxtapose asymmetrical orders in the works of Lettner, *Vessels of Vanitas* articulates a construct based on a technological made visible nature and the 3D printed amalgamation of it.

Starting with the project *Soft Immortality* back in 2008, the author worked continuously with the Magnetic Resonance Imaging (MRI) as a source of a technological augmented natural. The 3D construct resulting from MRI scanning is a voxel space. In difference to finite geometric forms, a voxel data form is malleable and not finite as other forms of 3D data like the mesh data. Used as a medical non-invasive diagnosis tool, a voxel dataset shows the body as a field of density of its various matter and constitutes a continuous gradient field of possible form.

Thus, the body cannot be defined anymore as figurative and external form, finite through its physical outer presence, yet as an internal infinite gradient field of densities.

This divergence from finite form as a basis in the formal imitation of nature in the Rococo marks a clear departure from and allows exploration beyond the figurative nature, allowing the removal of imitation of natural forms from the ornament. Thus, *Vessels of Vanitas* establishes an eco-system of MRI data scans that form, through selection of density states individual organ like constructs named organelles. Each of the organelles is a found object, constituted through selective density states from the embodied data. Each individually is the amalgamation of connective tissue, ligaments, muscles, veins and arteries using tools of digital modelling software. Each in itself acts as a microscopic organism construct not too dissimilar to the individually drawn radiolarian by Ernst Haeckel. Together and interconnected, they form what Haeckel describes as a biotope, a specific environment of interrelates species. The formal quality though of each organelle, part of the later symmetrical arranged total construct *Vessels of Vanitas*, is designed as a series of interrelated concave and convex curvatures, reminiscent of the cartouches of Johan Esaias Nilson. Where Nilson, due

to technological restrictions of the time, resorted to 2D etchings and speculative pseudo-architectures, and Haeckel resorted to symmetry as a classification tool of single cell organisms again in 2D, the work expands beyond these obstacles, combining the asymmetric individual cells into a symmetric larger multi-cell complex organism. At the same time, the work is transforming the traditional craftsmanship methods and approaches of the Rococo and the computational and algorithmic workflows behind the works of Robert Lettner to create a new synthesis in the form of a Digital Craftsmanship [12] of a new, hybrid, Ornament.

While Robert Lettner plays through the confrontation of arabesques in the ornamental carpet with an asymmetrical element in a symmetrical environment, *Vessels of Vanitas* goes a step further. The multitude of asymmetrical geometric organelles form an overall body created by their strong symmetry in space. *Vessels of Vanitas* thus combines the rules of the Rococo, Haeckel and Lettner and at the same time goes beyond them.

References

1. F. Knothe, H. Kraemer (Eds.), *Robert Lettner. In Dialogue with the Chinese Landscape / Utopia of Ornaments / New Wunderkammer of Rococo* (Hong Kong: University Museum and Art Gallery, The University of Hong Kong, 2017) see: 64–77.

2. H. Bredekamp, *Antikensehnsucht und Maschinenglauben. Die Geschichte der Kunstkammer und die Zukunft der Kunstgeschichte* (Berlin: Wagenbach, 2000).

3. G.-D. Helke, *Johann Esaias Nilson (1721–1788): Augsburger Miniaturmaler, Kupferstecher, Verleger und Kunstakademiedirektor* (München: Scaneg Verlag, 2005).

4. W. Hogarth, *The analysis of beauty : Written with a view of fixing the fluctuating ideas of taste.* [London: printed by J. Reeves for the author, and sold by him at his house in Leicester-Fields, 1753].

W. Hogarth, *The Analysis of Beauty* [1753], ed. by R. Paulson, (New Haven: Yale University Press 1997).

5. E. Haeckel, *Kunstformen der Natur* [Leipzig: Bibliographisches Institut, 1899–1904].

O. Breidbach, *Visions of Nature: The Art and Science of Ernst Haeckel*. (München: Prestel Verlag, 2006).

6. O. Jones, Grammar of Ornament. [1856] (New York: DK Publishing, 2001).

St. Sloboda: "The Grammar of Ornament: Cosmopolitanism and Reform in British Design." In *Journal of Design History*, Vol. 21, No. 3 (2008) 223–236.

7. H. Kraemer, "Ornamentik zwischen Opulenz und Virtualität: Worringers Vermächtnis?" In N. Gramaccini & J. Rößler (eds.) *Hundert Jahre Abstraktion und Einfühlung. Konstellationen um Wilhelm Worringer*, (München: Wilhelm Fink Verlag) 259–276 (2012).

H. Kraemer, "Ornament and Transformation - the Digital Painting of Robert Lettner at the Interface of Analogue and Algorithmic Art." In *Art Machines: International Symposium on Computational Media Art*, Edited by School of Creative Media, City University of Hong Kong, 04. –07. Jan. 2019, Conference Proceedings, (Hong Kong: School of Creative Media, City University of Hong Kong) 42–56 (2019).

8. *Ornament und Abstraktion – Kunst der Kulturen, Moderne und Gegenwart im Dialog,* Exh.Cat., Fondation Beyeler, Riehen/Basel, 10.6. –7.10.2001, (Köln: DuMont, 2001).

9. M. Brüderlin, *Die Einheit in der Differenz. Die Bedeutung des Ornaments für die abstrakte Kunst des 20. Jahrhunderts. Von Philipp Otto Runge bis Frank Stella*, Diss. 9.11.1994, (Bergische Univ. GH Wuppertal, 1995, Microfiche-Ausgabe).

10. R. Lettner. *Bilder zur magischen Geometrie,* Exh.Cat. (Wien: Wiener Secession, 1998).

H. Kraemer, *Robert Lettner. Das Spiel vom Kommen und Gehen. Widerstand – Utopie – Landschaft – Ornament* (Klagenfurt: Ritter, 2018).

11. A. Riegl, *Stilfragen. Grundlegung zu einer Geschichte der Ornamentik*, (Berlin: Verlag von Georg Siemens, 1893). *Unlocked* (Cambridge and London: MIT Press, 2013), 40.

12. T. Klein, "Augmented Fauna and Glass Mutations: A Dialogue Between Material and Technique in Glassblowing and 3D Printing." In *Leonardo* 51, no. 4 (2018) 336–342.

Acknowledgements

First, the authors would like to express their thanks to Kathrin Pokorny-Nagel, Peter Klinger, and Thomas Matyk of the MAK - Austrian Museum of Applied Arts, Vienna, Library and Works on Paper Collection for their support in giving access to their valuable collection of rare Ornament prints.

Secondly, we would like to express our deepest thanks to Margit and Markus Lettner, Vienna for allowing access to the works of Robert Lettner.

Lastly, we would like to thank the MA and MFA students participating and organizing the exhibition *New Wunderkammer of Rococo* shown between March 25th and April 3rd 2017 at the Run Run Shaw Centre for Creative Media in Hong Kong.

The work Vessels of Vanitas described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (project no.: CityU 21611115).

Author(s) Biography(ies)

Tobias Klein

Tobias Klein works in the fields of Architecture, Art, Design and interactive Media Installation. Trained as an Architect, his work generates a syncretism of contemporary CAD/CAM technologies with site and culturally specific design narratives, intuitive non-linear design processes, and historical cultural references.

Klein's works are exhibited international at the London Science Museum, the V&A, The Venice Architectural Biennale, the Science Gallery (Melbourne), the container (Tokyo), the Bellevue Arts Museum, Museum of Moscow and Vancouver and in the permanent collection of China's first 3D Print Museum in Shanghai, the Museum of Glass in Tacoma (USA) and the Antwerp Fashion Museum (MoMu). Brain Factory, his latest collaboration with Maurice Benayoun, has been exhibited widely, including the Art Centre Nabi (Korea) and Microwave 2018 (Hong Kong). Klein lectures and publishes internationally, recently winning SIGGRAPH 2018's Best Art Paper Award for his research on the translation from traditional to digital Craftsmanship using 3D printing and glass making and is currently finishing his doctoral thesis with the title '*Through the looking Glass – a synthetic model of techne and poiesis in Computer Aided Design and Manufacturing*'.

Harald Kraemer 孔慧銳

Currently Harald Kraemer is Associate Professor at School of Creative Media of City University of Hong Kong and Head of the *Curating Art & Media* stream of the Master of Arts in Creative Media program. Since his PhD in Art History on Museum Informatics & Digital Collections and his MA in Museum and Curatorial Studies, he has been involved in more than 60 museum management projects and he has produced more than 120 interactive online and offline applications. He curated and designed exhibitions like *ISEA2016* in Hong Kong, *The Age of Experience* (HK 2015 / Vienna 2016) or *Interval in Space* (Nairs / HK 2017). Kraemer has written and published widely on hypermedia design, museum informatics, digital collections, and contemporary art.
Recent publications: *The Age of Experience. Hong Kong – Vienna. Exhibition Strategy & Reflection* (2017); *Robert Lettner. Das Spiel vom Kommen und Gehen* (2018). Coming Publication: *Multimedia Classics – Hypermedia Hermeneutics. Museums and their Digital Intangible Heritage* (2020).

P@tch: Can We Use DIY Techno-Craftivism to End Armchair Activism

Janna Ahrndt
Purdue University
The United States of America
jahrndt@purdue.edu

Abstract

Like a Fitbit for your ethical performance, P@tch is a textile-based new media project that uses light and social media to allow the user to track their progress as an advocate for an environmental, ethical stance. P@tch workshops are built to create a space for creativity and discussion surrounding the conflict between personal and corporate accountability to affect change.

Keywords

Feminism, Craft, Wearable Technology, Workshop, Activism, Social Media, Accountability, Community, Ethics, Environmentalism

Introduction

Like a Fitbit for your ethical performance, P@tch (Figure 1.) is a hand-embroidered patch that allows the user to track their progress as an advocate for an ethical stance. This utilizes the ethos of Punk, DIY/Lo-fi, and digital opensource movements by posting all sources, material, and instructions online for anyone to access. By posting all of these resources on my website I hope to foster a more inclusive space for voices that are often unheard in new media art and tech fields in general.

The main components of P@tch are an RGB color mixing LED light, a small sewable microcontroller, a Bluetooth module, and a button switch. This wearable is made with soft circuit electronics allowing participants to sew the circuits directly into the fabric of their patch. The Bluetooth module connects to the Adafruit Bluefruit app on their phone which then sends self-reported data to a feed on an open source platform. It then triggers another online application created using IFTTT to transmit data from their feed to their twitter account.

Figure 1.

Conceptual Framework

Technology has biases and is shaped by the society that produces and uses it. Our self-tracking gadgets track everything from efficiency at work, diet, exercise, and sleep patterns, but there is not yet a market for tracking qualities such as our empathy or our ability to affect change. This absence may be due to the capitalistic, white and male power structure of current tech space and needs to be rejected and restructured to include women and people of color to unleash the true power of technology. The action of wearing the P@tch is a performance in the sense that it draws attention to the wearer and sparks

conversation with others in the surrounding community. We can imagine an alternative world in which tracking our environmental impact was as popular as tracking our fitness level. A glowing world full of low power LED accountability jackets.

Second wave feminist movements – such as the ecofeminist and anti-war movements, leaned into this essentialist notion of gender roles and saw science as "other", believing it to be inherently masculine and violent. Early ecofeminist movements emphasized women's connection to nature as intrinsic to their feminine identity. They argued there were irreconcilable differences between the mechanical/masculine and the natural/feminine [3].

Social scientists studying the gender problem in science in the '60s and '70s gave little thought to the nature of the technoscience industry as being exclusionary as it was believed that science is intrinsically concerned with unbiased and objective research. Since the 1960s, social scientists have studied women's exclusion from science and technology [1]. Many, such as Australian Sociologist Judy Wajcman, agree that it is not only the role of discrimination in these fields that discourage women from starting careers in the science and tech fields but the more complex issue of the internalization of prescribed gender roles penetrating our systems of mass media and education that tell women science and technology are for men [2]. In TechnoFeminism, Judy Wajcman points out that assuming the issue of socialization puts the problem on women's shoulders to become more "man-like" as opposed to questioning how the fields of technoscience can be altered to accommodate qualities women are socialized to have.

In the early 2000s, the Maker movement hoped to open up technology to everyone in true DIY fashion, but Makerspaces continue to have a gender gap issue. According to a 2012 independent market study published in Make: 81% of U.S. Makers identify as male [4]. This leaves many women and marginalized groups feeling that the power structure in these supposedly structureless spaces is just a continuation of the power structures of the tech industry, forcing them to create their own spaces such as Double Union or Hacker Moms in San Francisco [5].

The concept of this project is inspired by Judy Wajcman's position that subversive possibilities of new technology have been overlooked and can be a valuable tool for destabilizing the current patriarchal and classist power structure [6]. The structure, however, is taken partially from artists Anthea Black and Nicole Burisch's Key Features of craftivism: participatory projects that value democratic processes, use of various cross-disciplinary media, and ongoing commitment to politicized practices, issues, and actions [7].

White male domination over emerging technology and science has contributed to the idea that "man's work" is skilled or valuable work. This allows us as artists and marginalized people to use these emerging technologies subversively. By combining technology with the rich history of textiles in resistance and activist movements, we can create new objects that confuse the essentialism of masculine/feminine tech/textile.

Technology like craft stretches the bounds of aesthetics and the way we interpret how art can be made. Because of this, I view the tinkerers as the new craftsmen making things with our hands in the real world as well as in the digital realm. In my work, I want to blur these lines even further by utilizing ways in which textiles enhance my technological work and vice versa.

Workshops

In person, P@tch workshops invite participants to create their own critical design object that allows them to discuss boundaries that inhibit personal political action that shift from the online space to the physical realm, as well as question the limits of personal and corporate responsibility. The P@tch workshops teach participants the basics of embroidery, conductive thread circuitry, to get them started making their own self-accountability-tracker that can be synced to their twitter feed (Figure 2.).

Figure 2.

To begin a workshop, I begin by providing my own story of creating the P@tch and provide my personal plastic-use tracking P@tch as an example. I do not prescribe my own ethical beliefs to the participants, but encourage them to create a tracker to advocate for something they care about. I then have participants introduce themselves so participants get a short introduction and get to know one another. The participants are provided with written instructions that include images and circuit diagrams in an eleven-page zine. By providing instructions for workshop-goers that covers things like how not to create a short circuit, it is my goal to make participants feel less rushed to complete their P@tch by the end of the workshop. The zines also include instructions on where to find the code or how to get the microcontroller up and running. I walk from person to person helping and joining conversations instead of taking a place at the head of the workshop table. This allows me to help those too shy to ask for assistance, and I can encourage those who are more experienced to help others. It also gives those that wanted to the option to work ahead of the rest of the group and those who worked more slowly to go back and reference the instructions.

I had the opportunity to run the first iteration of this series of workshops at Purdue University on October 26th, 2018. Around 10 participants came to make a color change P@tch. The workshop participants were mainly college-educated women ranging in age from late teens to middle age with previous sewing experience, but little to no experience with electronics. Some participants had no sewing skills and that seemed like a larger hurdle than the circuitry. In these kinds of cases, I think it is important to demonstrate and provide clear guidelines on how to sew basic stitches and how to tie off their thread which I had left out in my first set of instructions. For this particular workshop, I adapted the P@tch to the skillset of the group by only include a color changing LED instead of the Bluetooth module. In this color change version of the P@tch, the button switch only triggers a color change in the LED, so those within your vicinity can see how you are doing on your goal. I intended to make the experience relaxed and low stress as I knew they had a lot to learn in a short amount of time. I did not ask them to share their tracked behavior (though many did) with other participants or me, but I did ask them to fill out an exit survey. One participant chose to follow their plastic use, three decided to monitor their water use, and one chose to be more conscious of riding their bike over driving to work.

Evaluation

At the moment P@tch is entirely reliant on self-reporting, requiring the user to evaluate their behavior and decide if they believe it to be in line with their ethical goal or not. While this may not be the most scientifically significant data to collect, I personally find that using P@tch to monitor and evaluate my behavior is quite effective because of this. The awareness I have gained by using this monitor has already impacted my consumer habits as I shop, particularly at the grocery store. I now notice all the sneaky ways manufacturers use plastic in their packaging and have realized how difficult it is to buy something without creating plastic waste. I am not opposed to utilizing more concrete data for the P@tch project, however. I am currently negotiating with Science Gallery Melbourne to put together a P@tch workshop that will include a CO_2 sensor to track air quality. I feel this kind of hard data along with self-reflection is a way to track the larger consequences of our consumer decisions.
I have a section of my website dedicated to sharing all resources and code I used to create my project and have included a discussion board section for people to ask for help or to start conversations surrounding their P@tch. In the future, I plan to continue to provide both demonstrations and written instructions to make the P@tch via workshops, but I am also creating a video tutorial to make it more accessible.

As I continue my opensource art practice, I continue to ask:
Can we re-engage the radical potential of craftivism without creating another neo-liberal capitalist site for self-promotion and marketing?
Can we hybridize practices by joining craft, technology to make a kind of Techno-craftivism making the personal political?

References

[1] Jennings, J. E., & Brush, C. G. (2013). Research on women entrepreneurs: Challenges to (and from) the broader entrepreneurship literature. Academy of Management Annals, 7, 663–715. doi:10.1080/19416520.2013.782190

[2] Aspray, W., & Cohoon, J. M. (2006). *Women and Information Technology : Research on Underrepresentation*. Cambridge, Mass: The MIT Press. Retrieved from http://search.ebscohost.com.ezproxy.lib.purdue.edu/login.aspx?direct=true&db=nlebk&AN=156930&site=ehost-live

[3] Shiva, V., & Mies, M. (2014). *Ecofeminism*. Retrieved from https://ebookcentral.proquest.com

[4] Make/Intel. (2012). Maker market study and media report. Retrieved from http://cdn.makezine.com/make/sales/Maker-Market-Study.pdf

[5] Henry, Liz.(2014). The Rise of Feminist Hackerspaces and How to Make Your Own. *Model View Culture*, Retrieved from modelviewculture.com/pieces/the-rise-of-feminist-hackerspaces-and-how-to-make-your-own.

[6] Wajcman, J. (2004). *TechnoFeminism*. Cambridge, UK; Malden, MA: Polity Press.

[7] Black, A. & Burisch, N. (2010). Craft Hard, Die Free: Radical Curatorial Strategies for Craftivism in Unruly Contexts, The *Craft Reader*. Oxford, England: Berg Publishers, 609-614.

Bibliography

Aspray, W., & Cohoon, J. M. (2006). *Women and Information Technology : Research on Underrepresentation*. Cambridge, Mass: The MIT Press. Retrieved from http://search.ebscohost.com.ezproxy.lib.purdue.edu/login.aspx?direct=true&db=nlebk&AN=156930&site=ehost-live

Henry, Liz.(2014). The Rise of Feminist Hackerspaces and How to Make Your Own. *Model View Culture*, Retrieved from modelviewculture.com/pieces/the-rise-of-feminist-hackerspaces-and-how-to-make-your-own.

Jennings, J. E., & Brush, C. G. (2013). Research on women entrepreneurs: Challenges to (and from) the broader entrepreneurship literature. Academy of Management Annals, 7, 663–715. doi:10.1080/19416520.2013.782190

Make/Intel. (2012). Maker market study and media report. Retrieved from http://cdn.makezine.com/make/sales/Maker-Market-Study.pdf

Shiva, V., & Mies, M. (2014). *Ecofeminism*. Retrieved from https://ebookcentral.proquest.com

Author Biography

Janna Ahrndt received her MFA in Electronic and Time Based Art from Purdue University. She is part of a wave of new media artists rejecting the notion that craft and technology are directly opposed. Her work explores how deconstructing everyday technologies, or even making them for yourself can be used to question larger oppressive systems and create a space for participatory political action. Her activist and social art practice blur the lines between the materiality of craft and the digital realm of new media technologies to create socio-political interventions.

“Site of Reversible Destiny Yoro AR”: Platform for Utilization of Art Database and Development of AR System

Masayuki Akamatsu[1], Yasuko Imura[2], Tomoki Kobayashi[3], Iku Harada[4], Shigeru Matsui[5]

[125]Institute of Advanced Media Arts and Sciences, 4-1-7 Kagano, Ogaki-shi, Gifu 503-0006 JAPAN

[3]stmn, inc., 1-1 Ibuka-cho Nakamura-ku, Nagoya-shi, Aichi 453-0012 JAPAN

[4]Tokyo Zokei University, 1556 Utsunuki-machi Hachioji-shi, Tokyo

Email: aka@iamas.ac.jp, imura@iamas.ac.jp, temoki@gmail.com, iku.harada.19@gmail.com, ma@iamas.ac.jp

Abstract

"Site of Reversible Destiny Yoro AR" is an appreciation tool that can be used in the facility "Site of Reversible Destiny Yoro " (1995-) which is the art works by Shusaku Arakawa + Madeline Gins and is also a park anyone can enter. The main feature of this art works/park is that visitors are made aware of the sense of balance of the body. One purpose of this application is to let users know their concept more deeply by showing artists’ idea left behind as CG or drawing including the plan which did not realize in the real space.

However, the purpose of the application is more than just a viewing tool. It works as a collaborative research platform of researchers, artists, software engineers by interrelation of reinterpretation of the work from the viewpoint of art history and the development of outdoor AR system. This article contributes to the discussion related to the results of publishing this application on Yoro Art Picnic held at the Yoro Park in Gifu Prefecture, Japan on November 3 and 4, 2018.

Keywords

AR, RTK-GNSS, HSR, Drone, Computational Imaging, Imaginary Modeling, Audience theory, Archives of media art

1. Outline of "Site of Reversible Destiny Yoro AR"

"Site of Reversible Destiny Yoro AR" is an appreciation tool that can be used in the facility " Site of Reversible Destiny Yoro" (1995-) which is the art works by Shusaku Arakawa + Madeline Gins and is also a park anyone can enter [Fig.1]. For this time, we decided to show artists' ideas by overlaying 1) model, 2) sign, 3) planting, in an elliptical and mortar-shaped space with a major diameter of 130 m and a minor diameter of 100 m, which called “Site of Reversible Destiny Yoro Park." This study can be positioned as a case study in the context of Digital Heritage using AR system. [1][2] We adopted AR (augmented reality) representation based on location (current location information) using mobile devices such as tablets. These methods may be applicable to AR utilization in a specific area outdoors.

Masayuki Akamatsu and Tomoki Kobayashi have developed the AR system, and Iku Harada is in charge of modeling. Yasuko Imura and Shigeru Matsui are investigating and analyzing the concept of Arakawa+Gins. Regarding the provision of materials and copyright permission, we have the cooperation of Arakawa + Gins Tokyo office and Reversible Destiny Foundation/Estate of Madeline Gins.

Fig. 1 Using the "Site of Reversible Destiny Yoro AR" in the field

2. About "Site of Reversible Destiny Yoro"

At first, Arakawa and Gins proposed the concept of " Site of Reversible Destiny Yoro" and raised the "The Master Plan for Yoro Cosmological Gardens" [Fig. 2]. The plan had a spectacular idea of changing the daily consciousness of the people by walking through several pavilions with poetic names. The main feature of this art works/park is the imagination created from the name of the pavilion and the road, in addition to making the sense of balance of the body aware. In the future, we are aiming for presentation of the "The Master Plan for Yoro Cosmological Gardens" by AR system including the pavilion, which has not been realized (places written in yellow letters in Figure 1). Prior to that, we examined how to show the "model" as a motif of reversal, the name of the pavilion "sign," the planting plan "planting" that imagines the changing garden in the "Site of Reversible Destiny Yoro Park" of the figure 2.

Fig. 2 "The Master Plan for Yoro Cosmological Gardens"

3. esearch method
AR system

In the " Site of Reversible Destiny Yoro AR," we adopted AR representation based on location using mobile devices such as tablets. Attach a handle to the tablet to make it easy to hold, so that viewer can change the direction freely. The viewer walks around by holding the tablet in their hand or puts the tablet on a tripod and stabilizes it, looking around while moving it up, down, left, and right. In addition to a satellite positioning system such as GPS with built-in tablet, the location uses position estimation with centimeter accuracy by RTK (real time kinematic) device. Also, the orientation is grasped by a gyroscope sensor and a direction sensor built in the tablet [Fig. 3].

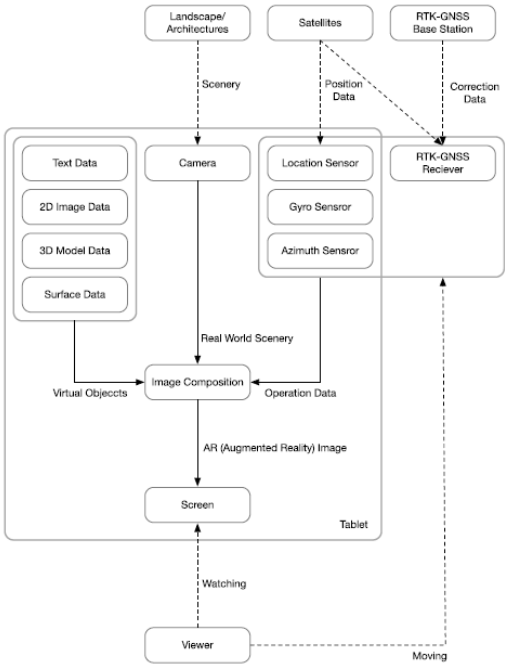


Fig. 3 System context diagram

As for the AR, virtual objects such as text and 3D model are synthesized on the tablet camera image and displayed on the screen [Fig. 4]. At this time, hidden surface removal of such as "model," "sign," "planting" is realized by real topography, buildings, trees, etc., which enabled a sense of depth. For this hidden surface removal, a shape model based on point cloud was prepared through hundreds of aerial photographs taken by a drone. This method is effective when the target is a wide area of several tens of meters or more.

With the user interface such as buttons and sliders on the screen, it is possible for the viewers to manipulate the presence/absence and position of display of the virtual object such as model, sign, planting. Through such an operation, the viewer can confirm correspondence between the real world in front of the eyes and the virtual object and deepen the viewing by themselves.

Fig.4 Interface screen

Utilization of Database of art works

As mentioned earlier, we tried to show artists' ideas by overlaying 1) model, 2) sign, 3) planting, in an elliptical and mortar-shaped space, which called “Site of Reversible Destiny Yoro Park." The reason is that these three elements are symbolic elements in showing the concept of the work, and at the same time, they are also suitable subjects for generating different expression effects such as 3D modeling, text and animation. In that sense, " Site of Reversible Destiny Yoro AR" has an aspect of a utilization of database of art works and a reinterpretation through AR.

1) "Model": a motif of reversal

Upside-down mirror image of " Site of Reversible Destiny Yoro" was displayed over the real [Fig.5]. This motif is a 3D modeling based on photos and completed drawings [Fig.6 & 7]. The idea of the reversal of Arakawa + Gins first appears in the model "The process in Question / Bridge of Reversible Destiny" (1973 - 1989) in the incomplete project of the bridge in Epinal in France. This project consists of space reversible from left to right and top to bottom, *cleaving* space, and space projecting perception. We interpreted their concepts from past works and displayed upside-down mirror images, which can not be realized in reality as a model. The viewer can display the model up and down by dragging on the screen.

Fig. 5 An aerial shot of "Site of Reversible Destiny Yoro"

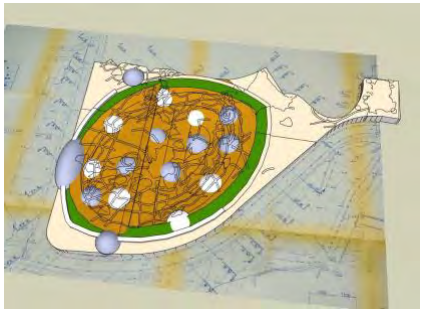


Fig. 6 3D modeling based on construction drawing

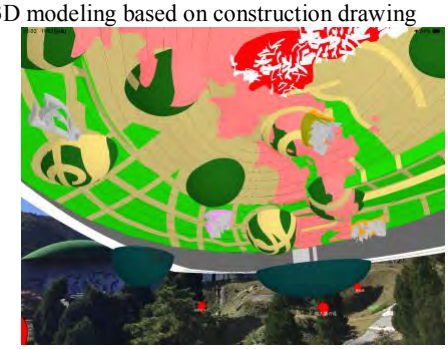


Fig. 7 Overlay the CG model in real scenery on the screen

2) "Sign": the name of the pavilion

There are 143 roads and 9 pavilions in 10 zones in the "Site of Reversible Destiny Yoro", each of which has a name. This time the name of the pavilion is displayed [Fig. 8]. The pavilion incorporates the view of the world that appears in their other works like Cleaving Hall, Destiny House / Landing Site Depot. With words as clues, viewers can imagine another world different from the perception experience.

Fig. 8 Display "Sign" with red markers

3) "Planting": the planting plan that imagines the changing garden Based on the planting plan of "CG for Garden of Reversible Destiny" (1992) [Fig. 9], 3D modeling of the six layers was created: spring flowers, evergreens, summer flower trees, deciduous trees, autumn flower trees, winter flower trees.

In order to convey the change of the four seasons, we provided animation mode that displays six layers slowly in the order of spring, summer, autumn and winter and a function to display each one separately. The trees are planned to be arranged at different heights according to the gradient and it is expected that the relationship between humans and plants will change due to the change in the positional relationship looking at each other.

Although the vegetation is currently different from the plan, the viewer raised and lowered the planting by dragging it on the screen and made it possible to change the relationship between humans and plants variously [Fig. 10].

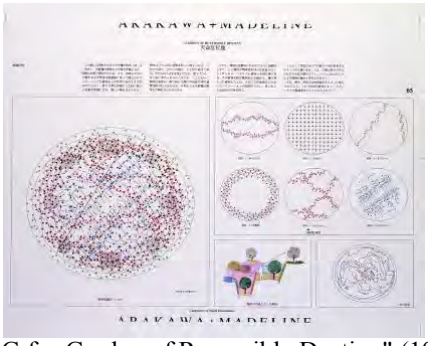


Fig. 9 "CG for Garden of Reversible Destiny" (1992)

Fig. 10 Overlay the vegetation changes

4. Conclusion

Today, over 20 years since "Site of Reversible Destiny Yoro" was constructed, reality and information are regarded as equally as before, which is becoming a natural sensation. In other words, what has changed the most in the past twenty years is the media environment surrounding us. In this research, we attempted to ask a new sense of reality through AR development with the theme of " Site of Reversible Destiny Yoro," which stated the extension of human cognitive function and change of consciousness. As a result, it is possible to remove the hidden surface of the virtual object and realize a sense of depth with depth. From the viewpoint of art history, we reinterpreted not only the concept of the artists but also created a new interface for the relationship between the audience and the work through AR. In that sense, the purpose of the application is more than just a viewing tool. It works as a collaborative research platform of researchers, artists, software engineers by interrelation of reinterpretation of the work from the viewpoint of art history and the development of outdoor AR system.

References

[1] Hermina Din and Steven Wu, *Digital Heritage and Culture:Strategy and Implementation* (WSPC, 2014)

[2] Peng, F., Zhai, J.: A mobile augmented reality system for exhibition hall based on Vuforia. In: 2nd International Conference on Image, Vision and Computing, pp. 1049-1052. IEEE, Chengdu, China (2017) https://ieeexplore.ieee.org/document/7984714

THE DANCE OF THE WOBBULATOR

Sara Bonaventura
Independent artist
Italy / Singapore
sara_vlinder@yahoo.it
http://www.s-a-r-a-h.it/

Abstract

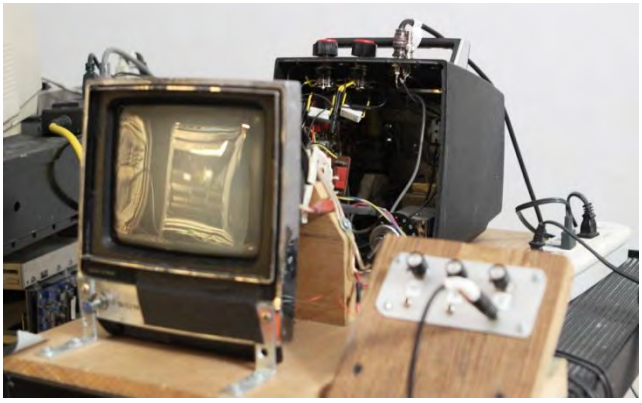
Stakra is a choreography for video space that has been processed mainly with a raster manipulation unit also known as wobbulator, first prototyped by Paik/Abe. It is inspired by Nam June Paik's "Dancing patterns" created during the 60s and his later collabora-tions with Merce Cunningham in the late 70s/80s. The single channel piece is part of a wider choreo-graphy for machines, a work in progress, which processing the original choreographic sequence for a solo performer with different combinations of analog video synthesizers, will culminate in an installative ex-panded choreography.

Keywords

Experimental, Video Installation, Videodance, Performing Arts, Choreography, Analog, Video Synthesizers, Wobbu-lator, Raster Manipulation Unit, Nam June Paik

Introduction

In 1972, a raster scan manipulation device was constructed for the Artist in Residency program at the Experimental Television Center in Binghamton, New York. Also known as the "Wobbulator" the apparatus operated alongside the Paik/Abe Video Synthesizer, leaving its mark most notice-ably upon Paik‟s early TV experiments, such as Dancing Patterns. The Paik/Abe Video Synthesizer primarily colo-rized imagery while the Wobbulator created the motion effects by magnetically scanning a "monitor modulated by audio signals." Additional cameras allowed for generating video feedback and fine adjustments to the input signals through knobs, shaping the wavy patterns into the types of abstractions that, like the device‟s name, distort recogniza-ble imagery into ever increasing waves of lines. [1]

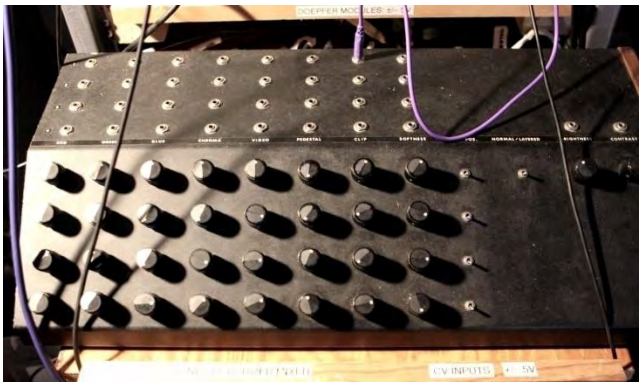


Signal Culture Wobbulator

Dancing Patterns

Some of Nam June Paik‟s most famous early works, like "Global Groove", with the wobbulating image of the tap dancer, were created with this manipulated television, the wobbulator. Paik deconstructed the television adding an interactive element to the medium, destabilizing the struc-ture of the medium itself. In his real time experiments called "Participation tv" viewers were invited to alter the video signal through a microphone. In his mid -1960s "Dancing patterns", like his single channels videos "Elec-tronic Blues" (1966) and "Electronic Waltz" (1967), mag-nets were used to manipulate the images.

Experimental Television Center The wobbulator has been later reproduced but it is a rare custom-made piece of equipment. The Experimental Television Center in Owego, directed by Ralph Hocking and Sherry Miller Hocking, was notably one of the very few Institutions with a repro-duction of it. The studio hosted many artists but closed down in 2011.



Jones Colorizer

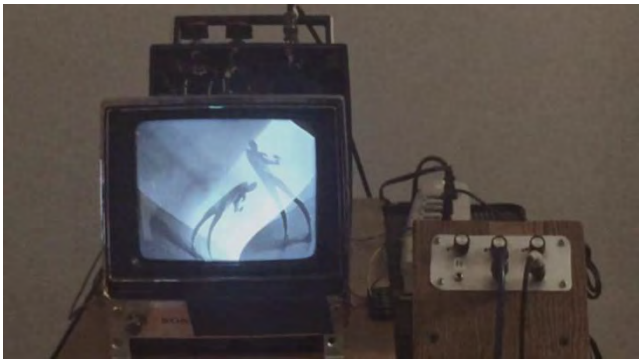
The legacy of the ETC has been carried on by the Owe-go based residency program Signal Culture. One of the early projects at the ETC, involving the construction of the „Paik/Abe video synthesizer‟, the video synthesizer de-signed by Shuya Abe and Nam June Paik, was built at the center by David Jones and Robert Diamond. David Jones is now collaborating with Signal Culture, meeting the artists in residence and providing highly professional technical support. Some of the tools available in the ETC studio in-cluded the 'Jones colorizer', the 'Jones raster' and the 'Raster manipulation unit - wobbulator', all of which are now available at Signal Culture.

Signal Culture Jason Bernagozzi, one of the co-founder of the live-in Signal Culture residency program for artists, researchers and tools makers in the field of experimental media art, built a custom made black and white wobbulator with a rescannig system connected to their unique system of several vintage real-time analog- processing equipment. Signal Culture has artist and toolmaker studios that are both equipped with a variety of media devices and compo-nents. The studios have been designed with the help of Hank Rudolph and Dave Jones through Organizational Development support from the Media Arts Technical As-sistance Fund of NYSCA Electronic Media and Film, ad-ministered by Wavefarm. In 2013 Signal Culture art resi-dency program received a generous 3-year grant by the Robert Raunschenberg Foundation,

Seed Grant, which enabled the founding members to secure a real home for the organization in Owego, New York. [2][3] The wobbulator, this "prepared television, has been in-vestigated by a number of video artists and engineers; this particular set of modifications was popularized by Nam June Paik. The distortions performed on the image result from the actions of audio signals on the yokes. Audio sig-nals which are periodic and regular, such as sine or square waves, are normally used when treating a video image; these signals are derived from an audio or function genera-tor. However, any audio signal source may be employed; these devices include audio synthesizers as well as more conventional components such as audio tape recorders, tuners, microphones or phonographs. These types of sig-nals are most evident visually when used in conjunction with the horizontal or vertical collapse functions which reduce the raster to a horizontal or vertical line. These au-dio signals cause the line to distort in direct correspon-dence with changes in the audio signal; often the frequen-cies present in this type of signal are such that the distor-tions produced by their actions on a complete image are not very noticeable." […] "The lines also respond to audio signals originating in the audio generators. The notions of these lines caused by these types of audio signals have been referred to as 'dancing patterns' by Nam June Paik."

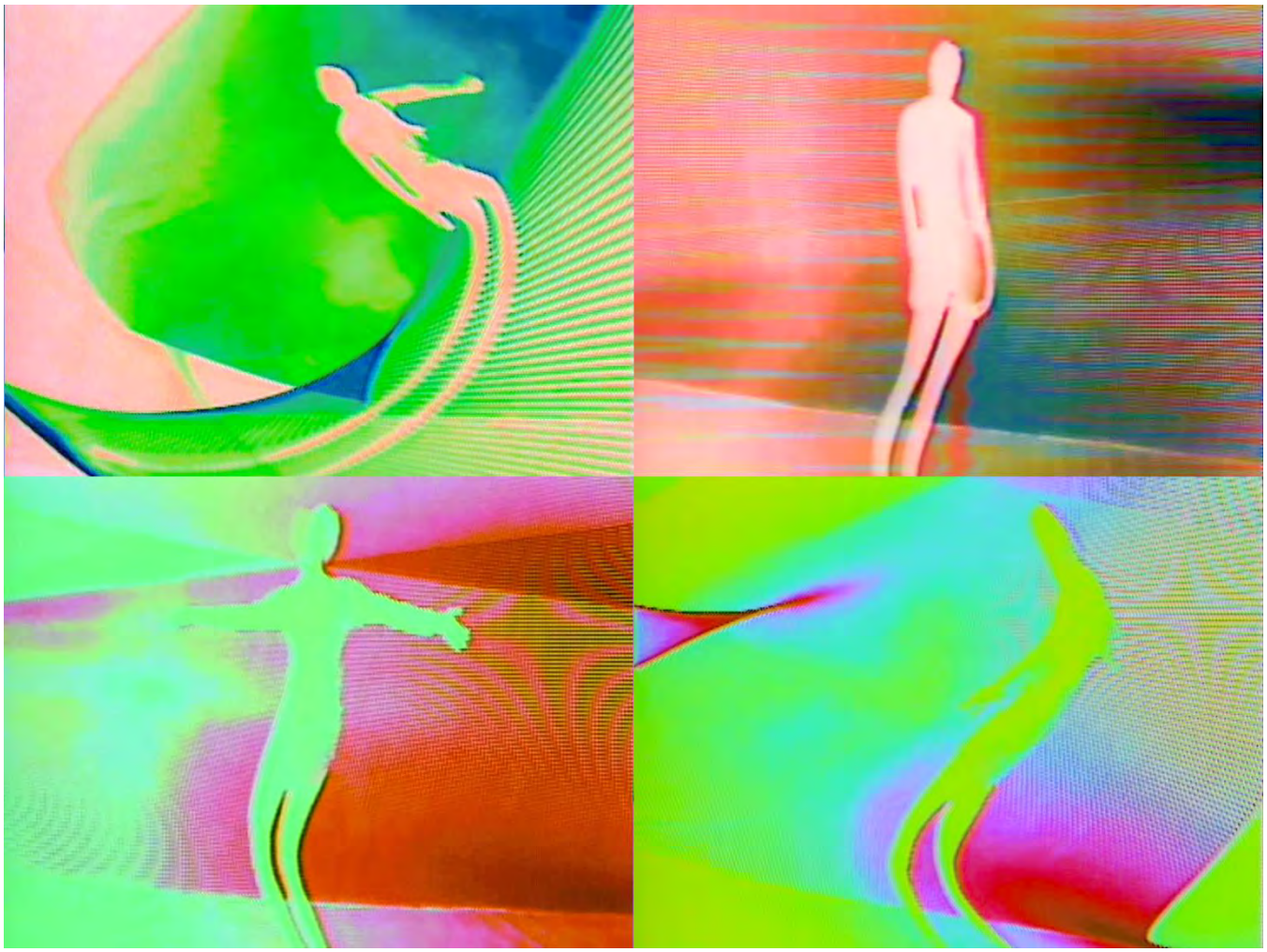
"All electrical signals have a waveform, indicating changes in voltage measured through time. Some signals have a periodic or repeating, regular waveform while oth-ers produce random or non-periodic waveforms An oscilla-tor is a device which produces a regular and periodic wave-form; for example, an oscillator may produce a sine, square or triangle wave." […] "Any of these devices may be uti-lized with the raster manipulation unit, but it is desirable to have at least two different waveforms available." [1] This analog quite rudimental device can produce an ex-tensive vocabulary of image treatment, especially when combined with the use of different oscillators, like the Doepfer Modules available at Signal Culture, as part of their rich and layered system, combining vintage equip-ment and digital technologies. I applied to the residency when working on a video dance project, which was originally conceived as rotoscope animation. I started thinking of the choreography of the space rather than the body within it. The body leaves traces but it is always erasing them. Body and matter are trans-forming entities. I started thinking of the body as a vibra-tion, as modes of vibration that go beyond it. The body is always escaping, escaping itself as prolongation in the space. We are sensing subjects but also sensed objects.

Frame by frame animation is a medium close to these un-foldments between the tangible and the intangible, but I felt that processing with analog synthesizers and wobbula-tor was a better negotiation between the materiality of the media and the articulation of the embedded identity.



My project was selected and I had a chance to access those machines. The sense of tactility and intimacy was very present during the process, adjusting knobs and cabling patches all day long. As a result the new kinetic image was not only the choreography of the body with its tasks, but also the choreography of the analog machines. The entire project, still open to multiple possibilities and combina-tions, started stretching the understanding of choreography in a media infiltrated world, where the body is an in between and the search for balance in the interface human being / machine is a crucial core. The interaction with these machines empowered the choreography by destabi-lizing it, showing the malleable capabilities of the body inside the screen, but also showing its vulnerability. I was interested in this liminal paradox, a fleeting, unfixed but still unavoidable nodal point that nonetheless conveys a sort of identity.

The project is still in progress but a few sequences have been released as single and multi channel works. One of them is a video called stakra, which has been scored by the Italian electronic composer Von Tesla. In each processed sequence there is a specific focus on different vintage syn-thesizers, e.g. in stakra the wobbulator is dominant, whe-reas in other sequences a scan processor similar to the Rutt Etra might be more characterizing. Each sequence is a var-iation on the texturality of the space of the choreography, and as a consequence, it also adds textured layers to the body of the choreography.



stakra, a single channel piece, is a mystical and hallucina-tory journey of a resilient subject, not completely seduced by the machines; entangled in their challenging system, but emitting glow and radiating dynamism while struggling for self determination. Getting lost, falling apart, splitting, vanishing and resetting. Finding balance in between. For the final multi channel installation I envision an ex-panded installative choreography, in an immersive space where the boundaries between the body electric, the virtual space, the actual body of the viewer and the exhibiting space will be suspended in a new mesmerizing dance of colors.

Acknowledgements

With this paper and this work I would like to pay homage to Nam June Paik, brilliant artist and intrepid pioneer in the media arts. It was possible thanks to the unique analog equipments provided by Signal Culture, an artist and researcher resi-dency located in Owego, NY State (US). Choreographer and performer: Annamaria Ajmone. Sound design: Marco Giotto, Von Tesla. Other sequences have been scored by Caterina Barbieri. Thanks to Adiacenze Gallery in Bologna (IT), where it was premiered for my solo show "Come se il colore stesse a guardarti" ("As if the color was looking at you").

stakra screening history

Videolands, MOMus-State Museum of Contemporary Art, Experimental Center for the Arts, Thessaloniki (GR), 2019; Frame Rush: A Place for Screendance, The Place, London (UK), 2019; RPM Fest, PROGRAM SIX: Blue-prints for Renewal, curated by Wenhua Shi, Boston (US), 2019; Pugnant series, Cinema Andora Ανδόρα, Athens (GR), 2019; Endless Biennial, curated by Lukaza Branf-man-Verissimo, NYC (US), 2018; KLEX 2018, Translu-cence, Kuala Lumpur (MY), 2018; Optronica 2, Other Ci-nema @ ATA Gallery, San Francisco (US), 2018; Cinema no cinemax, 1st Bck Symposium, Pugnant Film Series, Athens (GR), 2018; The Unseen Festival, Counterpath, Denver (US), 2018; ikonoTV & Pool Festival, POOL Vi-deodance Night, Berlin (DE), 2018; Worship the glitch, VIDEO HOOK-UPS, Manchester (UK), 2018; Fem Tour Truck, Festival itinerante de videoarte feminista, (ES, FR, PT, CO, EC, PE, RA), 2018; 10th Kalamata Street Festiv-al, Kalamata (GR), 2018; Lago Film Fest, Revine Lago (IT), 2018; POSITIONING, La Valletta (MT), 2018; Sarna 3 Festival de artes experimentales, Antofagasta (CL), 2018; Video Art Miden Festival, Kalamata (GR), 2018; History of the Future Exhibition, Boston Cyberarts Gal-lery, Boston (US), 2018; NOLI ME TANGERE Exhibi-tion, Gallery Nikola I – Museum JU, Niksic (ME), 2018; At a distance, Harvester Arts, Wichita, Kansas (US), 2018; SATURATE(D), Open Signal, Portland (US), 2018; EU-ROVIDEO 2018, Videographies, Liege (Be), 2018; Here Comes Everybody, Experimental Public Access show, Broadcast in Los Angeles, Berkeley, Portland, Olympia, Seattle & Chicago (US), 2018.

collaborators' websites

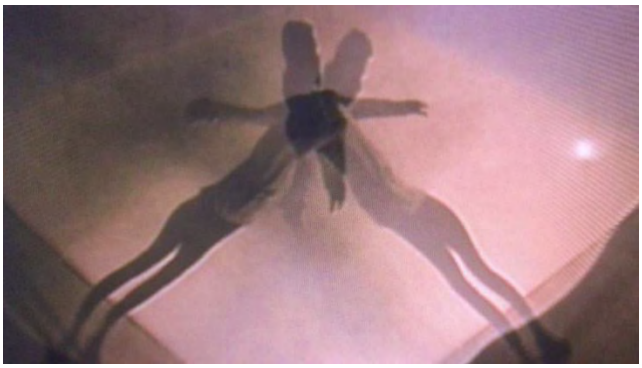
Annamaria Ajmone *annamariaajmone.com*
Caterina Barbieri *caterinabarbieri.com*
Von Tesla *vontesla.com*
Signal Culture *signalculture.org*

References

Magazines and Newspapers (online)
[1] Sherry Miller Hocking, with Richard Brewster and Walter Wright 1978-1980, *Raster Manipulation Unit: Operation and Construction*, Experimental Television Center Ltd, Binghamton, New York, c 1980
http://www.experimentaltvcenter.org/raster-manipulation-unit-operation-and-construction
Websites
[2] Signal Culture Experimental Media Art Residencies, Exhibitions and Resources, http://signalculture.org/facilities
[3] Robert Rauschenberg Foundation Grants program: https://www.rauschenbergfoundation.org/grants

Author Biography

Sara Bonaventura is an Italian visual artist currently based in Singapore. As independent videomaker she has been collaborating with performers and musicians, directing clips and adv. Her works have been screened at the Anthology Film Archives, at Other Cinema at San Francisco ATA Gallery, at the Ann Arbor Film Festival, the Miami New Media Festival, the Los Angeles Echo Park Film Center etc.; she won the Veneto Region Award at the 10th Lago Film Fest in 2014 and a merit for the 2019 Sino per NIIO Illumination Art Prizes; she has been selected for several residencies, ie by Joan Jonas at Fundación Botin (Spain), at Frans Masereel Centrum (Belgium) etc. She is currently working on her first feature film, Forest Hymn for Little Girls.
s-a-r-a-h.it



"Perception straddles the micro-folds of tiny perceptions and the great fold of consciousness, and matter, the tiny vibratory folds and their amplification on a receiving organ. The folds in the soul resemble the pleats of matter".
Gilles Deleuze, *The Fold: Leibniz and the Baroque*, 112, translated by Tom Conley, New York; London, Continuum, 2001

you can see stakra here:

Espherica01: visions of free falling water in stroboscopic media.

Reynaldo Thompson, Tirtha Prasad Mukhopadhyay
UNIVERSIDAD DE GUANAJUATO
MEXICO
thompson@ugto.mx, tirtha@ugto.mx

Abstract

A series of projects on stroboscopic light emissions has been installed by Arcangel Constantini, one of the frontline elec- tronic artists in Mexico. His works, especially the Espheri- ca01, raise interesting questions on how light-invasive me- dia impacts our understanding of the behavior of the water molecule, and in the process help visualize the origins of life in a supposedly prespacetime environment.

Keywords

Prespacetime, Schumann resonance, Stroboscopic light, Water

Introduction

Arcangel Constantini is perhaps one of the most innovative artists in Mexico, and in the context of Latin America as a whole, with an imagination that espouses all those issues relevant to the core of the continent's existence. In 2005-6 he dappled with robotics for a depletive envi- ronment, floating a series of *nanoid* robots over the profoundly green and mossy waters of lake Xochimilco, where the Aztecs once created and preserved the art of *chinanpas,* floating harvest gardens.[1] Whereas the *nanoids* were meant to emit warning signals for contaminated water, this concern for water - and for the environment - leads him to experiment with so many other aspects of nature's hidden secrets. This overarching idea recurs in *Espherica01*, which we might call *Spherecity01* in English perhaps, with respect to his intentions for the piece, alt- hough we wish to keep referring to it in terms of the origi- nal Spanish title. *Espherica01* is a vision of light mediated by water and its tendency to split and assume the shape of a drop or sphere in an environment bereft of gravity.

Constantini never tires us or leaves his viewer exasper- ated with technology, he explores the most obscure parts of the universe, and its processes which defy expectedness. The same is true of Mexico's other seasoned artist, Gilber- to Esparza. From an art historical perspective the valences of nature's forces, invisible to the eye, and yet tinkered with the extreme sensitivities of mathematical outliers, oscillates through the mysterious arts of several other art- ists of the southern continent, notably, the pioneering artist Argentinean Gyula Kosice, who tried to find representa- tions for light way back in the sixties, and in ways in which contemporary artists like Constantini found inspiration out of them. What is sustained in this new Latin American art is a vision of space and time as they would be embodied in technological objects, and which would continue to reveal the mysteries and beauties of creation as recorded by sci- ence.

Antecedents

Espherica01 however was built with water at its core, and light from a stroboscope illuminating the liquid's behavior in a free-falling universe. With multiple layers of techno- logy embedded in its structure *Es- pherica01* stands out uniquely to demonstrate (and demystify) within its context of eternal illumination, how water moves like a living, evolving, pre-plenum entity. Indeed the beauty of the pro- ject is evident in the way light is used as a medium. But before dis- cussing the material aspects of Constantini's work we can go back to place his work in the story of the arts districts in Mexico City.

The project had its inception different project sharing a climate of art and understanding with Gilberto Esparza, winner of the *Golden Nica* at Ars Electroni- ca (Linz, Aus- tria), a close contemporary and friend and also with Ivan Puig's ideas on artistic use of zero- gravity conditions. [2] The history of the zero-gravity project has been narrated elsewhere - in short it was an opportunity for realizing the artistic possibilities of zero gravity aesthetics, or free fall conceptualizations. The initial zero-gravity experiment was initiated in the Gagarin cosmodrome, which sponsored the zero gravity travel in the way the flight simulates a free fall atmosphere during its parabolic drop through space. The free fall dynamic could be used to create art of interspatial droplets, Constantini's pet idea of the spheroids.

Gravity of the Matter, or *Gravedad de los Asuntos (2015)*, as it was called in Spanish, was the first break- through project for the friends. Moscow Star City, a city famous for its military installations, was the venue for this work. The Russian Roscosmos at Star City includes the Gagarin trai- ning center; everything that had to do with the space race in Russia now formed the venue for art. Within this general scheme of anti-gravity art Con- stantini explored and foun- ded the *Espherica01* concept of a stroboscopic light insta- llation with water. Hence it is first necessary to consider how light defines the spa- tial behavior of water in a zero

gravity space. The ef- fects were naturally, dramatic. Constantini could help visualize this behavior of water by mediation of light - the principle itself was not easy to find. Perhaps one would have to go back to the resourceful installations of Gyula Kosice the Hungarian born Argentinian artist who conceived of a hydrospatial city in the 1950s. Themes resonate through Constantini's art and on a backdrop of perceptions which lead to the creation of *Esphe-rica01*.

History: The Gravity of Matters

In the blurb for the first exhibition of the project at the *Laboratorio Arte Alameda* in Mexico City in 2015, and later on in a similar version of the draft circulated at León, Guanajuato in 2018, Constantini himself speaks of the effects created by "mysterious clouds that float, drifting in constant transformation in the hydrological cycles of outer space".[3] What inspires the vision of *Esphérica01* is the whole pro- cess of lights on the outer surfaces of the atmosphere - what Neil Armstrong referred to as the deep light of space, an invisible light, and for Constantini what mattered most was the sight of foam contrasted to the blue and infinite firmament, already dark, with its thunder and lightning, and "with discharges of energy and the vision of trillions of tiny drops of water that fall to the earth, nourishing it and transforming it".[4] Constantini refers to this mystery of free floating water as one of those mysteries of nature that favored the inquisitive and mystical mind of earth's first self- conscious inhabitants and of the artist.[5] How is it possible that if everything falls, those mysterious forms float in the air? Constantini combines the vision of Thales of Miletus, electromagnetism, and particles and spirituality of Thales included, with all those insights from modern science : electromag- netism, gravity, and the principles of strong and weak nuclear forces.

The fundamental interactions of the universe are bent by means of light in *Esphérica01*. Just as electromagnetism of the solar cycle causes water to interact in a gaseous state, and as atmospheric pressure counteracts it to form micro droplets or crystals, we also witness how they accumulate as clouds and increase in size. As a principle gravity causes these micro-particles to rush towards the earth. But as the project shows Constantini was interested in the trajectory of the drop, and the evolution of its shape in the backdrop of the celestial lights.

Spherical drops that reflect the lights of the cosmos and the beautiful imperfection of asymmetry are ideally held together in the droplet. Further, this droplet starts to resemble a vitalistic, organic shape, as much as an intersecting reality of complexity, or as Constantini himself writes in his brochure "a microcosmos ... a detonating holism of speculations about reality".[6]

The droplet appears as a visual metaphor, a cosmo- formation of the basic elements in the universe. The beauty of the stroboscopic projections, splitted in time, and by means of a gestalt of perceptions, actual- izes this aim in Constantini's evolving spheres. Only the stroboscope could make it possible for us to visu- alize a singularity otherwise alien to our spectrum of perception.

The water molecule, by the bifurcation of its two hydrogen atoms and one of oxygen, is bipolar very nature and of imperfect symmetry. The electrons of the hydrogen atom, because of an electromagnetic spin, establish covalent bonds with oxygen and forms the water molecule. In a liquid state each molecule establishes these links with four other molecules: on the water's surface it connects with two or three mol- ecules to generate the surface tension. This happens due to the tendency of the water to associate as a unit, as a whole. When the water is in free fall, this tension takes the form of a sphere or a drop, which among all existing geometries, has the smallest surface area in ratio to volume. The water molecule is diamagnetic, the spin and behavior of its electrons can also be al- tered by other electromagnetic fields. Electromagnetism is fundamental in the immense amount of properties of this simple molecule, which Constantini calls, following Huping, the most wonderful of the universe, the evidence of the pre-biological construc- tion of consciousness. [7]

Structure of *Esphérica01*

The experiment for *Esphérica01* was developed primarily as an attempt to observe and record the behav- ior of the water in free fall. The stroboscopic light helps create a video of the kinetically evolving mole- cules. The crystals seem tending to perfection, under the influence of oscillatory electromagnetic fields. A little water is initially held inside the crystal cylinder, which Constantini then surrounded with a winding coil of enameled copper wire. The coil emits electrons in different frequencies and generates an elec- tromagnetic field in the form of a toroid, a doughnut shaped structure. The force of the field is oriented to the center of the crystal cylinder. A high speed macro lens is fitted at the upper end of the cylinder with its toroid ring of ultra bright LEDs and within the center of the ring. Small frequencies of current are transmitted to the coil by a microcontroller to generate a variable elec- tromagnetic field. The inside of the cylinder has a layer of hydrophobic material from which the water retracts under free fall or zero gravity conditions, as it would also presumably pertain to conditions of a pre- geological era. The space within the cylinder does not offer any resistance to the falling and kinetically modulating droplets of water, thus facilitating the molecule freedom to assume a near spherical shape. The camera registers this phenomena in a slow motion video. Spheres of water may have amazed humans through times. But it is definitely another thing to experience the behavior of this element under conditions of free space in the cylinder, as it evokes an unknown and unfathomable dimension for the imagination.

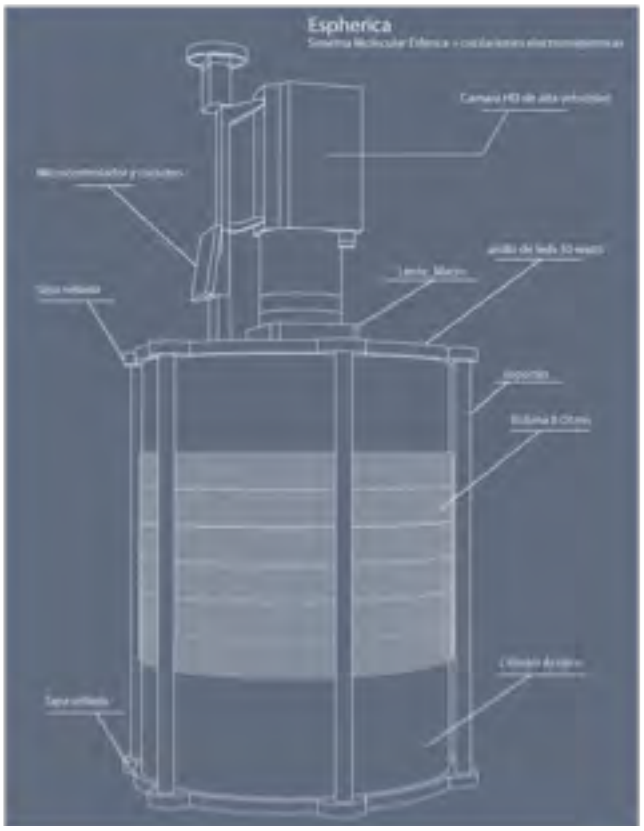


Figure 1. *Espherica diagram. ©Arcangel Constantini.*

In the universe everything tends to symmetry but is yet imperfect. This is how the droplets inside *Espherica01* are revealed to us by the stroboscope's media- tory role. The molecules of water in rise in the con- trolled atmosphere.
Constantini beautifully projects the phenomenon simulated inside the cylinder, as it falls under gravity. He creates it as a miniature of a kind of space experi- encing a lightning discharge in the upper layers of the atmosphere - a high energy discharge which illuminates the droplets floating within it. Its an ionospheric process that displays an oscillation in the molecule. Constantini urges us to believe that the frequencies simulated would also offer parallels to the Schumann resonance within the deeper low frequency architec- tures of the world. [8] In a sense, the parallels are intended to remind us of pre-geological realities to which any ordinary viewer would not normally have access. The LEDs play a key role in the process be- cause they create an intermittent visual spectrum for the viewer, like a stop-motion rendering of such mathematical realities.

Figure 2. Arcangel Constantini messuring the amount of water at the Russian Roscosmos (Star City). ©Arcangel Constantini.

Conclusions

The water molecule, in its elemental, oscillatory con- ditions also offers Constantini a scope to expand on a theme of visual pre-geologicality that he tried to cap- ture in some of his earlier pieces, notably the artificial *Magnetoplankton* (2012) and the intriguing *Aqua- planetarium* project from 2004: projects which he had been exhibiting at the *Transitio* international festival at Mexico City. In fact we are not reminded of very many artists while thinking of Constantini's works. But what stands out to be interesting is the way in which Constantini encapsulates space and time in his work, generating modules of life in a vitalistic uni- verse of which humans are merely a subject. This focus gives Constantini the merits of a microcosmic thinker - a unique attribute to have for a non- renaissance artist. To an extent we have seen fore- shadows of this art in Gyula Kosice in the fifties. We refer to Kosice's hydrospatial cities, another series of encapsulatory art, where models of future cities would be suspended in an independently hanging, pseudo-scientific space. Kosice's modeling constitut- ed an interesting step in any design thinking process. Constantini, like Kosice reverses the space of art, not to extend outward, but inward towards an encapsula- tory formation of ideas - this adds a new dimension to his art, just as it did for Kosice.

References

1. Thompson, R., & Mukhopadhyay, T. P. (2018). Microbial Nanoids: Electronic Arts in the Face of Mexico's Megadiversity Crisis. Leonardo, 51(03), 294-295.

2. Mukhopadhyay, T. P., & Thompson, R. EcoCybers: The Story of Digital Art in San Miguel De Allende, IDMAA, 2015.

3. Constantini, A. Espherica, LAA, 2015. http://www.arc-dta.net/espherica/?fbclid=IwAR1iansQclLTao9oldLDLUX_VOR

INyPFq2wmbH7m9l-ETNUo1uaZNQo6kMI

4. Constantini, A. Espherica, LAA, 2015. http://www.arc-dta.net/espherica/?fbclid=IwAR1iansQclLTao9oldLDLUX_VORINyPFq2wmbH7m9l-ETNUo1uaZNQo6kMI

5. Frank, Louis A., and Patrick Huyghe. "The big splash: a scientific discovery that revolutionizes the way we view the origin of life, the water we drink, the death of the dinosaurs, the creation of the oceans, the nature of the cosmos, and the very future of the Earth itself." New York, NY: Carol Pub. Group, c1990. (1990).

6. Oviedo, Cynthia Patricia Villagómez. "Arte Digital MX." AusArt 6, no. 1 (2018).

7. Hu, Huping. "Prespacetime model of elementary particles, four forces and consciousness." U.S. Patent Application 12/964,558, filed June 23, 2011.

8. Nickolaenko, Aleksandr Pavlovich, and Masashi Hayakawa. Resonances in the Earth-ionosphere cavity. Vol. 19. Springer Science & Business Media, 2002.

Authors Biographies

Reynaldo Thompson studied architecture at the University of Guanajuato and postgraduate studies at the Polytechnic University of Catalonia in Barcelona as well as at the University of Texas at Dallas, where he received his doctorate in the area of aesthetic studies focused on Contemporary Art.

He has participated in different solo and group exhibitions and curated shows in Mexico and abroad. He served as director of the Department of Art and Business of the University of Guanajuato and is currently focused on research on art, science and technology in Latin America. The results of their research have been published in international journals.

Forgotten Landscapes: Interactive Virtual Reality in Public Art

Ha Na Lee and James Hughes

Department of Film and Media Arts, The University of Utah,
Salt Lake City, UT U.S.A
hana.lee@utah.edu | james@isogr.am

Abstract

Forgotten Landscapes is a site-specific public art installation of interactive virtual reality (VR) viewing machines. The machines provide a perspective from which to explore a series of 360-degree videos of deserted landscapes filmed at the last-known location of missing persons in Austin, Texas. The piece revisits several cold cases related to women, children, and minorities from 1970s to the present. Using customized computer vision software all human activity is removed from each landscape while preserving the motion of nature, the sky, trees, grasses, and birds to promote the sense of isolation and emptiness. The project addresses criminal cases against minorities as well as challenges the use of media technology in a public space.

Keywords

Public art, virtual reality, 360 video, computer vision, socially-engaged art

Introduction

Forgotten Landscapes employs computer-vision techniques, 360-degree video, virtual reality hardware, sensors, and microcontrollers to create an interactive site-specific public art installation.

The 360-degree video is a series of Austin landscapes filmed at the last-known locations of several missing persons. Six unsolved cases were selected from local news archives and the National Missing and Unidentified Persons System (NamUs) [1]. The locations were chosen based on the stories surrounding the cold cases and focus on cases involving women, children, and minorities. Each video was filmed at a different time of day, and under varying weather conditions. To promote feelings of isolation and emptiness, all cars, pedestrians, and other human activity were digitally removed from the scene. The only motion in the videos comes from the subtle movements of nature, such as birds, grass, clouds, and architectural elements such as digital signage or awnings flapping in the wind. Each landscape and cold case are documented online [2] for further information.

The form of the piece is inspired by the familiar sight of public binoculars, and Thomas Edison's early motion picture viewing device, the Kinetoscope. Each machine is equipped with battery-powered virtual reality (VR) hardware and a hand-crank, which is mounted into a viewing head. The viewers are capable of rotating freely in the horizontal plane. The hand-crank and head rotation are the principal means for interaction with the piece. The installation is composed of three viewing stations (Figure 1).

Figure 1. The installation setup and interaction.

Background

Forgotten Landscapes was inspired by the case of Roxanne Elizabeth Paltauf in Austin, Texas [3]. She was a teenager when she disappeared in 2006. The local news covering her story reported her family is still looking for her. The police were concerned the missing person case might turn into a homicide. After more than a decade of looking for Elizabeth Paltauf the case remains unsolved.

Elizabeth Paltauf was last seen in the neighborhood where the authors live. Knowing the story changed our perspective of the neighborhood from a mundane landscape to a cinematic scene.

Though VR is a mediated experience, the interactive and immersive nature of virtual reality makes the technology

less noticeable and therefore more intimate and immediate to the viewers [4].

Mediated Vision

The mediated experience inherent in the work provided the authors with many subtle and interesting tools to manipulate the audience. Some of these tools are part of the cinematographic canon, while others are novel to our workflow and the VR platform.

Erasure Artifacts

The automated process of removing human activity from the videos (described below) relies on filling in areas of motion with the pixels from preceding frames. The technique is susceptible to rapid lighting intensity changes. For example, as clouds pass in front of the sun, the filled in areas may be too bright or too dark to match the surrounding background model since they are temporally shifted.

These rapid lighting intensity changes create ghostly artifacts in the final video, such as slightly darker or lighter shapes of cars driving down the road.

There are possible technical solutions to mitigate this ghosting, but for the purposes of this installation, we decided the artifacts have some artistic value. Perfect erasure of human activity can be easily overlooked by the audience. The artifacts of the removal process betray the tampering of the video and signal to the audience the video is a fiction. Viewers of the piece frequently remarked about these artifacts and it clearly caused them to reevaluate their understanding of what they were seeing - resulting in a deeper engagement with the piece.

Perspective and Embodiment

For all but one video, we used a bubble level to make sure the camera was level. A level video is crucial to making the VR scene natural and seamless. However, we shot one clip a few degrees off axis. As the VR head pans in the horizontal direction, the scene doesn't track naturally creating a slightly disorienting vertigo effect. This effect imparts a degree of discomfort on the viewer, which helps to reinforce the sense of isolation, desertion, and loneliness characterized by the installation.

The six landscapes were shot at different times of day such as, early afternoon, evening, clear day, sunset, and during a storm. Each cut transports the viewer into a new location, time of day, and different weather pattern. These transitions create a *refresh* – re-engaging the viewer and expanding their conception of the circumstances surrounding the unsolved cases.

Figure 2. The video scene, Top: Unprocessed video still, Bottom: Processed video still.

The light source in each image was carefully shot, placed, and lens flares were digitally inserted and enhanced (Figure 2) to emphasize that the audience is looking through the camera's (machine) eyes.

Production Workflow

The production workflow is designed to be highly streamlined and automated to facilitate the rapid deployment of this artwork in a site-specific manner.

Video Capture

Video is captured on a 360fly 4k video camera [5]. The camera is a single lens system with a 240-degree vertical field of view. The 120 degrees not captured by the camera are below the camera, where the tripod is mounted. For the purposes of this project, the missing 120 degrees of the field of view was irrelevant since it was below the field of the view of the VR system. A viewer can't change the angle of the viewing head to look downward.

The raw video is converted to equirectangular format and fed into our custom software written to detect and remove foreground motion from the video. The original footage, and the processed footage, are then composited together in Adobe After Effects. Color correction and effects are added to the scenes, and the SkyBox Studio V2 plugin [6] is used to preview the footage as VR.

Automated Foreground Activity Removal

The process of removing human activity from the scenes is automated by the use of computer vision techniques. The raw footage is fed into a custom program, called 'VideoEraser,' (Figure 3) which outputs an image sequence with all of the foreground objects erased.

VideoEraser uses an Adaptive Gaussian Mixture Model (GMM) [7] to perform foreground segmentation on

multimodal background scenes. GMMs work well for this application because they have a built-in learning component which allows the algorithm to efficiently ignore periodic movement such as tree branches swaying in the wind, or lighting changes due to passing clouds.

The software generates an output frame by first performing foreground image segmentation using the GMM algorithm. The segmentation process generates a 2-bit image mask with black pixels indicating the background and white pixels marking the foreground. The image mask is post-processed using a morphological closing algorithm to try to fill in small holes in the mask. After morphological closing, a final noise-removal pass helps to further clean up the image mask.

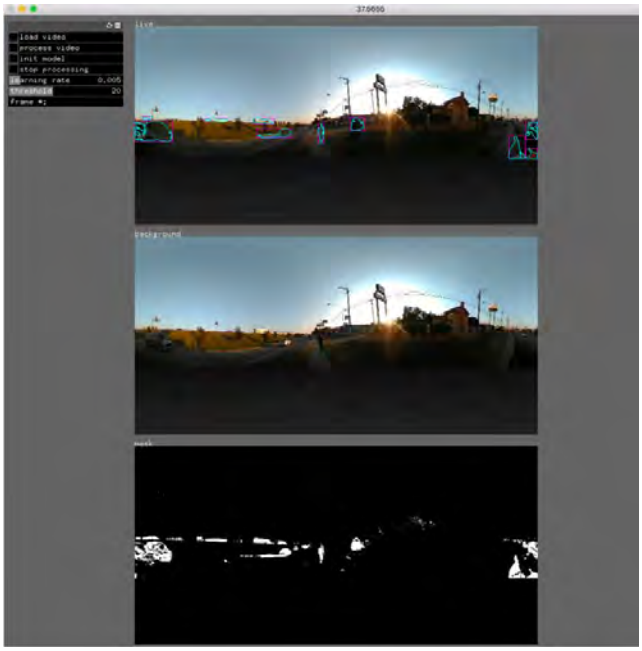


Figure 3. A screenshot of the 'VideoEraser' software. Top: foreground object detection, middle: source frame, bottom: generated foreground/background mask.

Using the 2-bit image mask as a reference, background pixels from the source frame are then copied into a persistent output pixel buffer. Each successive processed frame only updates the background pixels in the output buffer, so the foreground pixels are filled in by the last-known-good background pixels from previously processed frames. After each frame is processed the output frame is written to disk.

The resulting image sequence makes an unsatisfying video because it suppresses too much motion. To bring some life back to the video, the erased footage is then composited on top of the original footage using a coarsely drawn hand-crafted mask in After Effects. The erased footage is used to replace areas of high human activity, such as roads and sidewalks. Allowing areas of the original video to remain in the final product preserves the highly detailed motion caused by wind, weather, wildlife, etc.

Design

The piece is modeled after the vernacular of public park infrastructure. This design (Figure 4) is intended to help lower the barrier to engagement and create a surprise moment when the audience realizes what they're seeing.

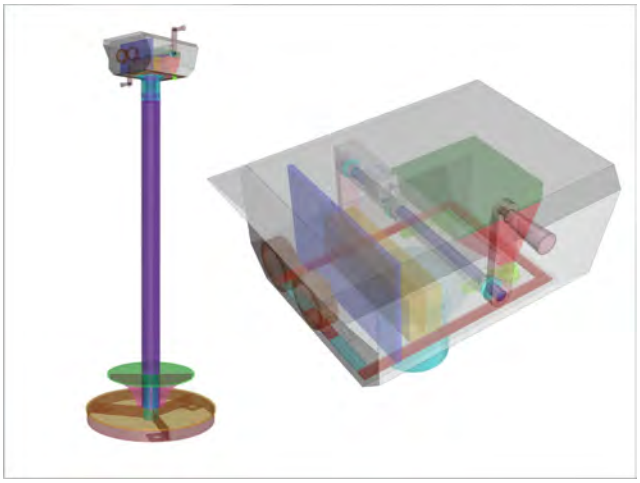


Figure 4. *Forgotten Landscapes*, CAD model

Human Factors

Each of the three stations has a different height stand (3', 4', and 5') to accommodate audience members of different heights and abilities. Each machine also has a built-in one-foot-high step stool to provide some overlap in sizes between viewing stations.

Each machine has crank handles on both the right and left side of the machine to accommodate right or left-handed people. The handles are offset 180 degrees on the through-shaft, so they counterbalance each other.

Site Layout

We moved the piece to three different locations in city parks over the duration of the exhibition. At each site we tried slightly different layouts of the three machines. In the first location the machines were spread out in an equilateral triangle about 10 feet apart. In the second location the machines were installed in a straight line, spaced about 10 feet apart. Over a period of several weeks of observation of participant behavior, we noticed a lot of groups of people (e.g. families, groups of children, etc.) engaged with the piece. These groups tended to want to interact with the piece and each other, at the same time. This led to clusters of participants around one viewer, where one person was

experiencing the piece and everyone else was waiting around for their turn. At the third installation site, we moved the viewers back to a triangle configuration, so each viewer was only about 6 feet away from the others. This increased engagement as more participants could talk to each other and simultaneously experience the work.

System Design

The electronics consists of two main subsystems: a microcontroller for hardware interfacing, and a tablet computer for the VR system. The system is powered by the tablet, but a supplementary battery pack is used to boost the effective battery life of the system.

The microcontroller is connected to an encoder, a temperature sensor, and an electric fan. The microcontroller uses the temperature sensor and fan to regulate the temperature inside the enclosure and prevent the tablet from overheating. The encoder is attached to the crankshaft and sends position information to the microcontroller.

The microcontroller sends temperature and encoder information to the tablet over a Musical Instrument Digital Interface (MIDI) interface. Since the tablet is Apple iOS-based, the range of options for interfacing with hardware are quite limited. Apple provides an off-the-shelf Lightning to USB 3 Camera Adapter which can be used as a MIDI interface while also allowing an external battery pack to supplement the tablet's own battery pack.

The temperature and encoder information are marshalled into a custom data structure and sent over the MIDI interface using the System Exclusive (SysEx) message format. SysEx allows a MIDI device to send an arbitrary amount of data over the MIDI bus.

The tablet application is a custom iOS application. The VR viewer is built on top of Google's GVRKit [8]. The application has some code to handle translating and processing the MIDI messages. Temperature information is logged to disk for analytics purposes. Hand crank position is fed into the brightness control.

Conclusion and Future Directions

Democratizing VR by placing all the necessary equipment in a public setting was an extremely interesting exercise. VR-based art projects are largely confined to downloadable applications or sequestered within the confines of New Media festivals or galleries. Reaching such a broad and diverse audience was really satisfying.

This work could easily be installed in another city on a very short installation schedule. The physical setup time for the piece only takes a few hours but collecting the video is the bulk of the work. The streamlined machine-assisted workflow for producing the video makes it easy for this work to be site-specific.

This format for a public video viewer holds a lot of potential. Installing a camera, along with the viewer, opens up possibilities mixed/augmented reality applications.

Acknowledgements

Forgotten Landscapes was created through a commission by the Austin Art in Public Places TEMPO program and installed in Bartholomew Park in Austin, Texas. The piece was reinstalled for exhibition by Art Alliance Austin, and also included in the SXSW Festival UNESCO Showcase in 2018.

References

[1] National Missing and Unidentified Persons System, https://namus.gov/
[2] Ha Na Lee, "Forgotten Landscapes documentation", http://isogr.am/forgotten.html
[3] Esmi Careaga. "What Happened to Roxanne Paltauf?" *KTBC*, July 08, 2017, http://www.fox7austin.com/news/local-news/what-happened-to-roxanne-paltauf
[4] Bucher, John K. "Storytelling for Virtual Reality: Methods and Principles for Crafting Immersive Narratives". Routledge, 2018.
[5] 360 Fly Camera, https://www.360fly.com/360fly-4k
[6] Skybox Studio,
[7] Zivkovic Z., Improved adaptive Gaussian mixture model for background subtraction. Int Conf Pattern Recognition (ICPR 2004), 2004, 2: 28-31
[8] Google GVRKit, https://github.com/googlevr/gvr-ios-sdk/tree/master/Samples/GVRKit

Reflective Remediation as Critical Design Strategy: Lessons from László Moholy-Nagy and Olafur Eliasson

Marios Samdanis
Brunel University London
London, UK
marios.samdanis@brunel.ac.uk

Chrystalla Kapetaniou
University of Cyprus
Nicosia, Cyprus
kapetaniou.chrystalla@ucy.ac.cy

Yi Kyung Kim
National University of Science &Technology, Seoul, Korea
clarakkim@gmail.com

Soo Hee Lee
University of Kent
Canterbury, UK
s.h.lee@kent.ac.uk

Abstract

Reflective remediation is an important component of contemporary media theory, which emphasises the creative efforts of avant-garde artists and designers to shape the evolution of media in a critical way. However, the critical capacity of reflective remediations may be compromised by commercial dynamics or conventions, such as the celebration of 'reflectivity for reflectivity's sake' that aims to construct an auratic experience for viewers. Because reflectivity is a critical media practice, it is vital to investigate reflective remediations in tandem with the critical intensions and creative visions of artists and designers. We investigate the critical media practices of the Bauhaus master, László Moholy-Nagy (1895-1946) who explored the concept of 'productive creativity', according to which creative experimentation should lead to design knowledge, redefining the relationship between what is known and unknown. We then scrutinise the artistic practice of the Icelandic-Danish contemporary artist Olafur Eliasson (b.1967), who contextualises reflectivity as an embodied experience, in terms of what he calls 'frictional encounters'. When applied together, the two concepts enhance our understanding of reflective remediation as a critical design strategy.

Keywords

Remediation; digital art; digital design; interactivity.

Introduction

Reflectivity – or hypermediacy – is a key concept in the theory of *remediation*, a theory that explains how new media forms emerge by borrowing representational strategies from older ones [1]. The process of remediation is key to an understanding of the drivers of interactive design development, as new media emerge by competing with older and contemporary media forms, to construct an authentic or 'real' experience for the viewer [2]. In particular, transparency – or immediacy – is a powerful driver for remediation which prioritises efficiency, simplicity, functionality and clarity in design which progressively improves due to technological innovations.

Reflectivity manifests resistance to the singular and deterministic vision of transparency, according to which advanced technology always leads to more nuanced, authentic and real experiences. As a design principle, reflectivity critiques the belief that good design should be transparent, functional, auratic and immediate [3]. By prioritising agency and pluralism, reflectivity provides an alternative vision of interactive design which is materialised in the form of radical experiments in art and technology. In addition, the notion of reflectivity highlights the agency of users in shaping their desired experience of media. Users do not simply consume experiences, but also construct cultural, social, economic and political practices through interaction with media, often in collaboration with other users [4].

We aim to refine the concept of reflectivity, by scrutinising the politics of remediation in digital art and design. To do this, we synthesise Moholy-Nagy's idea of productive creativity with Eliasson's concept of frictional experience. The design practices of Moholy-Nagy and Eliasson seem to contrast with each other, as the former aimed in his experiments in graphic design to make 'visual noise' invisible, and the latter attempts to enhance human knowledge and experience by using his interactive installations to make the invisible visible. By integrating the two concepts, we define critical reflective remediation: on the one hand, as a cultural practice in which artists and designers aim to deconstruct the 'real' by demonstrating the effects of immediacy on a cultural experience; and, on the other, as a political practice that positions art and design as critical forces which empower users to participate in processes of meaning-making and action through new media.

Reflective Remediation in Digital Art and Design

Remediation is defined as a process in which new media forms emerge through the borrowing of strategies of representation from previous media forms [1]. Bolter and Gromala identify two competing visions of new media evolution: "the pragmatic vision offered by Norman and other HCI experts, for whom computers are information appliances, and the vision offered by digital artists and interaction designers" who use technology to create compelling experiences for the audience [1:7]. In their book *Windows and Mirrors*, Bolter and Gromala introduce two powerful metaphors which define the antagonistic visions of the two communities: the metaphor of an interface as a *window* which demands clarity, efficiency, accuracy and simplicity; and the metaphor of the *mirror*, as technology can also shape aesthetic experiences for viewers, reflecting our technological, cultural and social contexts.

Transparency has received excessive attention in terms of its cultural effect: "Transparency was and remains a powerful media aesthetic that dates back hundreds of years. Certain media are potentially quite effective in promoting the aesthetics of transparency: painting, photography, film, television, and computer graphics. All of these media can also be used in other ways, but they are often, perhaps usually, designed to be transparent and present viewers with an unmediated view of the world" [3:42]. However, new media do not simply evolve within a linear and progressive fashion in which superior technological innovations replace previous ones. New media are also influenced by the creativity of digital artists and designers who radically experiment with media in their creative processes.

Reflectivity – or hypermediacy – is concerned with creating a compelling experience for a viewer who interacts with new media. According to Bolter et al., "designers in any media form, old or new, are making a claim that their particular representational practices can provide an experience that is authentic, auratic or 'real'" [2:32]. Remediation is the outcome of digital creativity as a cultural practice, according to which artists and designers borrow representational practices from earlier media and claim to be improving on them. However, remediation is not a new phenomenon, as art and media forms evolve through processes of imitation, assimilation and antagonism. For instance, early photography and film at the beginning of the twentieth century introduced the element of time in art, challenging the timeless dimension of painting [5:12]. Among the first artists who experimented with time in art was the pioneer photographer Eadweard Muybridge, who introduced motion using sequential photographs, as evident in his famous studies of locomotion.

The appearance of the first 'new media', such as photography and film, initiated cross-fertilisation between different art forms, as artists started to borrow representational strategies from other art forms. For instance, the Futurists Giacomo Balla and Umberto Boccioni, together with Marcel Duchamp, incorporated Muybridge's photographic studies in order to capture the dynamism of real movements on canvas [5]. In addition, the Russian film director Sergei Eisenstein transferred the fragmented shapes of Cubism into film through dynamic images, "accomplished by varied camera angles and sophisticated montage" [5:19]. New media have also given rise to hybrid art and design forms, such as digital sculpture, integrating software generating objects with conceptual and installation art [6]. Hence, the mediations of artists take place on two levels: on the one hand, digital artists intervene between software and the creation of an object, and therefore, remediation takes place as a creative practice, in interaction with a software interface. On the other hand, artists, often in collaboration with curators, also mediate between the object and its viewers, staging and orchestrating their interactive, spatial, or embodied experience [6].

Whether it be a contemporary art gallery or public space, the exhibition context of digital art and design is also considered as a medium. Among the first who experimented with the exhibition context as a medium was the French post-modern philosopher, Jean-François Lyotard, who curated the monumental multimedia art exhibition 'Les Immatériaux' (1985) at the Centre Pompidou in Paris. Lyotard conceptualised the exhibition space as an interface: acting as a programmer, he invited the spectator to 'run the program' and interact with multiple media forms [7]. Lyotard's reflectivity was manifested in the remediation of the exhibition medium, in order to make the post-modern condition visible in the information age: humans no longer control material, but are immaterialising into message and information when interacting with technology. According to the scholar of new media, Jorinde Seijdel, "by making this, Lyotard wanted to create a 'reflexive unease' in the viewer regarding the implications of the information age" [7:n.p.].

Bolter and Gromala address reflective remediation as a critique of transparency that reflects the politics between the computer scientists and digital artists [1]. This critique, aligned with Lyotard's post-modern condition, aims to deconstruct the power of media to create singular versions of the 'real', through a revelation of the effects of immediacy on a cultural experience. By embracing this post-modern critique fully, our intention in the following sections is to move beyond it, and identify the roots of reflectivity in modernity, revealing its role in the vision of artists such as László Moholy-Nagy, who aimed to create art and design for social change. Reflectivity is evident in a contemporary art too, as artists like Olafur Eliasson experiment with new media forms in order to create embodied experiences that push the aesthetic and intellectual boundaries of viewers. The design thinking which originates from modernity reveals a version of reflectivity which is not restricted to the use of new media to stage compelling aesthetic experiences, but positions design as a critical force that allows users to become participants in processes of political and socio-cultural of meaning-making and action through new media.

László Moholy-Nagy and Productive Creativity

László Moholy-Nagy, the Hungarian Bauhaus master, experimented in his art and design with elements including geometry, light and transparency, and media, such as photography, film and typography [8]. His design practice was based on what he termed 'productive creativity', as he aimed to create designs that establish "new relationships between the known and the as yet unknown optical, acoustical, and other functional phenomena" [9:31]. Moholy-Nagy's legacy within the Bauhaus is connected with his experimental work in graphic and industrial design [10]. The concept of productive creativity is epitomised by a series of experiments that Moholy-Nagy conducted in the 1920s, in which he filmed and photographed everyday life in order to capture the rhythms or *tempo* of the modern metropolis. The dynamism captured in media reflected his thinking on graphic design, which, in his view, had to shift from two-dimensional black-and-white into a three-dimensional aesthetic. In the words of Moholy-Nagy, graphic design should be functional and transparent: "Printed matter today will have to correspond to the most modern machines; that is, it must be based on clarity, conciseness and precision" [10].

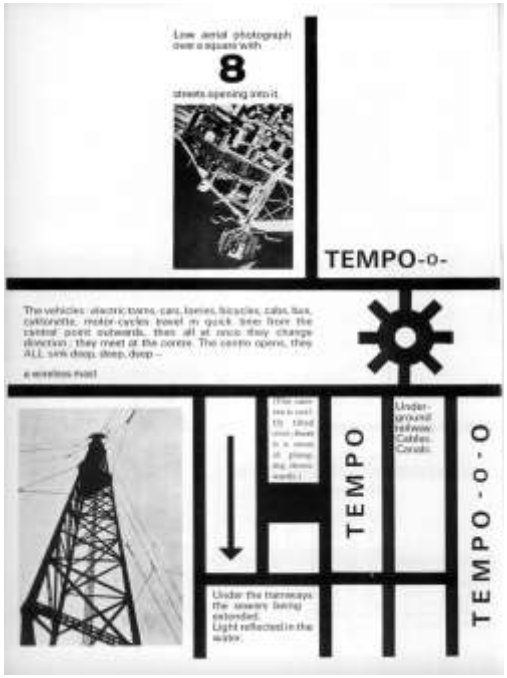


Figure 1. László Moholy-Nagy, *Dynamic of the Metropolis* (1925/28) © László Moholy-Nagy.

His experimentation with film and photography in *Dynamic of the Metropolis* (Fig.1) led to the invention of new forms of typography and visual communication, in order to meet the needs of people in the modern metropolis, "adequate to the new conditions of attention, perception and thought" [10:405]. In *Painting, Photography, Film*, Moholy-Nagy wrote of: "a state of increased activity in the observer, who – instead of mediating upon a static image and instead of immersing himself in it … is forced … simultaneously to comprehend and to participate in the optical events. Kinetic composition … enables the observer … to participate, to seize instantly upon new moments of vital insight" [10:411]. Interestingly, his reflective vision of graphic design contextualised the viewer in movement, creating meaning within an embodied situation. Graphic design for Moholy-Nagy was about constructing optical events as compelling experiences for viewers, who created meaning in interaction with media. Borrowing techniques from a discipline described at the time as 'psychotechnics', Moholy-Nagy instigated a new form of experimental design that appropriated the principles of applied psychology to demystify the laws of visual attention [10]. The charismatic designer experimented with these laws of visual attention in order to strip away the powerful symbolic effect of images, as well as improving visual hygiene within an emerging and chaotic urban landscape [9]. Ironically, Moholy-Nagy, an artist who passionately subscribed to the values of Constructivism, which aimed to create art with social impact, applied these techniques later in the advertising industry, working as an illustrator to construct new images and symbols in the mind of the consumer [10].

Olafur Eliasson and Frictional Encounters

Olafur Eliasson is a contemporary artist known for his large-scale installations, sculptures and public artworks, using elements such as light, temperature, water and digital media, in order to create embodied aesthetic experiences for viewers. The elements of transparency and reflectivity are manifested in his work: transparency in his immersive total works of art (Gesamtkunstwerke) aiming to unify art forms and "the senses of seeing, hearing, palpation, taste" [11:9]; and reflectivity, in terms of deliberatively creating context-specific and situated 'frictional encounters': "interactions between viewers and artworks, or subjects and objects, that are always riven with tension, conflict, and misunderstanding" [11:7]. According to Kuo, "Eliasson himself has often invoked the total work of art, constructing immersive and multisensory environments in order to elicit and perturb our impressions of colour, light, sound, and material" [11:9].

For Eliasson, to create a reflective experience for the viewer requires two elements. First, it requires empathy, "the aesthetic encounter as a psychological projection of the self into the object of perception" [11:7]. As Eliasson explains, a frictional encounter occurs when psychological projection of the self into the object of perception is interrupted: "You never look at something as if for the first time. Your gaze is essentially old, even though the artwork might be new to you … Encountering a work of art is, to a great extent, about recognition and identification, about feeling listened to – and then there's the element of surprise and uncertainty where identification collapses. As an artist I work actively with this – I integrate what I expect people's expectations to be into the artwork. I am keen to make works that exist to be seen while also inviting reflection on how they are seen" [12:I].

Figure 2. Olafur Eliasson. *The Weather Project* (2003), Tate Modern, 2003. © Tate, Andrew Dunkley & Marcus Leith.

Perhaps his most popular installation is the *Weather Project* (2003) in the Turbine Hall of Tate Modern, which invited the spectator to become part of the large site-specific installation. This immersive installation demonstrated aspects of transparency by creating the illusion of a sun and weather system using monofrequency lamps projected onto a screen, together with controlled humidity and mist [11]. This installation created a compelling social experience for the audience, as many people treated the museum as a social space for interaction and relaxation. In other words, the audience's reflectivity emanated from the creation of an auratic and transparent experience, something which is often institutionalised by contemporary art museums, galleries, biennials and corporate lobbies, which use immersive experiences to attract attention. More broadly, a reflective experience is no longer the exception but an expectation, and when it is not accompanied by critical design thinking, it risks being reduced to a form of entertainment and spectacle.

Reflective Remediation as an Auratic Experience

According to Bolter et al., "the strategy of transparency aims to evoke aura in the viewer, while hypermediacy [reflectivity] calls aura in question" [2:33]. Walter Benjamin coined the concept of 'aura' and claimed that in its immediate form it can only be experienced in nature. In works of art and media, the notion of aura is constructed using rituals and politics that constitute the real and authentic. An auratic experience, therefore, constructs an illusion of the real through immediacy based on the design principle of transparency. The role of reflectivity is to challenge and expose the cultural and media mechanisms that construct the real.

Designers have long questioned the responses of viewers to aesthetic stimuli, with the aim of understanding their perceptions, cognitions and behaviours, in order to create less or more disturbing experiences. "For [Walter] Benjamin, distraction was the ability to register stimuli, to think and to act; for the psychologists, it was the refusal or resistance to do so" [10:421]. Reflectivity is a critical concept that aims to make visible to the viewer the use of new media as ideological devices that promote the hegemony of specific transparent strategies and messages. Transparent media tend to create an illusion of the 'real', themselves becoming the message, as Marshall McLuhan predicted.

Artist	Transparency	Reflectivity
László Moholy-Nagy	Graphic design: clarity, conciseness and precision	Productive creativity: media experiments for social change
Olafur Eliasson	Immersive work: total work of art as illusionary space	Frictional encounters: empathy to create aesthetic experiences

Table 1. Remediation of the Creative Practices of László Moholy-Nagy and Olafur Eliasson. Source: The Authors.

As Bolter and Gromala claim, every design is both transparent and reflective [1]. Indeed, Moholy-Nagy's experiments in graphic design and Eliasson's immersive installation oscillate between transparency and reflectivity (Table 1). They both embarked on reflective creative processes in order to create compelling experiences for their audiences. However, when it shifts from the avant-garde into the mainstream and gains cultural acceptance, a reflective experience runs the risk of becoming a transparent auratic experience. Bolter et al. are right to argue that new media have not led to the demise of aura, as Benjamin (1936) predicted in *The Work of Art in the Age of Mechanical Reproduction* [2]. However, in the age of new media, aura is not always in a state of permanent crisis due to reflectivity, as reflective designs also have the potential to construct an auratic experience, as they may be reduced to entertainment and subjected to the commercial forces of capitalism. The selection of certain representational strategies is influenced by the broader socio-cultural, technological and economic context, as that is much broader than the interaction of an individual artist or designer with an interface, as Bolter and Gromala argue. In the case of Moholy-Nagy, this context was the rise of the advertising industry and the appropriation of psychotechnics by commerce. In the case of Eliasson, the context is the establishment of exhibition-making as the dominant medium for the representation of contemporary art within a gallery context that aims to attract a wider audience.

References

[1] Bolter, J. D. & Gromala, D., *Windows and Mirrors* (Cambridge, MA: MIT Press).

[2] Bolter, J. D., MacIntyre, B., Gandy, M. and Schweitzer, P. "New media and the permanent crisis of aura", *Convergence*, 12, (2006): 21-39.

[3] Bolter, J. D., Engberg, M. and MacIntyre, B. "Media studies, mobile augmented reality, and interaction design", *Interactions*, 20, (2013): 36-45.

[4] Lee, S. H., Samdanis, M. and Gkiousou, S. "Hybridizing food cultures in computer-mediated environments: Creativity and improvisation in Greek food blogs", *International Journal of Human-Computer Studies*, *72*, (2014): 224-238.

[5] Rush, M. *New Media Art* (London: Thames & Hudson).

[6] Paul, C. *Digital Art* (London: Thames & Hudson).

[7] Seijel, J. "The exhibition as emulator", Mediamatic, January 1 2000, accessed December 12 2018, https://www.mediamatic.net/en/page/10326/the-exhibition-as-emulator

[8] Borchardt-Hume, A, "Two Bauhaus histories", in *Albers and Moholy-Nagy: From the Bauhaus to the New World,* ed. A. Borchardt-Hume (New Haven: Yale University Press, 2006).

[9] Prager, P. "Making sense of the modernist muse: Creative cognition and play at the Bauhaus", *American Journal of Play*, 7, (2014): 27-49.

[10] Schwartz, F. J. "The eye of the expert: Walter Benjamin and the Avant Garde", *Art History*, 24, (2001): 401-444.

[11] Kuo, M. "More than a feeling", in *Olafur Eliasson: Experience,* ed. A. Engberg-Pedersen (London: Phaidon, 2018).

[12] Eliasson, O. "The whys and hows of my art-making", in *Olafur Eliasson: Experience,* ed. A. Engberg-Pedersen (London: Phaidon, 2018).

Authors Biographies

Dr Marios Samdanis is a Lecturer in Strategy, Entrepreneurship and International Management at Brunel University London. His research focuses on remediation, artistic innovation, media convergence, sociomateriality and digital creativity.

Dr. Chrystalla Kapetaniou is a Special Scientist at the Economics Research Centre at University of Cyprus. Her research interests focus on automation technologies and employment, 3D printing ecosystems, and the role of institutions in influencing start-ups.

Yi Kyung Kim is Adjunct Professor at Seoul National University of Science and Technology. She is an acclaimed scenographer, choreographer and costume designer, featuring digital dance performance works in Korea, Spain and the UK.

Soo Hee Lee is Professor in Organization Studies at University of Kent, UK and the Director of the Creative City Forum in Korea. His research focuses on behavioral underpinnings and organisational dynamics of digital convergence and creativity.

Fugitive Color and the Choreographed Escape

Scott Hessels
School of Creative Media, City University of Hong Kong
Hong Kong, SAR
shessels@cityu.edu.hk

Abstract

For centuries, color was mortal, its fate tied to its organic roots. Fugitive colors change due to an array of factors and have tragically distanced the art artefact from the artists' intent. Developments in chemistry gradually synthesized pigments that defied the inevitable. The quest for fixed color however took an unusual turn with the discovery of liquid crystal display. Electronic control of the crystal structure sparked recent display evolution, but the same effect can be triggered through environmental factors. Adding deliberate temporality to hue and matching it with hardware controls, a class of artworks is emerging that utilizes these new pigments. Technology first halted the dying of colors of Art History and has now given them life. Smart materials can now be programmed, choreographing the chemistry that once threatened masterpieces. The paper will discuss fugitive colors as villain, captive and hero, presenting recent projects that embrace colors that won't sit still.

Keywords

Smart Materials, Chromism, Programmed Display, Thermochromic Pigments, Fugitive Color

Introduction

In George Field's seminal treatise on chromatography in 1885, he describes the personality of each pigment, not in terms of human metaphor or psychology, but the color's actual behavior. Pure Scarlet, for example, "has all the body and opacity of vermilion, and is as much inferior to it in permanence as it is superior in brilliancy. Of all artistic pigments, it is at once the most dazzling and fugitive." [1]

Fugitive colors is a term from technical painting that refers to pigments that lose longevity when exposed to particular environmental elements such as sunlight, humidity, temperature or even pollutants. With longer exposure, these colors change, lighten, darken or fade over time. The changes are unintentional by the artist, often occurring due to incorrect mixing, compromises in materials, or unfortunate siting.

However, an emerging class of pigments are being engineered to intentionally change color in response many of these same environmental elements. As they become more chemically stable and more readily available, they are attracting the interest of artists and designers seeking low-energy urban solutions.

Accidental Fugitives

Discoloration suggests an unattractive shift; most dictionary definitions include a negative connotation. But the complexity of color extends beyond the aesthetic and is key in how the perception of depth, dimensionality, and illusion are often dependent on very detailed shifts in color and tone. Losing these details changes the meaning of the art.

When one considers the history and delicacy of mixing color, it's surprising that more discoloration hasn't occurred. Our first five colors were created 40,000 years ago—black, white, yellow, brown and red—from varying elements of soil, animal fat, charcoal and chalk. Since then, and exploding in advances concurrent with art historical movements, color has evolved through experimentation, exploration, and science. Few plant or animal-derived pigments are still in use, but their exotic history is marked with novel concoctions of rare, exotic plants and animal/plant hybrids including yellow from the urine of mango-fed cattle and black from cuttlefish ink sacs. Lead White, now banned but once renowned for its unique gleam of light, was made by layering horse manure over lead and vinegar for three months in a sealed room. [2]

In the past, from the moment a painting was completed, a gradual shift of color began, often over centuries. In oil painting, the binders used often darkened the mineral-based pigments, while organic dyes tended to lighten over time when exposed to light. Contamination from pollutants like hydrogen sulphide could change the white in lead-based paints to black. The resin varnishes used also often added to the problem by turning yellow with age. Recently, the yellows in Vincent van Gogh's *Sunflowers* turning brown had stumped historians until radiation technology revealed that white sulphates had been added by the artist to brighten his Chrome Yellow, only to have it darken over time due to UV exposure. [3]

As repainting the original works is not an option, new media are being explored to at least digitally re-color the art. Mark Rothko's *Harvard Mural Triptych,* which spent years in direct sunlight in a university dining hall in the 1960's and 1970's, was dramatically faded due to his use of a highly fugitive organic pigment. MIT researchers restored first the color transparencies from 1964 and then projection-mapped the canvases using a program that calculated and corrected the colors as a "compensation image." [4] Other digital solutions have included recreations of the fading blues made

with smalt in Hendrick Ter Brugghen's 17th century paintings [5] and a range of digital humanities projects including Jeffrey Shaw's *Dunhuang Caves*. [6]

Born Fugitives

The mortality of color was resultant on the mortality of its materials, particularly those founded in plants and animals. Fugitive color became less destructive as advances in chemistry synthesized many of the compounds, fixing color into place for eternity. The first digital watches and the first thermochromic materials surfaced simultaneously in the 1960's due to sharing the same fundamental display technology—liquid crystals. By changing the equilibrium spacing between the aligned sheets of molecules, light wavelengths are diffracted and the perception of color changes. Electronics allowed for detailed changes in the crystal structure, triggering the next fifty years of display technology. However, the same effect could be achieved with an array of environmental factors, e.g. heat, although usually less controlled, less immediate and less useful. From these initial developments, different types of molecules were discovered with the same variant properties including the popular Leuco dyes. [7] As with LCD, chromic pigments have become highly engineered and are now capable of dramatic color shifts at extremely specific temperature thresholds.

The novelty era of thermochromics began first, the paints appearing on T-shirts, bikinis, coffee mugs, patches, and even a 2017 United States postage stamp revealing a solar eclipse with one's thumb. [8] The novelty persists and on a larger scale, the Shenzhen Institute of Advanced Technology in China recently developed controllable nano cells, or crystalline micro beads, whose size can be increased or decreased to deflect light at the different wavelengths to produce colors. Any stimulus can be programmed to reshape the beads, meaning weather, heartbeat, or music could change the colored walls of a room. [9] Liquid crystal is being replaced by nano-technology and a new age of modifiable hue is beginning.

Choreographed Escapes

Smart materials including chromic pigments can now be mediated by electronically controlling their environments, meaning that a message can be presented that requires no display or projection. By choreographing the behavior inherent in adaptive and reactive materials as the foundation of an art system, the process allows for multiple design trajectories and applications.

Advances in programmable environments have meant that interest in emerging materials has reignited beyond their playful novelty. Environmentally-reactive and networked objects are increasingly using a a variety of conductive and semi-smart materials to become innovative and intelligent. More artists and designers are incorporating thermochromics with phase change materials to create new types of display and interaction.

Combining developments in both the materials and programmable interfaces has reduced their unpredictability making them essentially controllable, although their possibilities for mediation are still rarely considered. [10] A recent exhibition in Los Angeles' Container Yard, *Degrees of Perfect*, gave street artists the opportunity to design massive color changing murals that were only possible due to recent advances in HVAC heating systems. This merging of both dynamic canvas and dynamic pigment was a new revelation for the artists, with Fluke explaining, "you can feel the engineering, and you can feel the artist discovering the paint." [11]

His comment also demonstrates how the emergence of a new material flips the usual design process. "Discovering the paint" suggests a creative process that starts with determining what's possible with the material and letting that revelation lead to to the artwork's form. Potentiality supersedes design, in which an artist asks, "what can I make from this?" instead of "how do I make this?" This dynamism is gaining impetus, a creative strategy that MIT's Neri Oxman refers to as "design by immaculate conception." [12] With no pre-established plans, no goal pre-envisioned, an artwork rises from a confluence of matter and energy.

Environmental Appeal

The chemical and computational advances aside, adaptive and reactive materials are being embraced for another reason—they usually require minimal resources to trigger their reaction. On a global scale, no options for improved sustainability or lower energy consumption are being dismissed quickly. While the creative potential of these new pigments is exciting, they also use less energy, create less pollutant, are longer lasting, and are safer for public interaction than electronic signage. These paints are not only more ecologically responsible, their presence in urban contexts may also remind the public in a direct, recognizable way of possibilities being explored that improve city life with minimal harm to the environment.

Because of this, both architecture and industrial design are investigating materials that signal environmental changes via color. Smart coatings and performance glazes can affect infra-red transparency, letting heat in during winter and blocking in summers, making solutions based on programmable fugitive colors an actual option to reduce urban energy consumption. The diversity of the reagent categories—electrical, magnetic, optical, thermal, mechanical and chemical—possible for color shift mean that temporality is now possible that is radically different than digital simulation. [13]

A new aesthetic is possible in which the object is capable of diagnostic display, allowing an opportunity to symbiotically articulate these new pigments into innovative products. Urban space is often augmented with signage; these paints could allow a type of display that is more assimilated with the environment.

Summary

While digital technology seems to promise immortality through pure immateriality, other innovations are battling on the physical front. Emerging materials are allowing non-binary representations of temporality, creating a living object founded in choreographed chemistry. When triggered with programmed electronic interfaces, these adaptive and reactive materials enter gradated flux, able to loop yet not repeat, able to perform yet retain elements of chance. The effects possible with smart materials are both pre- and post-digital. They are not simulations of life, but life itself able to transform indefinitely.

The dying colors in our entire history of art that were first halted are now subservient, their changes no longer out of our control but under our manipulation. Temporality and its transcendence are the core of the separation of the physical world from the immortal. This binary understanding, however, ignores energy and chemical reactions that are part of an ongoing evolution that is also unending yet based in the material world. Roy Ascott wrote that "All hypotheses—about ourselves, or of the world—are transient and incomplete. The only certainty is the process of becoming." [14] If eternity is not a destination but an evolution, a gradient of becoming, flux and dynamism are integral.

References

[1] George Field and John Scott Taylor, Field's Chromatography or Treatise on Colours and Pigments as Used by Artists (London: Windsor and Newton, 1885) 109.

[2] Sarah Gottesman, "A Brief History of Color in Art", Artsy, May 20, 2016 accessed 28 November 2018 from https://www.artsy.net/article/the-art-genome-project-a-brief-history-of-color-in-art

[3] Ian Sample, "Van Gogh Doomed His Sunflowers by Adding White Pigments To Yellow Paint" in The Guardian, February 14, 2011, accessed November 27, 2018 from https://www.theguardian.com/science/2011/feb/14/van-gogh-sunflowers-yellow-paint

[4] Noémie Jennifer, "Vivid Color Projections Revive Faded Works of Art" Vice, April 20, 2016, accessed November 27, 2018. https://www.vice.com/en_us/article/ez57e7/projections-mapping-faded-art-conservation-lab

[5] J. Dik, M. den Leeuw, W. Verbakel, R. Peschar, R. Schillemans and Henk Schenk, "The Digital Reconstruction of a Smalt Discoloured Painting By Hendrick Ter Brugghen", in Zeitschrift filer Kunsttechnologie und Konservierung, 16, 2002, p. 130-146.

[6] Jane O'Brien, "Digital Chinese caves preserve history," BBC News, January 6, 2013 accessed November 27, 2018 from https://www.bbc.com/news/magazine-20802947

[7] Unknown, "The Time for Thermochromics, Materials Today, 2008, accessed November 28, 2018 from https://www.materialstoday.com/amorphous/news/the-time-for-thermochromics/

[8] Erin Blackmore, "Celebrate the Eclipse with a Color-Shifting Stamp" Smithsonian Magazine, June 21, 2017, accessed November 28, 2018 from https://www.smithsonianmag.com/smart-news/celebrate-eclipse-color-shifting-stamp-180963787/

[9] James Billington, "Chinese Scientists Are Developing Color-changing Paint You Can Remotely Control" International Business Times, October 13, 2015, accessed November 28, 2018 from https://www.businessinsider.com/chinese-scientists-are-developing-color-changing-paint-you-can-control-2015-10/?IR=T&r=SG

[10] Michelle Addington and Daniel Schodek, Smart Materials and Technologies in Architecture (New York: Architectural Press, 2004.

[11] Unknown, "Degrees of Perfect, Behind the Murals that Morph," Mashable, July 13, 2016, accessed November 27, 2018 from https://mashable.com/2016/07/13/thermochromic-murals-exhibit/#YHrbn9HSNkqG

[12] Neri Oxman, "Material-based Design Computation," (Thesis submitted to the Department of Architecture, Massachusetts Institute of Technology, 2010) 302.

[13] Axel Ritter, Smart Materials in Architecture, Interior Architecture and Design (Basel: Birkhäuser, 2006).

[14] Roy Ascott, "Statement for The 9th Shanghai Biennale", Shanghai Biennale, 2012, accessed 29 November 2018 from http://www.shanghaibiennale.org/en/artist/detail_past/148/58.html

Acknowledgements

The work described in this paper was fully supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China [Project No. CityU16274416 Reactive Media Display]

Author Biography

Scott Hessels is an American filmmaker, sculptor and media artist based in Hong Kong whose artworks explore new relationships between the moving image and the environment. He produced some the first experiments in the fields of online streaming and locative media and has mixed cinema with a range of emerging technologies including computational sensors, robotics, GPS systems, and alternative forms of interactivity. His data-driven works have included partnerships with key science and government organizations, his films have shown internationally, and his new media installations have been presented in museum exhibitions focusing on both technology and fine art. His recognitions include patents for developed technologies, references in books and periodicals on new media art, and coverage in cultural media like *Wired* and *Discover*. He is currently an associate professor at The School of Creative Media and executive producer of the Extreme Environments Programme which organizes art/science expeditions to environmentally significant sites.

The "Piano-of-Lights": a visual-music instrument for FullDome display

Yan Breuleux, Rémi Lapierre
Université du Québec à Chicoutimi (UQAC-NAD)
NAD - École des arts numériques, de l'animation et du design
Montréal, Canada
ybreuleux@nad.ca, remi.lapierre1@uqac.ca

Abstract

Les Planètes is a "FullDome" immersive concert generated entirely in real time. The concert is made possible by the "Piano-of-Lights," an instrument that enables a visual dialogue with pianist Louise Bessette during a novel performance of the work *Les Planètes* from composer Walter Boudreau. The Piano-of-Lights' dynamic constellations of small spheres are projected across the space of the satosphere of the Society of Art and Technology (SAT) in Montreal. The visual shapes are based on an analysis of the different sections of the score. During this process, the Piano-of-Lights emits light particles, becoming a catalyst for the dynamic constellations distributed across the dome. The project blends the tradition of colour organs and the live A/V approach of digital technology, bringing together an analogue piano, digital recording and immersive projection. The originality of this research primarily lies in the use of a colour-piano, which was designed to create a synthesis of the colour-sound association in an immersive format.

Keywords

Sound and Music Computing, Live performance, Colour Organ, Virtual Colour Organ (VCO), Visual Music, FullDome, Environmental Storytelling, Immersive Media, Virtual Reality.

Introduction

The first *clavecin oculaire* or "Ocular Harpsichord" was invented by Father Castel to address criticism of the overly static dimension of painting. Starting in 1725, and throughout his life, Castel worked on designing a colour harpsichord that would make for "hearing with the eyes" and thus creating visual music [1]. As Kenneth Peacock has noted, the 18th and 19th centuries gave rise to much experimentation shaped by the colour theory of Isaac Newton [2]. It is worth pointing out that, in spite of his observations, Newton strived to align his theory with the notes in the musical octave [3]. The modern period, building on Father Castel, would be marked by the work of the master in this field, Alexander Wallace Rimington, who designed multiple versions of his light organ. Influenced by this research, Alexander Scriabin composed a synesthetic symphony, *Prometheus or the Poem of Fire*, which made its own light-music associations. The use of colour organs supported the composer's artistic and spiritual vision, and tended toward a Total Art project. According to Françoise Roy-Gerboud:

> "In this composition, he [Scriabin] uses the possibilities of all the arts, such as music, visual arts (colours and the art of miming), choreography and poetry" [4].

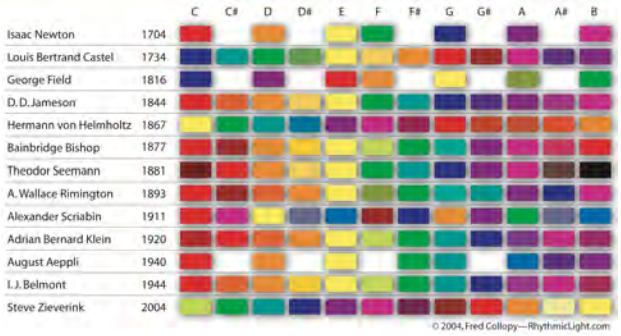


Figure 1: Three centuries of colour scales. © 2004 Fred Collopy - RhythmicLight.com (author permission)

Scriabin's aesthetic project was consistent with a synesthetic vision of performance involving a dynamic union of the senses of sight, smell, touch and hearing. The futurists would inaugurate the art of noise by building their own tools, such as "chromatic music" or Russolo's "rumorarmonio." In 1922, Raoul Hausmann devised his "Optophone" to be able to electronically transform light into sound waves and vice versa. In his own words, "Light is vibrating electricity, and sound is also vibrating electricity" [5]. Another striking instrument to emerge from continued experimentation was the famed organ-like "Clavilux" by Thomas Wilfred. Each section of the mechanical invention contained a series of sliding keys divided into three groups: shapes, colours and movements. A complex arrangement of lenses helped create movement animated by different rhythms. The device could be adapted to a musical score, and each light composition could be played on the instrument with a degree of artistic latitude [6]. The tradition of colour organs was continued in the field of analogue technology-driven video art with the creation of multiple devices that responded to sound amplitude and frequencies. Gene Youngblood, in his book *Expanded Cinema*, discusses this topic at length in a chapter entitled "Television as a creative medium." Of Nam June Paik, he writes:

> "In recent years Paik has abandoned his mixed-media environmental Happenings to concentrate exclusively on television as an aesthetic and communicative instrument" [7].

A musician by training, Paik always treasured music and the notion of instrument in his conception of art. This initiator of the Fluxus movement was naturally attracted to different forms of music visualization [8]. Using the video collage to this end, Paik adopted an intermedia approach in his projections, leading him to continually work at the frontier of all the arts [9]. The current of colour organs is vast, and is reflected in many trends of visual music. It is important here to emphasize that artists, developers, designers and researchers have never ceased working on this project of associating sound and light by means of the invention

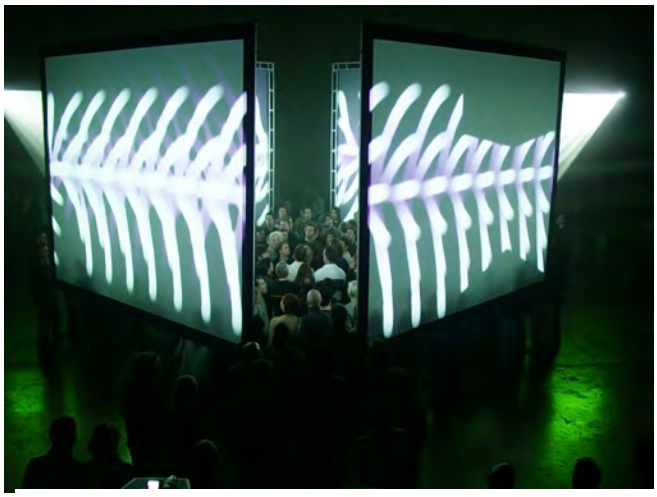


Figure 2: *Black Box*. Usine C, Ekektra Festival, Montreal. © 2003. Purform: Yan Breuleux, Alain Thibault

of synesthetic instruments. In an article recounting the history of the colour organ phenomenon, Kenneth Peacock concludes with the following reflection:

> "Although experimenters during the past two centuries hardly could have anticipated today's widespread use of laser light in combination with electronic computers, these marvellous inventions are, in some ways, refinements of earlier technological proposals for a viable colour-music instrument. Every generation, it seems, must re-discover and re-define the art of colour-music for itself" [10].

Indeed, the generation of digital art and A/V performance or Live A/V [11] artists has reinvented certain aspects of the light organ approach. The research of Golan Levine, in the context of his M.S. thesis at the Massachusetts Institute of Technology (MIT), has precisely examined such efforts. Levine abundantly refers to the colour organ current in connection with the conception of a real-time visual creation interface [12]. Along these lines, artist Edwin van der Heider [13] in the context of the Ondulations project from the artistic duo The Users [14] uses light to give visibility to musical structures. The Rutt/Etra raster-based analogue synthesizer (1973) used by artists Steina and Woody Vasulka has been reproduced in the shape of a plugin by V002 (Anton Marini alis vade & Tom Butterworth) [15]. Another example is the Simple Harmonic Motion project from the artist Memo Atken. Even if the performances do not specifically involve the use of a keyboard, this project clearly entails visualizing certain structures of musical rhythms [16]. The simulation is in keeping with the whole current of emulators or "soft synth" in the audio field. As part of the Canadian and international community of artists, and more specifically those gravitating around the Technical Arts Society (TAS) [17] and the Mutek [18] and Elektra [19] festivals, many artists such as Mathieu Lesourd, Louis-Philippe St-Arnaud, Éric Raynaud, Ouchhh Studio, Francis Théberge, Joanie Lemercier, Abstract Birds, Matthew Biederman, Kurt Hentschläger, Ryoji Ikeda, Herman Kolgen, Ryoichi Kurokawa, Ulf Langheinrich, Carsten Nicolai and more are taking an interest in sound visualization [20]. The Piano-of-Lights strives to contribute to this flourishing community of practice, which is carrying out research-creation projects as a means of studying different forms of sound visualization. However, even if this community is exploring the medium of immersion in relation to issues of sound visualization, it has not directly addressed the specific question of designing colour organs. Since 2003, the Purform duo, in collaboration with composer Alain Thibault, has been working on visual synthesizers via several projects such as Black Box (2003) and After Dark (2007). The project Les Planètes, based on a piece by Walter Boudreau, is a first attempt at systematizing the colour organ using a FullDome installation[21].

Les Planètes: score by Walter Boudreau

Composed and commissioned by Louis-Philippe Pelletier in 1983, *Les Planètes* was created on May 21, 1998 in Montreal's Bon-Pasteur Historic Chapel after a long and winding journey. The realization of the piece was jeopardized several times over the years for a host of reasons beyond the composer's control. The piece holds a unique place in the artist's works as it was composed over a very long period, with a 13-year "gap" from conception to final completion. As with the entire series of works that come under *Le Cercle Gnostique*, the piece is essentially described as an exploration in which characteristics of the nine main planets of the solar system (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and *Pluto) are transposed into music. Partly "calculated" long ago using a CYBER 7400 computer from the Université de Montréal computing centre, the music is exclusively informed and developed based on struc-tural premises that embrace a vast sonic and psychological range in which the delicate balance between form and substance, expression and impression(s), is both the theme and the object [22].

The Piano-of-Lights instrument

In his article on the history and origins of colour organs, Teun Lucassen gives the following definition:

> "A colour organ can be defined as an instrument which is able to simultaneously produce colour and music. The produced colours are based on the music by a certain mapping" [23].

The Piano-of-Lights transforms the score into an immersive format based on an analysis of the composer's vision for Full-Dome. It translates the abstract structures at the heart of Walter Boudreau's composition into virtual environments. Louise Bessette's playing is amplified so as to transform the energy of her performance into an immersive experience. The Piano-of-Lights is an instrument that creates worlds, generating multiple virtual spaces that enable the audience to see, feel and live the sounds in their material dimension. In this context, the sounds become objects materializing in sound visualization environments. The visuals are generated by the score, with the shapes forming abstract environments. The audiovisual objects offer the audience an open work in which they can imagine their own narrative space. The Piano-of-Lights uses the 88 keys of the Yamaha Disklavier concert piano to generate environments of animated particles, to bring various stage elements to life, and to modify the lighting. The instrument explores multiple forms of sound visualization, with a programming structure that allows it to bring visibility to multiple scores. The principle is always the same: to design procedurally generated environments that respond to the actions of the pianist. The Piano-of-Lights uses the entire colour scale from the Fred Collopy chart entitled "Three centuries of colour scales" [24] (Figure 1) in order to contribute to the re-

search on what Jack Ox is dubbing the "Virtual Colour Organ" (VCO). The goal is to imagine a "21st century virtual reality colour organ" [19]. According to Ox, the VCO can be defined as a visualization instrument:

> "The Virtual Colour Organ™ (VCO) is a 3D immersive environment in which music is visually realized in coloured and image-textured shapes as it is heard" [25].

Our project is based on the Touch Designer software programming environment. The goal is to contribute to the VCO field by means of a study on the spatialization of visual representations of piano notes within a Full Dome projection environment.

Environmental storytelling for FullDome

Environmental storytelling is based on a complex structure of interconnected virtual environments. The story emerges from the sensory aesthetics and the colour visualization of each planet. The objective is to translate Henry Jenkins' conceptual framework, Marie-Laure Ryan's narrative architecture [26], and the idea of spatialized narrative [27] in the service of the expressive potential of the FullDome medium. Our goal is to add the FullDome 3D space to the visual music colour organ tradition. The notes of the scores are three-dimensional objects that move around the dome surface or form objects. For example, depending on the note and the octave, some pulses produce the rings of Saturn. Each environment corresponds to the score's narrative logic while creating note-colour associations.

The visual music structure of the experience

In the context of the Piano-of-Lights, I designed a system that allows for rapidly putting in place different forms of mapping. The system is able to incorporate any association. This will make it possible to work with researcher-artists and composers in order to create various forms of association between the colours and the notes of the octave. The project is thus located between the artistic approaches of sound visualization and the tradition of colour organs. The correlations are sometimes immediate and directly correspond to the instrument's pulses, and sometimes less direct, responding to various logics. This said, the environments are assembled as follows. The first environment [Mercury] demonstrates the piano's system. Playing with the keys generates light shapes consistent with the Newton colour palette [28]. The second environment [Sun] portrays an eclipse, with the pianist's actions producing rays of light. The third environment [Re-Sun] projects a space of light turbulence. The fourth space [Venus] is

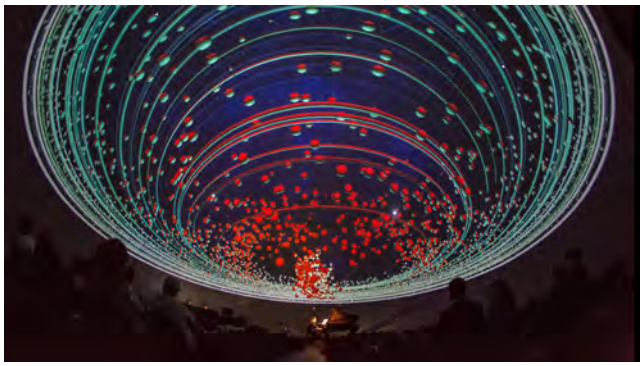


Figure 3: *Les Planètes*. Society for Arts and Technology (SAT). © 2018 Yan Breuleux

made up of spheres concentrically embedded in one another. The particles in the middle respond to the higher octaves whereas the vast spheres forming the circumference are activated by the lower ones. The [Earth] environment has the performer make a drawing in space, in sync with the inflections of the music. Then, [Jupiter] associates colours with the seven octaves of the musical scale, which are spatialized in the SATosphere. In the next environment [Saturn] (Figure 3), the generated notes are transformed into the rings of Saturn. The piano generates a column of light using a Remington colour palette. After an intense experience, [Uranus] scatters notes against stellar space, turning stars into sounds. Almost at the end [Pluto] displays the score by controlling light emissions. Each scene is the result of generating principles that bring visibility to the space of the score. The piece closes with infinite space as the audience is drawn into a chaotic interstellar void. The ISEA demo will display the piece inside a virtual environment using the HTC Vive Headset. We are showing our previsualization system. To control the environments with a midi score, the Disklavier piano is replaced with a computer. Our latest production, *Enigma*, takes up the tools of the Piano-of-Lights to create an A/V performance. The principle remains unchanged; midi input is associated with objects, which, taken together, form environments. This approach, introduced in 2003 with the Purform group and the Black Box project, leverages an iterative process based on the production of multiple objects in order to produce a visual synthesizer for immersive formats. Thus, consistent with the perspective of environmental storytelling composition, the system allows for adapting the project to a wide array of projection setups such as architectural video projection, multi-screen, poly-screen, virtual reality and FullDome. The overall idea is to design synthetic environments that serve as a springboard for experiences in a wide variety of contexts and installations.

References

[1] Anne-Marie Chouillet, "Le Clavecin oculaire du P. Castel," *Les Jésuites: Dix-huitième Siècle* 8, (1976): 141-166.

[2] Kenneth Peacock, "Instruments to perform color-music: Two centuries of technological experimentation," *Leonardo* 21, no.4, (1988): 397-406.

[3] Alan E. Shapiro, "Artists' colors and Newton's colors," *Isis* 85, no. 4, (1994): 600-630.

[4] Françoise Roy-Gerboud, *La musique comme Art total au XXe siècle. Son-couleurs-formes. Systémique et symbolique* (Paris, L'harmattan: Univers Musical, 2009), 130.

[5] Jean-Noël Von der Weid, *Le Flux Et Le Fixe : Peinture Et Musique* (Paris: Fayard, 2012), 29.

[6] Fred Colopy, "Color, form, and motion: Dimensions of a musical art of light," *Leonardo* 33, no. 5, (2000): 355-360.

[7] Gene Youngblood, and Richard Buckminster Fuller, *Expanded cinema* (New York: Dutton, 1970), 302.
[8] Holly Rogers, "The Unification of the senses: intermediality in video art-music," *Journal of the Royal Musical Association* 136, no. 2, (2011): 399-428.
[9] Man-Yong Song and Kim Chee-Yong, "Research on the Visualization of Music and Hypermediacy in Paik Nam-June's Video Art," *Journal of Korea Multimedia Society* 10, no. 12, (2007): 1687-1697.
[10] Kenneth Peacock, "Instruments to perform color-music: Two centuries of technological experimentation," *Leonardo* 21, no.4, (1988): 397-406.
[11] *Hors-Série,* "*LIVE A/V* Performances Audiovisuelles," *MCD, Musiques et Cultures Digitales*, (2010).
[12] Golan Levin, "Painterly Interfaces for Audiovisual Performance," (M.S. Thesis, School of Architecture and and Planning, Massachusetts Institute of Technology, 2000).
[13] Edwin van der Heide, "Lsp (2003)", Artist website, accessed April 13, 2019, http://www.evdh.net/lsp/
[14] Thomas McIntosh and Emmanuel Madan, "Ondulations (2002)", Artist website, accessed April 13, 2019, http://www.undefine.ca/en/projects/ondulation/
[15] Anton Marini alias vade and Tom Butterworth, "Rutt-Etra plugin (2009)", Artist website, accessed April 13, 2019, http://v002.info/plugins/v002-rutt-etra/
[16] Memo Akten, "Simple Harmonic Motion #5 (2011)", Artist website, accessed April 13, 2019, http://www.memo.tv/portfolio/simple-harmonic-motion-5/
[17] Society of Arts and Technology, "Les Planètes (2018)", accessed April 13, 2019, http://sat.qc.ca/fr/planetes
[18] Mutek Festival, accessed April 13, 2019, http://www.mutek.ca/
[19] Elektra Festival, accessed April 13, 2019, https://www.elektrafestival.ca/
[20] Il est possible de consulter de nombreux projets sur le catalogue de la Society of Arts and Technology (SAT). Online page, "Immersive Catalog", Society of Arts and Technology, accessed April 13, 2019, http://sat.qc.ca/catalog/
[21] Online page, Documentation and credits of "Les Planètes (2018)", Society of Arts and Technology, accessed December 10, 2018, http://sat.qc.ca/fr/planetes
[22] Description from Walter Boudreau (with author permission).
[23] Teun Lucassen, "Color Organs," *University of Twente [interaktyvus]*, (2008).
[24] Fred Collopy, "Playing (with) color," *Glimpse* 2, no.3, (2009): 62-67.
[25] Kack Ox and David Britton, "The 21st century virtual reality color organ," *IEEE MultiMedia* 3, (2000): 6-9.
[26] Henry Jenkins, "Game design as narrative," *Computer* 44, (2004): 53.
[27] Marie-Laure Ryan, Kenneth Foote, and Maoz Azaryahu, *Narrating space / spatializing narrative: Where narrative theory and geography meet* (Ohio State University Press, 2016), 266.
[28] Society of Arts and Technology, Online documentation of "*Les Planètes* (2018)", vimeo album, accessed December 10, 2018, https://vimeo.com/album/5622492

Author(s) Biography(ies)

Yan Breuleux is a professor at NAD-UQAC (École des arts numériques, de l'animation et du design à Montréal). He is also a researcher and practitioner in the field of visual music for immersive display. For 20 years, he has collaborated with musicians and composers to create multi-screen, panoramic, architectural projection and FullDome pieces. Since 1998, he has created powerful sensorial A/V performances as part of the PURFORM duo with the composer Alain Thibault.

Rémi Lapierre has a solid background in programming, graphic novelling, 3D modelling and video games. His multidisciplinary skill set gives him an in-depth understanding of advanced technical issues in software design as well as the expressive dynamics of digital creation. Rémi is currently devoting his efforts to automated virtual environment generation. He is a master's degree student at the NAD (École des arts numériques, de l'animation et du design).

Sonic Transformation with Living Matter

Sabina Hyoju Ahn
Tangible Music Lab, Institute of Media Studies
University of Art and Design Linz, Austria
hyoju.ahn@ufg.at

Abstract

Sonomatter (2017) is a sound installation and performance that transforms the bioelectrical signals from microorganisms into sound. This work starts with building Winogradsky Columns to make a small ecosystem out of mud and water and generate an electric signal with a Microbial Fuel Cell (MFC). As time proceeds, the microbes will create electricity and eventually die when they lack nutrients. A custom-designed *Bioelectricity-Controlled-Oscillator (BCO)* circuit converts the bioelectricity to sound at the same time, it consumes the (bioelectrical) energy to control the sound of the oscillator.
In this work, mud is seen as a matter that implies a circular relationship between life and death because life and death phenomenon happen in the same material. Mud takes in valueless things such as dead bodies and digest it into nutrients to grow living things. A poetics of microbial sphere can be described throughout the interaction between organic matters such as soil and water, and natural phenomenon such as respiration and oxidation in the mud. It describes a symbiotic relationship in a microcosm. The project is thus not only a metaphorical exploration of the interaction between living matters and natural phenomena, but it also explores the domain of energy harvesting as well as sonification.

Keywords

Microbial data transformation, BCO, sonification, biobattery, bioelectricity, control voltage, microcosm, Winogradsky Column, energy harvesting, dark fermentation

Introduction

Artworks using biomatters and living organisms have become very vigorous in recent contemporary media art. It seems to be a natural development stemming from an awareness of the ecological crisis, as well as the convergence of art and science which evolved into an artistic experimentation in new media and post media discourses. The concept of this project is post digital media – mixing different media [9] such as sound, analogue electronics, computer software and hardware and microorganisms – intertwine (wet) biological processes and (dry) technology [1]. In recent days, bioart is associated with technical and cultural boundaries of biology from speculative research to practical works. In this work, a biological material (soil/mud) has been translated into audible experience and this paper is to discuss its design and implementation as a work of art, *Sonomatter* where I utilize the bioelectricity, MFC, sonification and Winogradsky columns. Ecological perspectives such as sustainability of our biosphere, self-sufficient ecosystems, and energy harvesting domain are discussed as well. Also, I elaborate the audience responses from artistic presentations including festivals, exhibitions, talks and performances in Europe and South Korea.

Related Works

The theory of *Animal Electricity* by Luigi Galvani is the first scientific research about electrical potential in living organisms (1791). He discovered that frog legs twitched when a lightning rod is connected to frog legs.[7] Galvani's research around bioelectricity experiment was the origin of the current biosignal applications for medical purpose such as EEG, EMG and EOG.
In artistic musical works, Alvin Lucier premiered *Music for Solo Performer* in 1965. This piece uses an amplifier to pick up Lucier's brainwave signal to control the loudspeakers and percussion instruments. Lucier had to be in a meditational status in order for the amplifier to pick up alpha waves from his brain. Therefore, he explains sound as energy-controlled, non-deterministic translation which can be transformed by the performers' brain waves [5].
In recent times, there are many artworks of using MFC devices to implement bioelectricity. For instance, Gilberto Esparza used e-wastes and recycled it to make alternative energy in an urban environment contaminated by human beings. He found bacteria in severely polluted water in Peru and generated electricity to create light source for plants (algae). His work *Plantas Autofotosintticas (2014)* demonstrates an eco-friendly, self-sufficient, and self-energy circulation system that can generate photosynthesis from feedback.[4]
Guy Ben-Ary's artwork *CellF (2016)* uses cell's chemical activities (bioelectricity) to create an autonomous musical instrument. He extracted his own skin cells, turned them into stem cells, and then transformed them into a neural network. The neural network grew on a MEA (Multi-Electrode Array) system which has 60 electrodes and is connected to a custom-built analog synthesiser.[2]

Sonomatter

Sonomatter is an interdisciplinary project that uses a methodology from diverse fields: microbiology, sonification, MFC, and sound art. This project focuses on transforming a bioelectrical signal from soil bacteria into sound, connect-ing living matter to an analog circuit board and biological data to human perceptional experience. This project started with making a small ecosystem out of mud and water (Wino-gradsky Column) and measured the electrical signal with a Microbial Fuel Cell (MFC). A customized Bioelectricity-Controlled-Ociallator (BCO) has been designed to use bio-electricity to control the oscillator as a CV (Control Voltage). This work aims at creating a sonic transformation of living matters in real-time that can be a self-sustainable and reusable similar to a biobattery.

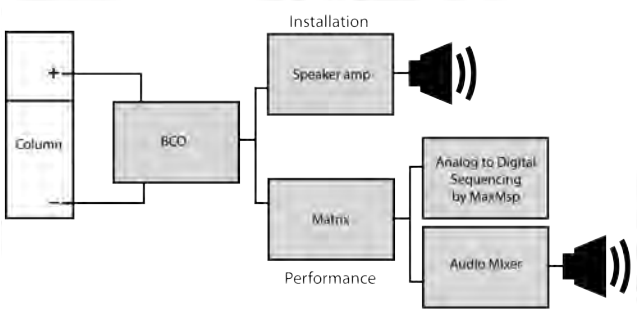


Figure 1: Sonomatter setup diagram for Installation and Performance.

Bioelectricity and Microbial Fuel Cell

Bioelectricity refers to electric potentials and currents produced by living organisms. A microbial fuel cell (MFC) is a device that converts bio-electrochemical to electrical energy by the metabolic activity of microorganisms. The bioelectricity is constructed by using an anode and a cathode. Most of MFC models have a membrane between two compartments, oxidation occurs on the anode side and reduction occurs on the cathode side. The electrical potential or charge occurs in between the anode and the cathode, and can be measured by connecting these two electrodes. This device is considered as *biobattery* that can store energy powered by organic compounds. A MFC device has been installed in each Winogradsky Column to create a complete self-harvesting energy system and to operate the BCO circuit that can variate the sound of the circuit. The variation depends on the amount of electrical energy (voltage, current) generated from microorganisms in Winogradsky Columns.

The bioelectrical signal from the soil microbes in a Winogradsky Column ranges from few millivolt (mV) to 1.127 volts (V) in my experiment and it maintains an average range between 0.5V and 0.7V for more than a year so far.

The bacteria grow based on two molecules – oxygen and hydrogen sulfide. And these two sections are also divided into anaerobic zone and aerobic zone. An anode is placed in anaerobic zone and a cathode is placed in aerobic zone, in the

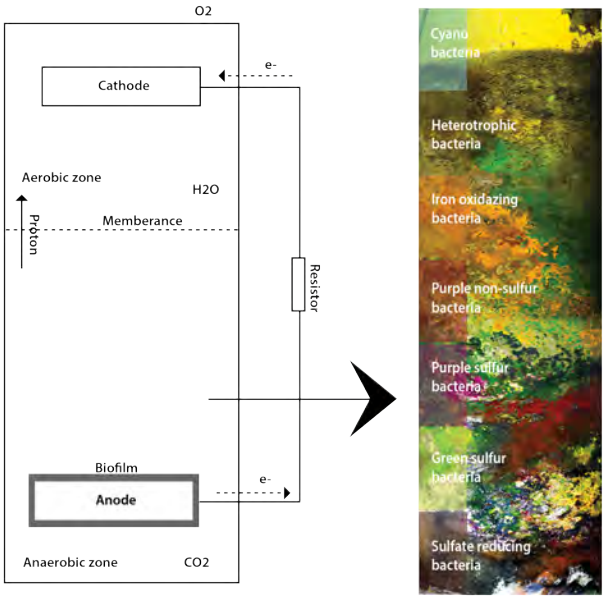


Figure 2: A MFC design and bacteria layers in Winogrdasky Columns.

water on the top of the columns. The MFC creates electricity basically by oxidation of bacteria on the electrodes which cause to form a biofilm. Higher power production was observed when biofilm formed on a graphite anode. To utilize higher voltage, *Sonomatter* uses 99% carbon felt electrodes. Carbon felt electrodes are used to avoid corrosion and chemical reaction from electrode material as well as to facilliate forming the required size. Bigger electrodes produce bigger current, but the size of the electrode is not related to the amount of voltage. I made different anode electrode sizes that has a thickness of 6.35mm. The sizes differ from 1cm x 1cm to 8cm X 8cm.

Winogradsky Column and Microbial Fermentation

In this project, soil bacterial activity demonstrates the self-regulation between different kinds of bacterial growth based in anaerobic zone and aerobic zone. The whole fermentation process in the mud shows a significant amount of life activities that can illustrate a prosperity of microscopic world.

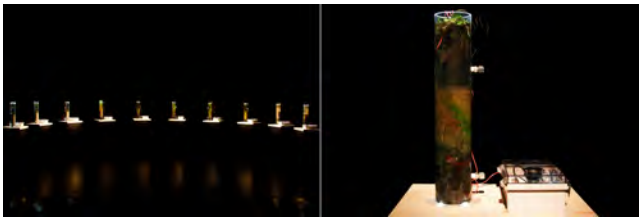


Figure 3: Sonomatter installation in Seoul, South Korea. Photo by Sey Parc.

In order to culture different types of microorganisms, I made Winogradsky Columns invented by Sergei Winogradsky (1856-1953) [3]. Winogradsky column is a microbial garden that can grow a much larger number of microbes than normally found in nature. For this project, I designed custom-made transparent cylinders, and made ten columns measuring 50 cm in height in South Korea and ten columns measuring 30 cm in height in Netherlands and Austria. In order to make a mud base, I mixed mud with carbon sources such as newspapers and sulfur sources such as egg yolk and cheese. The rest of the bottle is filled with collected mud and water. After incubating these columns under sunlight for one to three months, it goes through chemical processes that allow the growth of different microorganisms such as Clostridium, Desulfovibrio, Chlorobium, Chromatium, Rhodomicrobium and Beggiatoa, as well as many other species of bacteria, cyanobacteria, and algae – colors can be visible to human eyes. [6]

Sonic Transformation and Bioelectricity-Controlled-Oscillator (BCO)

A methodology of sonification is used for translating the electrical energy of microbes into sound, with a focus on transforming imperceptible data to acoustic signal. In order to perceive the micro-bacterial activity, I developed a module, called BCO that can convert the bioelectricity into sound in audible scale. In the process, I tried to avoid using computational processes and artistic compositional decision to minimize the manipulation on the data of the bioelectrical signal. As a result, the BCO is different from signal processing in computational environment. A physical circuit board translate the biosignal from microbes through an amplifier and an oscillator with simple controls. It has two knobs to control the amount of electricity from microbes and pitch of the oscillator.

Figure 4: Circuit box. Photo by Sey Parc.

In terms of a mechanical design of the BCO, it uses bioelectricity as control voltage to operate an oscillator. Control Voltage (CV) is a direct current (DC) electrical signal, used to control the values of components in analogue circuits the same function as any other electronic music instruments such as synthesizers, drum machines and sequencers.
In the circuit, I placed an instrumentation amplifier chip for amplifying bioelectricity. The amplified energy is connected to a Hex Schmitt oscillator chip and the amount of bioelectrical voltage influences the pitch and duration (pulse).
For the performance setup, I use these two potentiometers and a matrix interface (DIFAS) developed by Lex van den Broek [8] for sequencing with ten columns. This device can convert analogue signal to digital signal, and the incoming signal to BCO circuit can also be routed to the computer musical software MaxMsp. This setup is only for the performance to make fast sequencing between columns. For the installation, no additional computer musical software is used and the sound comes from the built-in speakers of the circuit boxes.

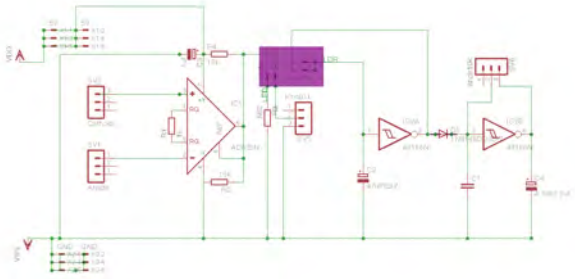


Figure 5: The BCO circuit consists of two parts: oscillator (CD40106BE) and instrumentation amplifier (AD620). There are two potentiometers (1K Ohm, 10K Ohm) to control the energy and pitch respectively: one to control the amount of energy from the bioelectricity and the other one is for the pitch of oscillator.

Figure 6: Matrix: Digital Interface for Analog Signals by Lex van den Broek. Photo by Sey Parc.

Artistic Representation

Sonomatter has been shown in many different artistic events such as exhibitions, festivals and performances in South Korea and Europe. I typically utilize five to ten columns. I have found that the sound is getting slower as time proceeds because microbial process takes more time to generate electricity than normal electricity generation. However,

after disconnecting from the circuit for eight to ten hours, bio-electricity level is back to normal value.
For the performance, I tested several different setups with and without a visual projection. For the sound, I controlled the pitch and pulse by controlling the amount of bioelectri-cal energy from microbes of each columns. Also, by adding more bioelectrical energy such as putting my fingers or dis-connecting and connecting a cathode, the value of bioelec-tricity is changed and this is directly connected to the sound. The higher voltage makes faster pulse and the lower voltage makes the slower pulse. For the visual element, I used an en-doscope camera to project flickering LED lights and explored the interior of the columns. LED lights are placed under a wooden frame which made for mounting a column and it is synchronized with audio signal.

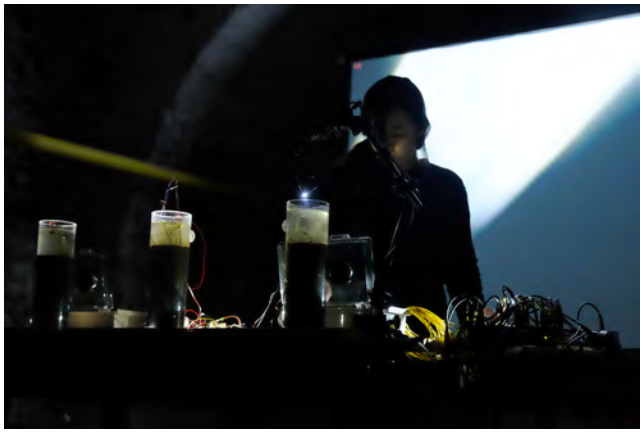


Figure 7: Sonomatter performance in Linz, Austria. Photo by Florian Voggeneder.

I have also performed a toxicity test. After injecting 1mm of Clorox onto the anode, the voltage dropped immediately to almost zero and the BCO circuit could not measure any voltage from microbes. However, the voltage value is gradually increased and reached its normal value again after two days. I tried to use this dramatic change during the performance, but I decided not to add this to maintain the columns for a long time.
The responses from the audience of my work is positive. Also, people remained in the exhibition space for a longer duration of time as the sound from each column made harmony and echoed magnificently, creating a certain meditative atmosphere. I also sometimes guided the audience to interact with bioelectricity from the columns by touching the surface of water or the cylinders. Such interaction can make different speed of sound instantly. In doing so, audience can understand how the mud makes the sound through the circuit.
The audience from the sound and music domain wanted to focus on the details of a sound structure. They preferred to listen only to the sound instead of the visual projection. An electronic music teacher in the Netherlands said a sonical dynamics of this work is interesting because it is from a very small range of scale, normally between 0.6v and 0.7v. Also another member of the audience in South Korea has said that the performance was like a microbial orchestra where I was the conductor controlling the each individual column, similar to being a pet trainer.

Figure 8: The audience after performance in Seoul, South Korea. Photo by Sey Parc.

Acknowledgement

This project was funded by Seoul Metropolitan Government, Seoul Foundation for Arts and Culture, Munllae Arts Plus 2016. https://sabinaahn.com/sonomatter

References

[1] Ascott, R. 2006. Planetary technoetics: Art, technology and consciousness. *Leonardo* 37:111–116.

[2] Ben-Ary, G., and et al. 2016. cellf: a neuron-driven music synthesiser for realtime performance. *International Journal of Performance Arts and Digital* 12:31–43.

[3] Corner, T. 2006. Ecology in a jar. *The Science Teacher* 59:32–36.

[4] Esparza, G. Plantas autofotosintticas. http://prix2015.aec.at/prixwinner/16228/.

[5] Kahn, D. 2013. *Earth sound earth signal*. Berkeley, Calif: University of California Press.

[6] Moshynets, O., and et al. 2013. From winogradsky's column to contemporary research using bacterial microcosms. In Harris., C. C., ed., *Microcosms*. New York, United State: Nova Science Publishers INC.

[7] Ortiz, M. 2012. A brief history of biosignal-driven art: From biofeedback to biophysical performance. *eContact! Biotechnological Performance Practice / Pratiques de performance biotechnologique* 14 (2).

[8] van den broek, L. Complex (vc-spg)– an opensoundcontrol (osc) and voltage controlled signal path generator (masters thesis). https://www.researchcatalogue.net/view/353107/353108.

[9] Weibel, P. Mute the post-media condition. http://www.metamute.org/editorial/lab/post-media-condition.

MYSTERIOUS CHINESE MOVABLE TYPE PRINTING FRONM TECHNOLOGY TO ART

Haoyi Zhang
Tianjin Normal University No.393, Extension of Bin Shui West Road, Xi Qing District. Post Code: 300387
Tianjin, China
Email: haoyizhy@163.com

Abstract

This research explores and analyzes the technical and artistic forms of the Chinese movable type printing in the ancient and our contemporary new media arts. In the ancient civilizations of the world, the mysterious and ancient Chinese movable type printing technology played an important role applying various materials and producing a large amount of prints. In society, it has also created a new kind of labors and professions providing opportunities for women. Since the industrial revolution, the technical function of movable type printing has been replaced by new technical improvements, but its hidden artistic functions have been noticed and explored by many artists. Now, many digital media arts use the form and method of ancient movable type printing, shining in advertising, stage performances and artificial intelligence.

Keywords

Movable Type Printing, Digital Media Art, Thinking Art

Introduction

Along with the development of economy and science, many ancient handicraft skills were replaced by the rapid technology. They are leaving the stage of history. But the mysterious Chinese movable type printing has revived a new vivid life with a variety of artistic forms nowadays. We can find its prototype in many digital media arts.

Mysterious Chinese movable type printing

The development of Internet symbolic language is cross culture.

Technical: according to historical records, the movable type had been invented in China four centuries prior to Johannes Gutenberg in Mainz. In the eleventh century, Bi Sheng (990-1051) developed earthenware movable type, which was arranged into an iron frame lined with paste to secure the fonts during the printing process. In the fourteenth century, records by Wang Zhen (fl. 1290-1330) cite the usage of wooden movable type, "with bronze and other metals being used in the process by the late fifteenth century".[1] The 2010 Wooden movable-type printing of China was selected into the Intangible Cultural Heritage List of Continuing Protection announced by UNESCO. In China, wood using has a long history, especially in technology.

1 Thomas S, Mullaney, The Chinese Typewriter: a history (Cambridge, MA: MIT Press,2017), 81-82

If we would like to know the ancient techniques of Chinese wooden structures, there is an application in mobile phone named "Wood Joints", in it we can know the maturity of Chinese wood technology. (Figure1).

Figure1. The mobile phone application "Wood Joints". © Copyright the Artist.

We can also understand that through the app those wood products have almost perfect maturity in the following aspects: 1. Every object is small and delicate enough; 2. The connection between articles is tightly combined, no nails are needed; 3. Installation and disassembly are very flexible; 4. A variety of product types and forms. So, the wooden handicraft products represented by Wood Joints, the technology has promoted the invention and development. More and more elaborate handicraft products in ancient China, they all use wood as raw material and represent the brilliance of an era of Chinese wooden products.

In historical records, it can be found that wooden movable type printing technology has developed very widely and mature. From the case (Figure 2), this is a printed font group, which shows that there are different fonts and different sizes. At that time, wooden technology has been deeply developed and widely used in society. Among the Microsoft Office Software fonts used by users all over the world. The Chinese font "Song Style"(宋体) comes from the Song Dynasty in China. As shown in figure2, which is the prototype of the "Song Style" font, with the passage of time and constant updates, it developed into the simplified version.

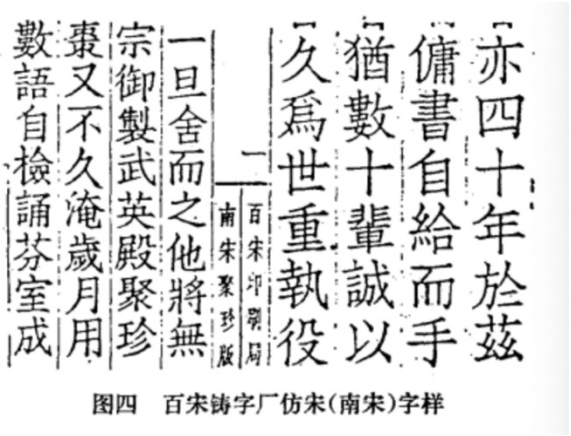


Figure2. The origin of movable type printing. ©Copyright the Artist

Sociality: first, the development of technology always gets too much attention, however, movable type printing is another important role to play in the field of society. In agricultural society, movable type printing creates the jobs in handicraft, which is a major breakthrough. Form it, we seem to find the beginning of the industrial society. It provides a new labor position, opens a new career. It is an important innovation of that era. Second, enhance China's position in the world. The movable type printing and Compass (the Warring States Period), the Paper-making technique (the Eastern Han Dynasty), the gunpowder (the Eastern Jin Dynasty) are side by side for China's four major inventions. They have changed the appearance and situation of many things in the word., such as war and navigation. China has attracted the attention of the world once again. (Figure3)

Figure3.Roles and tasks in Commercial Press typewriter manufacturing plant. ©Copyright the Artist

Magic artistic movable type printing in the modern society

Now movable type printing has change dramatically, its technical functions have great reduced, and the artistic function has been more and more attention. Among so many fields it shows the wonderful imagination of digital media art, such as in stage performance, commercial advertising, artificial intelligence.

Firstly，the evolution of art. Among the modern digital media fields, artworks made in the form of movable type printing have more symbolic features. At the opening ceremony of the 20008 Beijing Olympic Games, (figure 4) three-dimensional printing element is composed of hundreds of actors, activities of man bump ups and downs, like movable type plates in printing. 2008 famous actors formed a square matrix, using a Chinese character "he" to show the world one of China's four ancient inventions, movable type printing. It has won great success on the content and visual. Formed a visual identity with a clear theme. Here, the movable type printing has become a media art in which technology and art are intertwined. It has the aesthetic appeal of modern society. At the same time, the exaggeration of art was carried out, which is from the small single one expanded to the big size. The size is one person, and grouped in groups of many persons. From one to combination, the mystery and variety of movable type printing are reproduced formally.

Figure4. The 20008 Beijing Olympic Games. ©Copyright the Internet

From this case, it shows the development of digital media art and creative industry, the transformation and extension of globalization culture. Integrate new media technology into cultural heritage experience, explore ways to gather interactive experience, and adapt to the ephemeral nature of contemporary culture. At the same time, from this kind of live performance, we can find more temperature and more depth. It seems that the ancient movable type printing shared the same space and time with us. Dialogues between ancient and modern, we can truly feel the power of culture to influence digital media art. With the help of modern science and technology, the ancient cultural heritage can redisplay its colorful colors and vivid charm. This is the gentlest response to modern people. All over the world are protecting the ancient history and culture more serious.

Secondly, three- dimensional expansion. From 2004 to 2017, Coca-Cola's billboards in New York's Times

Square have never changed. But on August 8th, the billboard three-dimensional moving up. Consisting of 1760 pieces can be independent mobile LED screen, about 21 meters high, 13 meters wide. (figure5) This commercial simulates the forma of movable type printing, continues to use three-dimensional form with modern digital technology. As a symbol of Coca-Cola culture, it is not just a simple advertisement, but also a magical art. Using the communication function of media art, Coca-Cola was showing once again to the audience. All of everyone are full of surprises and love it.

Figure5. The Coca-Cola Advertising. ©Copyright the Japan Design Station

Through this commercial, we get the important information, now is the era of digital media art. We live in the media space, and art relate to the media closely. In the past, when people lived in the era of architecture, they used architecture to express art. Later they lived in the era of plane and painting everything. Now, in the era of media, media art is the art that we care about and love.

Advertisements have strong rules and performances. After a long period of cultural accumulation, they form a relatively strong style. But the Coca-Cola case is different, it expresses the relationship between media art and user experience. Breaking the traditional rules, combining some interdisciplinary elements. These elements are product and media, advertising and life, technology and tradition and so on. Such innovation not only enriches the expressive force of advertisements but also changes people's traditional habits and cultural concept. Digital media art reinforces modern art and new ideas. It's not just a formal breakthrough from two-dimensional space to three-dimensional space. Because of so many commercials in our life, people often ignore them, but the Coca-Cola digital media AD in Times Square must be full of joy. So, everyone will to spent time to pay attention. This is a great success in combining digital media art with advertising.

Thirdly, the art understand movable type printing is more interesting and creative. In animation of "*Big Hero 6*" the actor boy's invention took advantage of the relationship between" single independent elements" and "rich changes" and "accumulation" in movable type printing. Such a robot has won so curiosity and attention from the audience, enhancing the fun and competitiveness of the animated film.

Life is aesthetic，thinking art is future

In the book of *Performing Live* Richard Shusterman mentioned the practical aesthetics theory essence. "All kinds of life experiences and life problems, all of them will make the aesthetic observations exude a keen and beautiful light. At the same time, he also pointed out the way for life, that is the construction of art."[2]

First of all, the ancient Chinese movable type printing technology, not only based on the printer, computer invention of modern society, has become more prototype assembly line manufacturing work. Secondly, in the southeast Asia, Japan, Korea, Vietnam, also were reference to similar movable type print development way, and all earlier than the western countries. Thus, both ancient and modern, China, Japan and Korea are close to the national cultural exchange is very frequent. Thus, culture and art, is understand the charm of ancient technology deeply. In the future, humans will explore more artistic and aesthetic life, the meaning of life is not only production, art is life.

Figure6. The shock beauty of Chinese movable type printing. ©Copyright d2ziran

The aesthetic significance of digital media art and thinking art

First, only by placing art in the context of society and history, and considering fully its political, economic and cultural factors, art and aesthetics can be truly understood. In today's era, digital media art fully understands the meaning of elements such as technology, art, media and aesthetics. Combine them freely and realize a variety of works of art. From art show to advertisement, to movies and animations. Thus, digital media art. Then, digital media art combines art and life perfectly. We not only understand the technical methods of human writing and recording by understanding ancient printing, but also try to understand the way the ancients invented and recorded. To today, digital media art has extent technology to the diversify art. It combines media methods, cultural spirit, symbolic meaning. It constants creation, experimentation and continuous integration. Make human's life beautiful.

Art is an imaginative activity. Thinking is a decisive role in aesthetic dynamics, and it is the most active element of psychological experience. Thinking is the key to artistic creation. In the process of aesthetic creation, by the specific form of media, materials and rules, thinking is presented the artistic creation. Real art exists in the thinking structure of the subject. According to its life experience and the emotion at that time, it evolves into a new art form.

2 Richard. Schusterman, Aesthetic Alternatives for the Ends of Art (Beijing: Beijing University Press,2001), 253.

In summary, life is art, and art is based on human brain imagination. There are some elements influence people's judgment of art, such as the times, human thinking activities. Therefore, a variety of artistic styles combining digital art media with ancient printing techniques were born. Not only enriched life, but also opened up the way of thinking.

Conclusion

From the perspective of ancient and mysterious movable type printing, this paper discusses the origin, inheritance, innovation and relationship of human living. The type of movable type has been carried with traditional Chinese elements in modern design, art, stage performance, decorative background, artificial intelligence and other fields. With the rich expression of digital media art, it provides more opportunities for the life of human's feeling and enjoying art. In the field of culture, digital media make movable type printing culture continue and inherit, which is more and more important. Movable type printing carries the cultural exchange and spirit of history, China and all of the word. Art is aesthetic, art is life, art is a community of human destiny, art is a cultural reappearance. From these, we need to generate more ideas, in the future, we will use these ways of thinking, apply it, develop it, and explore the relationship between human thinking art and life design. Perhaps this is the artistic essence of the digital media art we are pursuing.

References

Books

[1] Thomas S, Mullaney, *The Chinese Typewriter: a history* (Cambridge, MA: MIT Press,2017), 81-82

[2] Richard. Schusterman, *Aesthetic Alternatives for the Ends of Art* (Beijing: Beijing University Press,2001), 253.

[3] Shanghai fourth army history research institute printing and printing branch, *The origin of movable type printing* (Beijing: Printing Industry Press,1990),79

[4] James E. McClellan, third, Harold Donne, *Science and technology in world history* (Mingyang Wang, Trans) (Shang: Shanghai Science and Technology Press,2003),14

[5] Xiumin Zhang, *History of Chinese Printing* (Hangzhou: Zhejiang ancient books publishing Press,2006),137

[6] Xiumin Zhang, Hanqi, History of Movable Type Printing in China (Beijing: Chinese Books Press,1998),86

[7] Jixing Pan, *The Four Great Inventions of Ancient China: origin, spread and world influence* (Hefei: University of science and technology of China,2002),125

[8] Cunxun Qian, *Chinese Paper and Print Culture History* (Guilin: Guangxi Normal University Press,2004),94

[9] Yangjing, Youjin Huang, *Ruian Dongyuan Reproduces Wood Type Printing* (Hangzhou: Zhejiang University Press,2011),105

[10] Jixing Pan, *History of Chinese Metal Type Printing Technology* (Shenyang: Liaoning science and technology Press,2001),206

Edited Books

[11] Jinbo Shi, *The Earliest Movable Type Printed Matter in the Word: Xixia Movable Type Printing* (Beijing: Beijing Library Press,1997),26

Journal article (online)

[12] Liushan, Shaoxin Luo, "Interactive Design in Print" *Packaging Engineer*, Vol. 32, No. 14, accessed July 28, 2011, http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFQ&dbname=CJFD2011&filename=BZGC201114008&v=MDI0NjRi Ykc0SDlETnE0OUZiSVI4ZVgxTHV4WVM3RGgxVDNxVHJXTTFGckNVUkxLZVplZHJGaS9rVnIzQUp6Zk0=

[13] Lijuan He, "Product Design on the Perspective of Semiotics" *Journal of Shanxi Vocational College of National Defense Industry*, No.4, accessed June 15, 2008, http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFQ&dbname=CJFD2008&filename=GZSG200802007&v=MDYwND haZWRyRmkvbVU3dkFJamZZYWJHNEh0bk1yWTlGWTRSOGVYMUx1eFlTN0RoMVQzcVRyV00xRnJDVVJMS2U=

[14] Shengjian Xue, Weiwei Tang, "Research of the Visual Promotion of National Image of China in the Beijing Olympic Games" *Packaging Engineering*, Vol.32, No.16, accessed August20,2011, http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFQ&dbname=CJFD2011&filename=BZGC201116028&v=MTUyOD VMS2VaZWRyRmkvbVc3M0pKemZNYmJHNEg5RE5xWTlIYklSOGVYMUx1eFlTN0RoMVQzcVRyV00xRnJDVVI=

[15] Chuangjian Yang, Xueli, "Analysis of Chinese Traditional Cultural Elements on the Opening Ceremony of Beijing Olympic Games", *Movie Review*, No. 9, accessed May 8, 2009, http://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFQ&dbname=CJFD2009&filename=DYPJ200909057&v=MTg0MjBJ VFRiWkxHNEh0ak1wbzlBWTRSOGVYMUx1eFlTN0RoMVQzcVRyV00xRnJDVVJMS2VaZWRyRmkvblViek0=

Author Biography

Personal:

Haoyi Zhang is working in Tianjin Normal University, lecturer of the College of Fine Arts and Design.

Education:

MA in Science Multimedia and Entertainment Technology, The Hong Kong Polytechnic University.

BA in Digital Media Arts, Communication University of China.

Academic Research:

Digital media arts, Communication, Gender arts.

Touched, a penumbra keyboard projection

Paul Sermon
School of Art, University of Brighton
Brighton, United Kingdom
P.Sermon@brighton.ac.uk

Abstract

The underlying research for this paper recalls the development and presentation of telepresent installations 'Telematic Dreaming' and 'The Telematic Séance' from 1993. Twenty-five years on I produced the installation 'Touched', exhibited in the Digital Encounters Show for the British Science Festival in 2017. Technically, 'Touched' worked in exactly the same way as 'The Telematic Séance', its layering of keyboard projection, text and image explores a new telematic experience of intimacy where the meaning of the type becomes dependent on the richness of touch. The paper compares this with Myron Krueger's founding 'Metaplay' experiments in the late 1970s involving touching hands on a telepresent screen and the findings of the proprioceptive 'Rubber Hand Illusion' developed by Psychologists Matthew Botvinick and Jonathan Cohen. These comparisons concur with the phenomenological outcomes participants experienced in 'Touched' where a greater sense of empathy emerges through a shared space of mutual presence.

Keywords

Telematic, installation, telepresence, proprioceptive, chat, interface, keyboard, cognitive, illusion, intimacy.

Touched, a penumbra keyboard projection

This recent telematic installation 'Touched' converges space and distant audience participants in a third space telepresent environment. The project focuses on the kinaesthetic and proprioceptive nature of audience participation involving a keyboard projection and an online chat conversation. The underlying research for 'Touched' recalls the development and presentation of 'Telematic Dreaming' in June 1992, an experimental telepresence performance installation produced for the 'Koti' exhibition at the Kajaani Art Museum in Finland, curated by Marita Liulia and sponsored by the Finnish Telecom. Shortly after the development of 'Telematic Dreaming' I returned to Finland in 1993 to produce a new installation 'The Telematic Séance' for the exhibition 'Interactive Garden', curated by Erkki Huhtamo at the OTSO Gallery in Espoo, Finland. The installation was derived from the telepresent concept of 'Telematic Dreaming' allowing two distant people the opportunity to coexist at the same séance table. What had explored a telematic extension of body scheme through a life size digital other on a bed was used in 'The Telematic Séance' to new effect; echoing ideas of Spiritual Telegraphy in the 1900s that compared the invention of the terrestrial telegraph to connections with the afterlife. Technically the installation functioned in exactly the same way as 'Telematic Dreaming', but it was conceptually problematic for the participants involved. The title and séance context was too restrictive, limiting the potential agency within the piece and leaving the participants uncertain about what was being inferred. Twenty-five years on I produced the installation 'Touched' in 2017, which technically worked in exactly the same way as 'The Telematic Séance', but in this new work the implications were more open. 'Touched' involved a computer screen and keyboard, where the projected hands of one person appear on the keyboard of another's. The hands meet, touch and type together on this penumbra keyboard surface, whilst also appearing as a live computer desktop image upon which a simple command line chat interface is overlaid (see figure 1). This layering of keyboard, text and image explores a new telematic experience of intimacy where the meaning of the type becomes dependent on the richness of touch.

Figure 1. Camera capturing image of participant's hands on the keyboard below in 'Touched'. © Paul Sermon.

'Touched' was exhibited in the Digital Encounters Show at Horatio's Bar on Brighton Palace Pier for the British Science Festival in Brighton from the 5th to 9th September 2017. Using standard video cables the installation was linked between two disclosed blacked out booth spaces in the bar, approximately 6 metres apart. Horatio's Bar and its secluded ornate drinking booths, complete with tables and

velvet seating afforded an apt environment; its fake Edwardian interior assumed a context suggestive of a 'spiritualist' encounter of the 1900s, whilst its contrasting 1980's fabricated exterior provided a postmodern twist to the show.

Figure 2. Projected hands of the remote 'Touched' participant on the other participant's keyboard. © Paul Sermon.

The installation consisted of a keyboard and computer screen on a table with a video camera situated directly above it, picking up a birds eye view of the table top and keyboard below. This image was sent to a video projector and projected directly down onto another table and keyboard at exactly same scale and location as the original (see figure 2). A video camera situated next to the projector picks up an image of the projected keyboard and the aligned actual keyboard and sends it to desktop computer screens on the tables in each of the booth spaces. A Unix command line chat interface is then composited on top of the live video image allowing the two separate participants to communicate via text over a Secure Shell (SSH) connection (SSH also known as Secure Socket Shell, is a network protocol that gives users, particularly system administrators, a secure way to access a computer over an unsecured network). This provided a very simple raw text-messaging interface overlaying the live video image (see figure 3), without any further distracting interface design. As each person begins to type and chat his or her hands meet and visually mix on this telepresent keyboard surface where dialogues, games, and encounters unfold.

Whilst on the one hand it is a completely simple set up it is on the other an entirely new physical encounter; echoing palmist conversations that suggest the convergence of virtual spirits and contemporary digital chat-room environments composited on screen. Our typing hands do not normally have any further role or function other than pressing keys, but 'Touched' turns our webcam chat attention away from our talking heads to focus on our hands, located on a shared telepresent keyboard, as a backdrop to a new space of remote intimacy. A space that was once the domain of textual exchanges now becomes the space of performance, abstract poetry, and handheld encounters as a new sensation of being touched by text. The Brighton Pier venue and British Science Festival event attracted a diverse range of participants, from academics, local families and teenage groups to seaside day-trippers and the occasional hen party. No one really knew what to expect, many participants were initially shocked and surprised, finding the opportunity to type messages a reassuring way of sharing their alarm. But playful encounters then unfolded. Participants played with aligning the keyboards, using them as props, as well other objects they might have on their person. One participant referred to it as 'keyboard ballet' in a text message. Hand clapping games and 'rock-paper-scissors' were also attempted, as well as the occasional rude hand gesture. Some people used their mobile phones to take and show photographs to each other. It also included putting their heads on the table, where profiles could meet and kiss. And it proved a good opportunity to discuss nail polish as well as a sense of proprioception. One member of a hen party turned up with a pack of Tarot cards, she moved the keyboard to one side and proceeded to make 'telepresent readings' for other members of the group. The table top alone provided an open platform to develop endless opportunities for engagement. The agency in 'Touched' was exploited in its secluded setting and contrasting context that was simultaneously artwork, invention, amusement and fantasy.

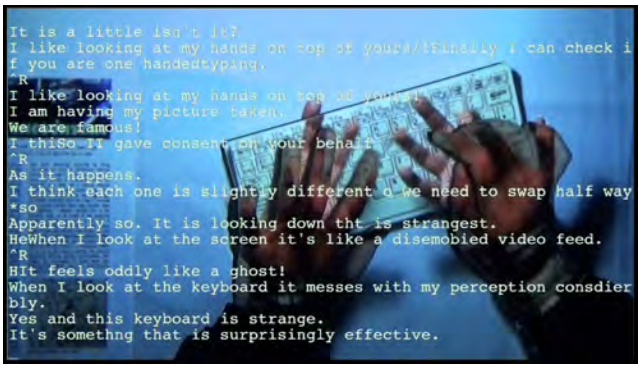


Figure 3. Video still of line out video feed from installation, with Unix chat interface overlaid on converged hands. © Paul Sermon.

In 1983 pioneering interactive digital media artist Myron Krueger wrote about his initial founding 'Metaplay' experiments in the late 1970s (Krueger 1991 [1983], 34) and the unexpected telepresent outcomes that led to his later VIDEOPLACE installations in the 1980s (Krueger 1991 [1983], 34–64). The encounter he described in those early experiments involving touching hands on a telepresent screen completely concurs with the phenomenological outcomes participants experienced in 'Touched'. Myron Krueger and his colleague were on the telephone discussing a waveform.

"After a few minutes of frustrating discussion, we realized that we had a far more powerful means of communication available. Using a two-way video link we turned the cameras on ourselves seated at our respective computers.

As we did this, we used our hands to point to various features on the composite display (…). It was exactly as if we were sitting together at a table with a piece of paper between us. After a while, I realized that I was seeing more than an illusion. As I moved my hand to point to the data my friend had just sent, the image of my hand briefly overlapped the image of his. He moved his hand (…). I was struck with the thought that he was uncomfortable about the image of my hand touching the image of his (…). The inescapable conclusion was that the same etiquette of personal space and avoidance of touching that exists in the real world was operating at that moment in this purely visual experience." (Krueger 1991 [1983], 34)

Both the awkward intimacy that Krueger experienced in 'Metaplay' and the converged images of hands and fingers playing, dancing and caressing upon the keyboard in 'Touched' are clearly present in the findings of proprioceptive experiments in other discourses, namely the 'Rubber Hand Illusion' developed by Psychologists Matthew Botvinick and Jonathan Cohen from Pittsburgh in the early 1990s. This now classic 'body transfer' experiment was performed on myself by a team of neuroscience researchers from the University of Manchester in 2003. I was positioned at a table so that one of my hands was out of sight under a small wooden bed tray, with a black tablecloth draped over it, from my shoulder to across the table. However my hand was still visible and accessible to the researcher sitting opposite me. A rubber hand was then placed on top of the tablecloth approximately 30cm to the left of my real hand, conceivably connected to my own arm under the draped tablecloth. The researcher then gently stroked both my hidden hand and the visible rubber hand simultaneously with a paintbrush in each of their hands. As I focused on the rubber hand in front of me the neuroscientist synchronously stroked the same parts of each hand, along each finger and across the back of my hand. After about 10 minutes I was then asked to close my eyes and with my other hand point towards the index finger of my hand resting on the table. I pointed directly at the index finger of the rubber hand, which had clearly been incorporated into my own body scheme through this experiment. The same conclusive results also occurred extensively in the original 'Rubber Hand Illusion' experiment (Botvinick and Cohen 1998, 756). What Maurice Merleau-Ponty identified as the 'extension of the bodily synthesis' in 1945 (Merleau-Ponty 2012 [1945], 154) is now commonplace in what neuroscience and cognitive science refers to as 'body transfer' or 'body ownership' through experiments such as the 'Rubber Hand Illusion', as well as discussions on virtual reality and presence research.

It is this unique sensory experience that offers my biggest contribution to knowledge in the field of interactive media arts, but from a public engagement perspective it provides most impact on those participating directly in the work, where a greater sense of empathy emerges through a shared space of mutual presence. At its most basic, the act of moving our eyesight from the internalised position in our head to a third-person view outside of our own body offers an entirely new sense of self and conscious experience. Combined with another (geographically distant) participant, that objective sense is shared and co-experienced, paving the way for a greater sense of empathy between them.

References

Botvinick, Matthew, and Jonathan Cohen. 1998. "Rubber hands 'feel' touch that eyes see." In Nature, Vol 391, 19 February 1998, 756. Macmillan Publishers Ltd.

Heidegger, Martin. 2001 [1953]. Being and Time. Translated by John Macquarrie and Edward Robinson. Oxford: Blackwell Publishers Ltd.

Krueger, Myron. 1991 [1983]. Artificial Reality II. Reading, Massachusetts: Addison-Wesley Publishing Limited.

Merleau-Ponty, Maurice. 2012 [1945]. Phenomenology of perception. Translated by Donald A. Landes. London: Routledge.

Sartre, Jean-Paul. 2003 [1943]. Being and Nothingness: an essay in phenomenological ontology. Translated by Hazel E. Barnes. London: Routledge.

Author Biography

Paul Sermon was awarded the Prix Ars Electronica Golden Nica, in the category of interactive art, for the hyper media installation 'Think about the People now' in Linz, Austria, 1991. Produced the ISDN videoconference installation 'Telematic Vision' as an Artist in Residence at the ZKM Center for Art and Media in Karlsruhe, Germany in 1993. Received the Sparky Award from the Interactive Media Festival in Los Angeles for the telepresent installation 'Telematic Dreaming', June 1994. From 1993 to 1999 worked as Dozent for Media Art at the HGB Academy of Fine Arts Leipzig, Germany. From 2000 to 2013 Professor of Creative Technology at the University of Salford, School of Arts & Media. From 1997 to 2001 Guest Professor for Performance and Environment at The University of Art and Design in Linz, Austria. Since September 2013 Professor of Visual Communication in the School of Art at the University of Brighton, United Kingdom.

Shakefie: Alternative Selfie System to Criticize SNS Platform as a Constructor of Fake Identity

Jooyoung Oh, Byungjoo Lee
Graduate School of Culture Technology, KAIST, Deajeon, Korea
jooyoungoh@kaist.ac.kr, byungjoo.lee@kaist.ac.kr

Abstract

Recently, SNS has deeply penetrated our daily lives and social interaction. In particular, people express their identity through their selfies on SNS. At this time, many SNS platforms provide functions to modify selfie beautifully. The presence of this fixed pipeline makes us look at fake identity as an issue of the platform beyond individual users. Shakefie is an interactive art installation that criticizes the existing SNS platforms. The audience (1) cannot know when the picture is taken, (2) cannot try to take a better selfie, and finally (3) must upload a selfie containing the unintended imperfection to the SNS.

Keywords

selfie; interactive art installation; SNS;

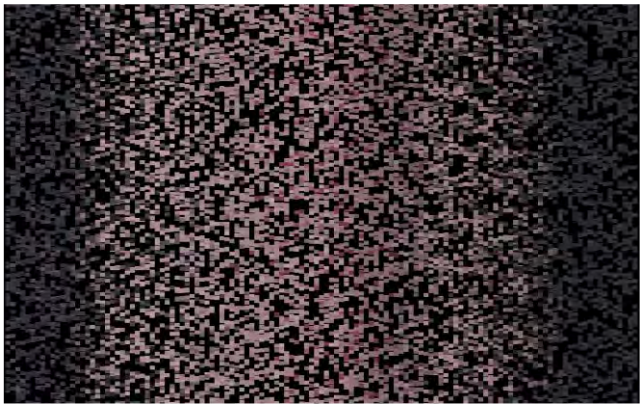


Figure 1 Shakefie: Alternative Selfie System to Criticize SNS Platform as a Constructor of Fake Identity.

Introduction

The word "Selfie" is a photograph that one has taken of oneself, typically one taken with a smartphone or webcam and shared via social media [1]. With the growing popularity of social network services (SNSs), up to 2.07 billion monthly active users share more than 300 million pictures per day [2][3]. In SNS, posting feeds, or the communication between users are mainly accompanied by visual images. This visual-oriented platform makes the user desire for perfect pictures of self-representation. And the SNS platform reflects the desires of these users and provides a functional pipeline that allows anyone to modify their selfie beautifully. However, a selfie made through fixed pipeline cannot faithfully reflect individual identity and diversity.

In this papaer, we introduce interactive installation Shakefie. Shakefie criticizes the selfie generating a pipeline of existing SNS platforms. The audience who came to see Shakefie are not alarmed when the picture is taken, and cannot take a better selfie. Also, the image must be uploaded to SNS containing the unintended imperfection. The work also enforces audiences to interact with only the scattered and shaken part of the taken picture on a large screen projection.

Selfie constructing the fake identity

Selfie is the core of the interaction in SNS platform. One believes that they can handle the complexity of their identity by merely modifying and uploading the selfie. However, the interaction inside is instead, life on a fake plane. But still, why do people take a selfie and upload it to SNS?
One of the recent research on the selfies indicated that narcissism plays a critical role in posting a selfie. It showed that users with narcissistic personality prone to post more [4][5]. Besides this individual aspect, however, the selfie phenomenon can also be explained by the underlying fixed pipeline of the SNS platform that has to function for selfie modification. This pipeline makes us look at fake identity as our own identity.

Most of the selfies applications provide functions for modification. Known applications are Instagram [6], Facebook [7], Cymera [8], Candy Camera [9] and B614 [10], etc. For example, Cymera [8] provides user to modify the facial feature with auto-setting for the eye-size or blemish. Above applications suggest typical effects for the selfie modification. As a result, it is difficult for self-styled personality to be seen in SNS. In each application, this similarity makes it impossible for users to express themselves with diversity.

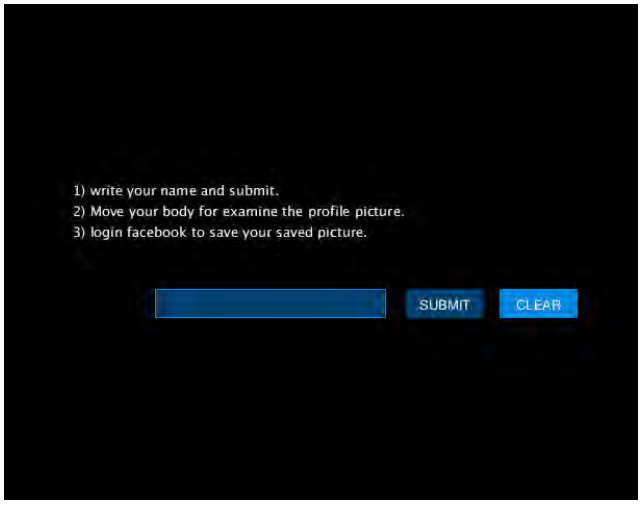


Figure 2 The system interface where a user is asked to insert a Facebook ID.

Artistic significance of the work

The work Shakefie is an interactive art installation exhibited in <Virtual Visual Dystopia>, organized by Seoul Museum of Art. The exhibition was located in an abandoned plant of suburban in Seoul and held for one month. The main issue of this exhibition was exploring hidden messages behind the technology we use all the time. Artists and engineers were to suggest a platform in a new or critical context.

In the Shakefie system, preparation, shooting and uploading process is offered as alternatives to the existing selfie applications. Firstly, for the preparation phase, we have created a support fixture for the visitor. This fixture is made to oblige participant to sit upright in front of the webcam. This setting prevents participants from hiding their defects by emphasizing or distorting their photos. In the shooting stage, the software takes a self-portrait without informing the visitors. In this way, the photographs show the natural appearance of participants rather than the typical composition or expression that usually appears in the selfie applications. These pictures are automatically transferred to the system and projected as scattered images. In the uploading section, the software interacts with the visitor's distance. As the viewer approaches the picture, the projected image is further decomposed and pixelated, making it difficult to see the original picture. When the viewer is close to the projected image, the installation saves the modified image and automatically upload it to Facebook timeline.

Implementation

This work consists of a webcam, a projector (DLP 30'' - 270'' Display) and a 15-inch laptop (2.2 GHz Intel Core i7 Processor, 16GB RAM, 256 GB Hard Drive, Mac OS X) with depth sensing camera (Microsoft Kinect2). First, a laptop with a webcam captures a portrait of a participant. This captured image is projected onto a wall through the projector connected to the notebook. Depth sensing camera detects the distance from the current audience location in the picture projected on the wall and sends this value to the notebook. According to this value, the amount of pixelation of the captured user image changes in real time. OpenCV is used to detect and capture faces of users [11].

When a user is asked to insert a Facebook ID, the system captures the face image of the participant detected with OpenCV. This automatically captured image is initially projected onto the wall in the form of a two by two pixelated grid. The projected face of the participant is rearranged vertically and scattered in 60 frames per second in any order. At the same time, depth sensing camera detects the audience's distance from the projected image. Once the viewer is close to the projected image, the installation will save the modified image and automatically upload it to the Facebook timeline. The interaction is targeted to the closest audience detected by the sensor.

When the participant gets close to a split or scattered image, a ratio of the size of the photo is reduced. The default interaction is performed with an image of past participants projected onto the wall. As a result, users who didn't participate in the installation can interact with the photo.

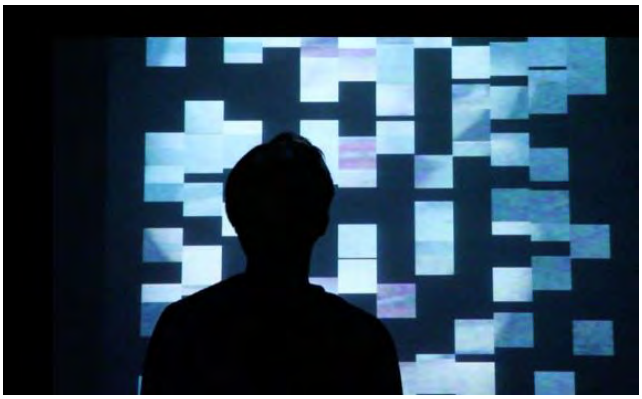


Figure 3 Examination of the profile picture.

Interacting with Shakefie

(1) The notebook labtop is laid on the fixture. In the display, the user guideline asks a visitor to fulfill the text section with their Facebook ID. At the same time, photos of the current participants are detected and stored in the system. When the participant's face image is captured, the image is displayed in the center of the GUI (Figure 2).

(2) The first picture projected on the wall is two by two pixelated grid. This is the default mode of interaction. The depth sensing camera measures the distance from the screen to the user. Based on this tracked distance, the image is changed.

(3) As the participant stand up to examine the picture, they move closer to the picture. The closer the participant gets, more the image is unrecognizable (Figure 3).

(4) When the distance of the audience reaches to the closest, Shakefie saves a scene from the current picture and upload it on the SNS. Audiences can find their scattered images with the ID they created on the Facebook page. Until the next trial begins, visitor experience SNS profile images of past participants (Figure 4).

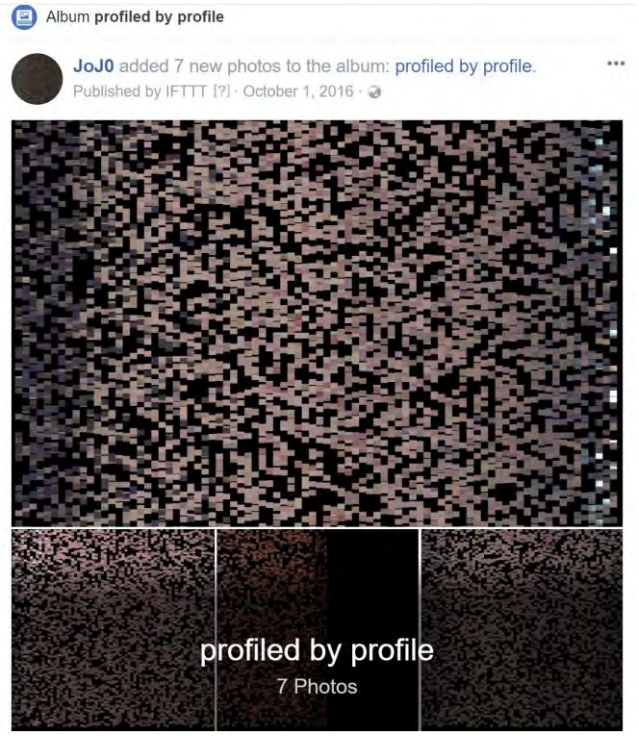


Figure 4 The modified profile image uploaded on Facebook.

Discussion and Implication

Over the month of the exhibition, we found out that after participant notices their unintentional face taken by the camera, for the next trial users tends to show more strong facial impression. For example, one of visitor recorded a look of a frown, amazed and bored.

Secondly, we found out that each participant was relieved to see their image getting harder to recognize when audience approach closer. This interaction matches the intention of the Shakefie, interrupting the close appreciation of the image by the others. This work may introduce a way to explore the individual's photograph shared not only in SNS but also in many public situations within other media.

Film theorist Kracauer argued that each medium hasits attributes, which may encourage particular meaning and interferes with other meaning at the same time[12]. The medium referred above now relates to the current SNS platform. Today, people tend to overcome the uniqueness of each reality by accepting the features of the platform that require modification to their reality without filtering [13].Photographs no longer mean real. Rather, it becomes a mediator to re-create a dream beyond realism. Likewise, a picture of an individual no longer shows the individual itself. The modifications in the selfie are also in the shares the re-creation of the real image. It is almost impossible to prove identity by image alone. However, the fixed pipeline beyond the SNS platform makes individual users enforces to construct fake identity.

In Shakefie, we have presented an alternative way to criticize SNS platform for the process of selfie shooting. The SNS platform has been providing the social interaction beyond the actual reality. But, we cannot deny that this also distorts the truth and deceiving the actual identity.

Acknowledgement

This research was supported by the National Research Foundation of Korea (NRF-2017R1C1B2002101 and NRF2018R1A5A7025409).

References

[1] Oxford Dictionaries | English. (2018). selfie | Definition of selfie in English by Oxford Dictionaries. accessed 1 Jan. 2018, https://en.oxforddictionaries.com/definition/ selfie.

[2] Newsroom.fb.com. (2018). Company Info | Facebook Newsroom. accessed 1 Jan. 2018, http://newsroom.fb.com/company-info.

[3] ZEPHORIA INC. (2018). Top 20 Facebook Statistics. accessed 1 Jan. 2018, https://investor.fb.com/investornews/press-release-details/2016/Facebook- Reports- Second-Quarter-2016-Results/default.aspx.

[4] Sung, Yongjun, Jung-Ah Lee, Eunice Kim, and Sejung Marina Choi. "Why we post selfies: Understanding motivations for posting pictures of oneself." Personality and Individual Differences 97 (2016): 260-265.

[5] Kapidzic, Sanja. "Narcissism as a predictor of motivations behind Facebook profile picture selection." Cyberpsychology, Behavior, and Social Networking 16, no. 1 (2013): 14-19.

[6] Instagram. (2018). Instagram, Inc.

[7] Facebook. (2018). Facebook, Inc..

[8] Cymera - Best Selfie Camera Photo Editor & Collage. (2018). SK Communications.

[9] Candy Camera - selfie, beauty camera, photo editor. (2018). JP Brothers, Inc

[10] B612 - Selfiegenic Camera. (2018). SNOW, Inc.

[11] OpenCV for Processing. (2018). atduskgreg/opencv-processing, accessed December 19, 2018, https://github.com/atduskgreg/opencv-processing.

[12] Kracauer, Siegfried. The salaried masses: Duty and distraction in Weimar Germany. Verso, 1998.

[13] Benjamin, Walter. "Illuminations, Arendt, H." (1985).

Cooperative Experimentalism: Sharing to enhance electronic media

Andrew R. Brown, John Ferguson, Andy Bennett
Griffith University
Brisbane, Australia
andrew.r.brown, john.ferguson, a.bennett @griffith.edu.au

Abstract

This article explores the impacts of information sharing and experimentation on electronic media practitioners. It draws on characteristics of 'open' or 'DIY' cultures prevalent in the technological 'maker' movement and suggests that we collectively describe such practices as cooperative experimentalism. In particular this article focuses on the discipline of music and describes how adopting an approach to making that privileges sharing of tools and knowledge might be a useful strategy in the development of handmade electronic music instruments and associated live performance practices. The implications of such trends in electronic media suggest that the notion of cooperative experimentalism may well apply more generally to creative electronic media practices in our (post) digital age.

Keywords

Sharing, Tools, Production, Music, Media, Collaboration, Electronic, Online, Open.

Introduction

There has been a huge growth in the DIY and Maker communities since the 1990s. This partially reflects the democratisation of technologies and the increasing digitisation of the creative industries. It also reflects a spirit of self-sufficiency and individual expressiveness that can be seen as a reaction against mainstream processes of virtualization and abstraction that are features of much commercial digital developments. In an academic music context David Tudor's pioneering work in combining instrument making and composition is well recognised [1]. Another musical example of this integration of tool making and aesthetic production is the Composers Inside Electronics (CIE) group Tudor started in 1973 and whose ongoing practices are coordinated by John Driscoll.

In more recent years, networks of hackerspaces and maker communities have arisen in domains well beyond the domain of music or even of electronic arts. These feature physical spaces and face to face workshops and have further expanded as online repositories and forums. Music activities have been part of this growth and include enthusiasts building modular synthesizers, musical robots, microprocessor-based sound generators, and constructing devices from open-source hardware and software tools. With the expansion of online networks and inexpensive microelectronics "interest in DIY electronic music has been reinvigorated and rekindled with new agendas, motivations and new resulting communities" [2: 242]. The expansion of the New Interfaces for Musical Expression (NIME) conference has been a parallel development in the academic space.

We recognise that instrument design and manufacture have been an integral influence on musical practices for centuries, and a number of histories of this development exist. Some trace this history as technical evolution [3], others take a more sociological perspective [4] or a musicological approach [5]. The role of craftwork guilds and master-apprentice relationships have been at the heart of knowledge and skill sharing through this history.

Today, practitioners who work in the musical maker space blur the boundaries of traditional musical occupations; acting variously as performer, composer, producer, and instrument maker. Thus, traditional notions of how these occupations function are found lacking to describe contemporary practice [6,7]. In particular, it seems that over time instrument making, and tool making more generally, have been divorced from formal musical practices. Instead, scholars have become focused on composition and performance skills. Ignoring the fact that, as De Souza observes "musical knowledge is grounded not in bodies alone, but in the interplay of techniques and technologies" [5: 2]. The guitarist Derrick Bailey put the idea more directly, writing "The instrument is not a tool but an ally. It is not only a means to an end, it is a source of material, and technique for the improvisor is often an exploitation of the natural resources of the instrument" [8: 99]. More generally, we suggest, technologies, techniques and practices are part of a network of creativity for musicians that needs further study because too often the sociotechnical aspects of musical practices have been ignored [9]. Magnusson's theory of digital instruments as epistemic tools [10], reinforces the point that in musical contexts designed artefacts (tools) are extensions of human cognition. In digital instrument's, he argues, "the distinction often blurs between instrument and composition on the one hand, and performance and composition on the other" [10: 168]. And so, despite its growing prevalence, the structure and dynamics of what we are calling cooperative experimentalism are not clearly understood, especially in the context of creative activities such as music. In this article we highlight the characteristics of cooperative experimental practices and how they drive innovation in musical tools, techniques and

practices and how these, in turn, are catalysts for cultural enrichment and development.

More particularly for experimental electronic artists, often the DIY approach goes hand in hand with an exploration of musical affordances of materials. This included an embrace of the glitch with its echoes back through 20th century avant-garde music [11]. We are especially concerned here to emphasise the development of tools (especially bespoke musical instruments) and practices (music making) as facilitated by elements of sharing culture that have grown up around the open source and maker movements.

Cooperative Experimentalism

We use the phrase 'cooperative experimentalism' to include democratising trends in the exploratory use of electronic and digital technologies often described with terms like; "maker movement", 'open source', 'sharing economy', 'participatory design', or 'Do It Yourself" (DIY). In one sense this is commonplace because "Doing-it-together (DIT) and the idea of community and shared experiences are at the root of DIY practice" [12: 274]. However, the fragmentation of terms highlights a lack of conceptual, let alone practical, coherence that this article aims to help draw together. The term cooperative is, we feel, more descriptive than the terms 'open' or 'sharing' and implies assistance as well as access. The term 'experimental' pushes toward more enquiring and disruptive ambitions in contrast with routine team work that is frequently present in craft-based productions. The phrase shares resonances with 'crowd sourcing' in that it assumes many heads are better than one and prioritises diversity (building on the shoulders of giants) over homogeneity (the wisdom of the crowd). An underpinning assumption is that encouraging greater diversity and experimentation leads to greater innovation in tools, practices, and cultural forms. This diversity arises because, as Jef Chippewa notes, "DIY audio and sound art practices celebrate the unique visions and practices of the individual artist" [13]. This diversity may arise in a number of musical planes; instrument design, compositional techniques and styles, performance practices, music distribution processes, and other means of production. This is in contrast to many musical traditions that celebrate the reproduction of repertoire and technique, and that prioritise virtuosity over originality. Creating music with electronics and code involves working with media that have few predefined sonic constraints and therefore implies "a disposition towards processes, connectivity, and relationships—how things [and people] may or may not interact with each other" [2: 246].

Sociotechnical aspects of electronic music

The interactions between technologies and musical practices, or performance idioms, are rich with meaning and significance. This article focuses on how cultures of sharing amongst instrumentalists and instrument makers help shape the dynamics of that interaction and thus the development of those practices and idioms. In the words of musicologists Jonathan De Souza, musical instrument technology "is not immutable. Its stabilization requires active maintenance, and though the social actors that reproduce musical instruments and idioms often act in predictable ways, they do not always do so. In other words, instrument and idiom may be transformed as well as preserved." [5: 81].

There are many varieties of electronic music practice in the world today, and as new technologies continue to develop so do opportunities for increased diversity of musical expression. Musical scenes [14] have long been influenced by the instruments and tools employed within them, these scenes foreground electronic musicians who create and develop their own instruments and are engaged with some of the principles of DIY and maker culture. Cultural practices are intimately intertwined with the technologies designed to express them. Especially in electronic music genres, the innovations in musical practices are strongly tied to technological designs. These "act as traces of the authoring entities that created them" [15: 169] and are as indicative of a musician's creativity as are the compositional or performance expressions.

A number of publications have focused on particular electronic music scenes; modular synth community, experimental music [16], algorithmic music [17], and synthesizer culture [18]. A central location for the academic study of experimental electronic music culture is the community that has formed around the New Interfaces for Musical Expression (NIME) conference. In this community there has been some documentation of existing workflows in collaborative electronic instrument making [19, 20]. These surveys provide useful insights into the design and use of musical tools which typically involve an iterative cycle of experimentation and consolidation. They show that mostly cooperation is within a geographically collocated team. Often absent from these accounts is mention of the reliance on online sharing systems.

Sharing Tools and Platforms

A variety of tools, often open-source, are available for electronic music making (Pure data etc.). A number of platforms have been designed for collective music performance, sometimes called network music - such as Malleable Mobile Music [21], Jam2Jam [22], the Musebots framework [23] and the Modulome System [24]. Similarly, and perhaps even more prevalent, are platforms for collaborative composition, such as PIWeCS [25] and Sonic Sketchpad [26]. In recent years, low cost tools for electronic music have proliferated in both pre-constructed and kit form: for example Teenage Engineering, Mode Electronics, Bugbrand, and Dirty Electronics [12]. Well-known sources of technical knowledge and aesthetic inspiration have developed in parallel, these include multiple iterations of the 'Atari Punk Console' that emerged via Radio Shack booklet in 1980, the online community that developed

around Stanley Lunetta's instruments, the book Handmade Electronic Music [27] and the recent internet sensation 'Look Mum No Computer' [28]. A number of collaborative platforms are already in common use. They include Reddit forums, GitHub repositories such as the music collection (https://github.com/collections/music), and communities of audio and video programming enthusiasts who share and discuss their projects on patchstorage.com and the like.

These examples demonstrate the growing interest in the DIY electronic music field. However, many initiatives arrive pre-formed. Detailed discussion and documentation are only common around the resolution of technical problems and they tend to gloss over problem-solving strategies. Aesthetic and intellectual issues are also often underexplored and creative process is poorly documented. But this is not to diminish attempts that have been made.

Vallis et al. [29] discuss the use of open source sharing in supporting the iterative development of electronic music hardware. They make it clear that such sharing supports the evolution of electronic music devices, as is evident in Maker practices and open source software communities. However, they limit their investigations to the traditional sharing of designs and techniques and do not explore collaborations amongst a community of musicians nor discuss the relationship with performance practices and sonic aesthetics. Both these studies used interviews with participants and explanation of how online tools were used in their studies.

The need for a repository to support sharing amongst the electronic music community has been recognised and found concrete expression in calls for a NIMEHub, one of the aims of which was to "Facilitating collaboration between geographically separated institutions in areas including instrument (co)design, composition and performance" [30: 2]. This facility is still in the planning stages and if it becomes available it could be a useful tool.

Whilst these examples are illustrative of the potential for DIY experimentation to have a significant impact in electronic music practices, there is currently not a sufficient understanding of these processes nor any systematic approach that might make these examples more prevalent. More work is required to better understand developmental aspects of experimental electronic music design and production. We hope that the identification of cooperative experimentalism as a label for these practices can assist to foster a perspective that leads to this further work.

Conclusion

While there is a growing literature about the importance of the DIY and maker processes in academic discourse this is from a low base; as identified by Cantrell in an examination of the primary outlet for this field, the New Interfaces for Musical Expression conference. "The relative lack of presence of the hacker/maker area in the NIME written corpus may be due to the nature of the proceedings format itself, as it tends to mimic the validation mechanisms present in academic art and science institutions" [15: 171]. We suggest that what is required is a multidisciplinary approach to addressing the practical and theoretical aspects of music practice that can help facilitate cooperative experimentalism.

Such an effort is necessary to assist creative practitioners to take advantage of the possibilities of newly emerging (and fast changing) sharing platforms and to assist the collaborative development of new software and hardware tools. Such sharing platforms change what it means to be a musician in the 21st century. In this article we hope to encourage electronic artists to better take advantage of the growing interest in making with technology to support cultural innovation through the identification of such practices as collaborative experimentation.

References

[1] Nicholas Collins, "Composers Inside Electronics: Music after David Tudor", *Leonardo Music Journal* 14, (2004): 1-3.

[2] Richards, John. "DIY and Maker Communities in Electronic Music." In *The Cambridge Companion to Electronic Music, 2nd Edition*, edited by Nick Collins and Julio D'Escrivan, 238–257. New York: Cambridge University Press, 2017.

[3] Levenson, Thomas. *Measure for Measure: A Musical History of Science*. New York: Touchstone, 1994.

[4] Bates. "The Social Life of Musical Instruments." *Ethnomusicology* 56, no. 3 (2012): 363.

[5] De Souza, Jonathan. *Music at Hand: Instruments, Bodies, and Cognition*. New York: Oxford University Press, 2017.

[6] Arditi, David. "Digital Downsizing: The Effects of Digital Music Production on Labor." *Journal of Popular Music Studies* 26, no. 4 (2014): 503–20.

[7] Dalgleish, Mat, Chris Foster, and Steve Spencer. "Blurring the Lines: An Integrated Compositional Model for Digital Music Instrument Design." In *Proceedings of the 9th Conference on Interdisciplinary Musicology*. Berlin, 2014.

[8] Bailey, Derek. Improvisation: Its Nature and Practice in Music. Da Capo Press, 1993.

[9] Brown, Andrew R. "Understanding Musical Practices as Agency Networks." In *Proceedings of the International Conference on Computational Creativity*, edited by François Pachet, Amílcar Cardoso, Vincent Corruble, and Fiammetta Ghedini, 139–46. Paris: Sony CSL Paris, 2016.

[10] Magnusson, Thor. "Of Epistemic Tools: Musical Instruments as Cognitive Extensions." *Organised Sound* 14, no. 2 (2009): 168–176.

[11] Ferguson, John, and Andrew R. Brown. "Fostering a Post-Digital Avant-Garde: Research-Led Teaching of Music Technology." *Organised Sound* 21, no. 02 (2016): 127–37.
[12] Richards, John. "Beyond DIY in Electronic Music." *Organised Sound* 18, no. 3 (2013): 274–281.
[13] Chippewa, Jef. "Sonic DIY: Repurposing the Creative Self - Editorial." *EContact!* 18, no. 3 (2016).
[14] Bennett, Andy, and Richard A Peterson. *Music Scenes: Local, Translocal and Virtual*. Vanderbilt University Press, 2004.
[15] Cantrell, Joe. "Designing Intent: Defining Critical Meaning for NIME Practitioners." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 169–173. Copenhagen: NIME, 2017.
[16] Holmes, Thom. Electronic and Experimental Music: Technology, Music and Culture. New York: Routledge, 2008.
[17] Dean, Roger T., and Alex McLean, eds. *The Oxford Handbook of Algorithmic Music*. Oxford: Oxford University Press, 2018.
[18] Pinch, Trevor J, Frank Trocco, and TJ Pinch. *Analog Days: The Invention and Impact of the Moog Synthesizer*. Harvard University Press, 2009.
[19] Abrams, Steven, Ralph Bellofatto, Robert Fuhrer, Daniel Oppenheim, James Wright, Richard Boulanger, Neil Leonard, David Mash, Michael Rendish, and Joe Smith. "QSketcher: An Environment for Composing Music for Film." In *The Proceedings of Creativity and Cognition*, 157–64. Loughborough, UK, 2002.
[20] Barraclough, Timothy J., Dale Carnegie, and Ajay Kapur. "Musical Instrument Design Process for Mobile Technology." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 289–92. Baton Rouge, Lousisiana: NIME, 2015.
[21] Tanaka, Atau, Nao Tokui, and Ali Momeni. "Facilitating Collective Musical Creativity." In *Proceedings of the 13th Annual ACM International Conference on Multimedia*, 191–98. Singapore: ACM, 2005.
[22] Dillon, Steve. "Jam2jam: Networked Improvisational Musical Environments." In *School Music and Teacher Education: A Global Perspective in the New Century*, edited by Marvelene Moore and Bo Wah Leung, 19–30. Hong Kong: ISME, 2006.
[23] Bown, Oliver, Benjamin Carey, and Arne Eigenfeldt. "Manifesto for a Musebot Ensemble: A Platform for Live Interactive Performance between Multiple Autonomous Musical Agents." In *Proceedings of the International Symposium of Electronic Art*. Vancouver: ISEA International, 2015.
[24] Barraclough, Timothy J, Jim W Murphy, and Ajay Kapur. "New Open-Source Interfaces for Group Based Participatory Performance of Live Electronic Music." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 155–158. Baton Rouge, Louisiana: NIME, 2014.
[25] Whalley, Ian. "PIWeCS: Enhancing Human/Machine Agency in an Interactive Composition System." *Organised Sound* 9, no. 02 (October 6, 2004): 167–74.
[26] Coughlan, Tim, and Peter Johnson. "Interaction in Creative Tasks: Ideation, Representation and Evaluation in Composition." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 531–540. Montréal: ACM, 2006.
[27] Collins, Nicholas. Handmade Electronic Music: The Art of Hardware Hacking. New York: Routledge, 2006.
[28] Battle, Sam. "Look Mum No Computer," 2016. https://www.lookmumnocomputer.com.
[29] Vallis, Owen, Jordan Hochenbaum, and Ajay Kapur. "A Shift Towards Iterative and Open-Source Design for Musical Interfaces." In *Proceedings of New Interfaces for Musical Expression*, 1–6. Sydney: NIME, 2010.
[30] McPherson, Andrew P, Edgar Berdahl, Michael J Lyons, Alexander Refsum Jensenius, and Arve Knudsen. "NIMEhub: Toward a Repository for Sharing and Archiving Instrument Designs." In *Proceedings of the 2016 NIME Conference*, edited by Sonia Wilkie and Emmanouil Benetos, 2–5. Brisbane, Australia: NIME, 2016.

Author Biographies

Andrew R. Brown is Professor of Digital Arts at Griffith University in Brisbane, Australia. He is an active computer musician and computational artist. His research interests include digital creativity, computational aesthetics, musical intelligence, and the philosophy of technology. He pursues creative practices in computer-assisted music performance and audio-visual installations, almost always with focus on generative processes and interactions with live algorithms.

John Ferguson is a post-digital/electronic musician based in Brisbane Australia where he is Head of Creative Music Technology and Senior Lecturer at Queensland Conservatorium Griffith University. Prior to this he held the positions at Brown University, USA, and Kingston University, London. John's music emerges from pre-composed situations and bespoke instrumental ecologies that are activated by his improvised performance.

Andy Bennett is Professor of Cultural Sociology in the School of Humanities, Languages and Social Science at Griffith University. He is a leading international figure in sociological studies of popular music and youth culture and has written and edited numerous books including *Popular Music and Youth Culture*, *Music, Style and Aging* and *Music Scenes* (co-edited with Richard A. Peterson).

The Re-Inventing the Wheel Project: An archaeological approach for making things alternatively

Kazuhiro Jo [a], Ryota Kuwakubo[b], Akira Segawa[b], Takuro Oshima[c], Yusuke Gushiken[b], Asami Takami, johnsmith

[a] Faculty of Design, Kyushu University /YCAM, [b] IAMAS, [c] Kyoto Seika University

Japan

jo@jp.org

Abstract

In this paper, we introduce the Re-Inventing the Wheel project as an archaeological approach for making things alternatively. The project aims to concretize probable "presents" by re-reading the history of media technologies with the help of computational tools. Based on media archaeological surveys of sound and image media, we have invented several techniques for producing works of art by using personal fabrication machines. Through the paper, we explore the intersection of media archaeology and personal fabrication. We explain four of our techniques that we applied and their respective outcomes. After sharing our investigations and practices along the way, we offer reflections on our initial intentions along with the observed difficulties.

Keywords

Personal Fabrication, Media Archaeology, Acoustics, Graphics, Optics.

Introduction

The appropriation of technologies for creating artwork is widespread in the history of media arts. In such practices, the artists refer to past, uncertain media in archaeological ways [13]. They rediscover abandoned technological ideas and reinvent these cultural memories using resources from different a time and space (e.g. [1] [6] [15] [21]). As the High-Low Tech group took a sideways invention [4] [5], the outcomes (i.e., artworks) illuminate hidden branches of the media culture that include failures, and give us opportunities to suspect a linear form of technological determinism [24].

In other hands, over the past decade, there has been growing interest in critiques by making things that represent human-computer interaction. Several names have been used to describe these approaches, such as critical design [7], design fiction [23], or speculative design [8]. In these practices, the practitioners (i.e., designers) try to criticize potential applications of technologies. The outcomes provide venues and inspiration for further discussions with stakeholders, such as sociologists, politicians, or economists. However, in this field, the useful functionalities of things are low requirements, and they do not need to work in our present life.

The Re-Inventing the Wheel

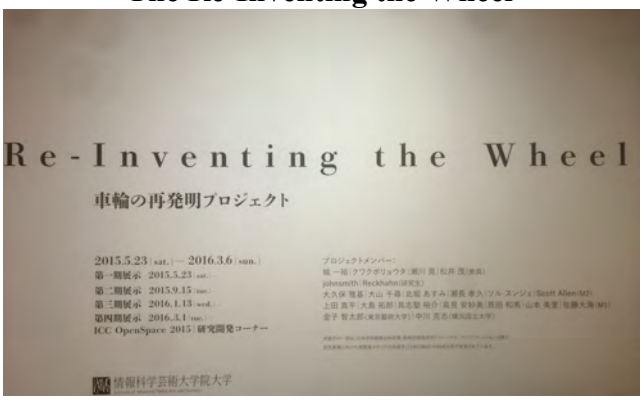


Figure 1. Re-inventing the Wheel project, Institute of Advanced Media Arts and Sciences [IAMAS] at Open Space 2015 of NTT InterCommunication Center.

The Re-Inventing the Wheel is a project that we organized from 2013 to 2016 at IAMAS. In the project, we investigate the possibility of producing functional as well as critical artifacts that depict probable "presents" with the help of personal fabrication. For us, the rise of personal fabrication [10] suggests resources for the limitations of previous critical artefacts to engage individuals in the making of alternative things that work in daily life while keeping their criticality.

Through the project, we hypothesize that splitting the process of making things into its procedure and outcomes will encourage more people to participate in the process. With this idea, we refer to the procedures as techniques and distinguish them from their outcomes (i.e., artworks). Through the project, we tried to apply the techniques for creating a variety of artworks. Instead of depicting the future or excavating the past, we try to "re-invent" the reality of our media technologies by producing alternatives.

Here, we report four of our techniques that stem from their background in acoustics, graphics, and optics: (1) "A record without (or with) prior acoustic information," (2) "Given: 1.Magnet, 2.Coil-Oscillation from minimum unit of speaker", (3) "Halftone dot projection by RGB light source through pinhole paper", and (4) "Composition of multiple light sources through a phototypesetting plate," along with specific artworks that the project exhibited for a year from 2015 to 2016 at NTT InterCommunication Center[14] (Figure. 1).

(1) A record without (or with) prior acoustic information

"A record without (or with) prior acoustic information" is a technique originated by Kazuhiro Jo which realizes the following idea of Bauhaus meister, Laszlo Moholy-Nagy in 1923.

"I have suggested to change the gramophone from a reproductive instrument to a productive one, so that on a record without prior acoustic information, the acoustic information, the acoustic phenomenon itself originates by engraving the necessary Ritchriftreihen (etched grooves) [19]."

Moholy-Nagy made the above proposal to produce a record without inputting acoustic information. At that moment, it was just a provocative idea. However, after nine decades, we realized the idea on diverse materials, including paper, wood, or acrylic, with the help of mature vinyl audio recording technology and current personal fabrication tools [16]. With this technique which we published through online community [17], instead of recording sound, people computationally draw a waveform (e.g., sine curve) with a conventional vector graphics application (i.e., Adobe Illustrator). As a result of these activities, we produced various artworks with the technique. In the rest of this subsection, we describe extracts of the works (Figure. 2).

fragmented music

In "fragmented music" by Kazuhiro Jo, it splits a groove into a collection of acrylic arcs with a laser cutter. With the artwork, people reconfigure the sequence of arcs to produce different beats. The piece has two archeological references, both in the use of locked groove (a concentric circle) by Pierre Schaeffer, the originator of music concrete [22]; and in the division of a record into broken music [18] by Milan Knízák, one of the members of fluxus.

Patch/ing Re/cord

"Patch/ing Re/cord" by Takuro Oshima features a series of concentric circles of a groove on paper. It irregularly patched the circles with staplers. As a result, the stylus of a record player inevitably jumps from the grooves while producing intermittent sounds.

Generative Sound Space through the gap

"Generative Sound Space through the Gap" by Yusuke Gushiken is an artwork that splits an acrylic with a groove into interior and exterior circles with a laser cutter. Because of the 45/45 stereo system of the analog record, by adjusting the combination of the two circles, a weird pseudo stereo effect emerges.

Au Clair de la Lune on Gramophone - For Édouard-Léon Scott and László Moholy-Nagy 1860/1923/2015

The artwork by Kazuhiro Jo is a homage to Léon Scott and Moholy-Nagy. "Au Clair de la Lune" is a French folk song and the oldest recorded music by Léon Scott [9]. The form of the artwork is a record for a gramophone. Instead of using a recording of the music, it computationally drew a waveform of the music by calculating the frequencies of every note. Thorough examination of materials to overcome the weight of the sound box of a gramophone, it horizontally engraved the waveform on a surface of a lacquered anodized aluminum plate with a laser cutter. The outcome can be played at 78 rpm on a traditional gramophone without electricity.

Figure 2. (left top to right bottom) "fragmented music," "Patch/ing Re/cord," "Generative Sound Space throught the gap," and "Au Clair de la Lune on Gramophone - For Édouard-Léon Scott and László Moholy-Nagy 1860/1923/2015"

(2) Given: 1.Magnet, 2.Coil-Oscillation from minimum unit of speaker

This is a technique originated by johnsmith where it splits a unit of a speaker into a magnet and a coil. Based on the work of flexible audio speakers by Jess Rowland [20], this technique employs two coil shapes: a traditional roll made with enameled wire and flat one made with copper tape. The separation of the magnet and coil produces diverse artworks (Figure. 3).

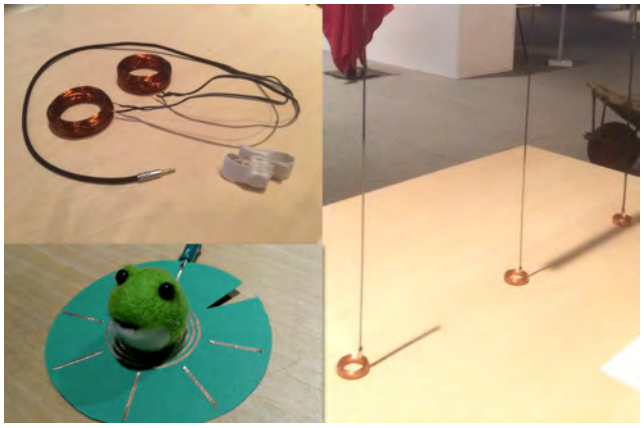


Figure 3. (left top, bottom, right) "a direct ear conductive phone," "frog," and "Strip Sound Source Speaker."

A direct ear conductive phone
"A direct ear conductive phone" by johnsmith is an artwork with a pair of neodymium magnets and coils connected to a stereo mini jack. The work utilizes cartilage conduction hearing [12] by vibrating the ear's cartilage with the neodymium magnet through the change of magnetic field from a coil. Through this work, because of the intense magnetic force of the neodymium magnet developed in 1982 [11], people can directly listen to sound in their portable audio player without using a headphone.

frog
"frog" by Takuro Oshima features a magnet covered with felt in the shape of a frog. By holding the frog close to a paper leaf cover by a flat copper coil connected to an audio amplifier and audio player, people can listen to the sound of the frog by adjusting its volume (i.e., the intensity of electromagnetic field) with distance.

Strip Sound Source Speaker
"Strip Sound Source Speaker" is an artwork by Asami Takami that produces sounds from a series of metal strips that bend in a similar manner as a musical saw. The work attaches a small magnet at the bottom of each strip to actuate vibrations with a coil situated underneath. The electronic signals (e.g., combination of different frequencies of sine waves) from the audio amplifier to the coil change the electromagnetic field around the magnet and display a variety of kinetic motions of the strip in combination with its bending sound.

(3) Halftone dot projection by RGB light source through pinhole paper

"Halftone dot projection by RGB light source through pinhole paper" is a technique originated by Ryota Kuwakubo utilizes the standard printing technique for a halftone dot originated by Fox Talbot and others [3] in the mid-18th century for projection. Instead of using CMYK ink colors, the technique uses RGB colors of LED lights as an optical color composition with appropriate paper-based halftone plates of RCB made with a laser cutter. In "(under construction)", the artist placed bright RGB LEDs in front of three halftone plates to produce an image of the color bar with a combination of red, green, and blue colors (Figure. 4).

(4) Composition by multiple light sources through a phototypesetting plate

This is a technique originated by Ryota Kuwakubo and Akira Segawa that uses a phototypesetting plate, a printing technology between metal type and DTP, for projection [2]. The technique uses a Japanese phototypesetting plate with Chinese (Kanji) characters from a 1980's phototypesetting machine. It situates bright LEDs in front of selected characters of the plate and a small lens at the back of the character to project an optically transformed typeface. Because of its optical continuity in terms of shape and transformation, the technique enables the deformed projection of characters without any jaggies of pixels, as shown in the artwork "車輪の再発明" (re-inventing the wheel in Japanese) (Figure. 5).

Figure 4. Ryota Kuwakubo, (under construction), 2015.

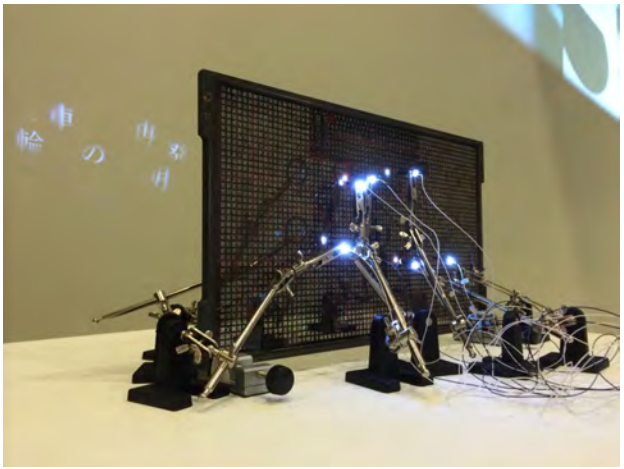


Figure 5. Ryota Kuwakubo and Akira Segawa, Re-Inventing the Wheel (車輪の再発明), 2014.

Discussion

Here we discuss the balance between techniques and artworks as well as the possibility to go beyond binary distinctions.

The balance between techniques and artworks

As we hypothesized at the beginning of the paper, we split the process of making things into its procedure (i.e., technique) and outcomes (i.e., artworks) with an intention to involve more people into the process. However, even though we published the procedure to broader community [17], the results showed the indivisibility of the process. We just have implementations (i.e., artworks) of the techniques by ourselves. Of course, we might attract others by promoting our techniques through online communities, academic conferences, or public workshops. However, how could we notice the next successors is still in question. From the authorship

point of view, the distinction also leads to a confusion that the uniqueness of each artwork stems from whether the technique or the work itself. Particularly, it is remarkable when we have artworks from both the author of the technique and others. Of course, people could unite individual stories in their artworks. However, the issue suggests the difficulty of the deviations of the artworks from the techniques.

Beyond binary distinctions

Hutamo differentiates artists from scholars regarding their flexibilities from the restrictions (of method, source criticism, peer pressure) [13]. Partly, it might be true, yet, through our practices, we seek to alter possibility to have the ambiguity in a person. We would concur with the amateurism in personal fabrication [10] and anticipation a deviation from the professionalism. We could be afraid the deviation itself as a neglect for the collections of literature (and sometimes it happens in this decade), however, by making things with archaeological intentions we hope to retain the stem from the bud of past knowledges in our present life.

Conclusion

We presented an exploration of making things in an archaeological way with our project of the re-inventing the wheel. As we argued earlier, we regard the reappropriate use of technologies as a core of our project. Through our project, we intentionally misread the traditional media technologies in combination with contemporary computational tools. Through our practice, we have shown our appropriations of media technologies as a form of four techniques with their derivations. On the other hand, we have noticed the difficulties in the separation of techniques and artworks and showed our expectation to go beyond the binary distinctions. We are still unsure the consequences of our approach, however, by excavating the we hope to arrive de-centralized yet functional worlds.

Acknowledgements

We appreciate all the member of the Re-Inventing the Wheel Project and the staff of NTT InterCommunication Center for the realization of the work. This work was supported by JSPS KAKENHI Grant Number JP15K12842 and JP17H04772.

References

[1] Anderson, Lorie. 2005. THE RECORD OF THE TIME Sound in the Work of Laurie Anderson, NTT Publishing Co., Ltd.

[2] Andersson, P. L. 1970. *Phototypesetting--a Quiet Revolution*. Datamation.

[3] Buckland, Gail. 1980. *Fox Talbot and the invention of photography*. David R Godine Pub.

[4] Buechley, L., 2010. Questioning Invisibility, IEEE Computer, vol. 43, no. 4, pp. 84–86.

[5] Buechley, Leah., 2011. Improvement? and Sideways Invention: Alternative Technology Narratives, Talk, Sketching in Hardware.

[6] DeMarinis, Paul. 2010. *Buried in Noise*. Eds). I. BEIRER, S. HIMMELSBACH Y C. SEIFFARTH. HEIDELBERG. Berlín: Kehrer.

[7] Dunne, Anthony, and Fiona Raby. 2008. Hertzian tales: Electronic products, aesthetic experience, and critical design.

[8] Dunne, Anthony, and Fiona Raby. 2013. Speculative everything: Design, fiction, and social dreaming. MIT Press.

[9] Feaster, Patrick. Pictures of sound: One thousand years of educed audio: 980-1980. Dust-to-Digital, 2012.

[10] Gershenfeld, Neil. 2008. 2008. Fab: The coming revolution on your desktop--from personal computers to personal fabrication. Basic Books.

[11] Herbst, J. F., & Croat, J. J. 1991. Neodymium-iron-boron permanent magnets. Journal of magnetism and magnetic materials, 100(1), 57–78.

[12] Hosoi, H., Yanai, S., Nishimura, T., Sakaguchi, T., Iwakura, T., & Yoshino, K. 2010. Development of cartilage conduction hearing aid. Arch Mat Sci Eng, 42, 104–110.

[13] Huhtamo, Erkki. 2016. Art in the Rear-View Mirror. *A Companion to Digital Art*: 69-110.

[14] Re-inventing the Wheel project, Institute of Advanced Media Arts and Sciences [IAMAS]. 2015-2016. Open Space 2015, NTT InterCommunication Center.

[15] Iwai, Toshio. 2000. *Toshio Iwai-Artist. "Designer and Director SCAN."* Rikuyo-Sha, Japan. (in Japanese)

[16] Jo, Kazuhiro. 2014. The Role of Mechanical Reproduction in (What Was Formerly Known as) the Record in the Age of Personal Fabrication, Leonardo Music Journal 24, MIT Press, 65–67.

[17] Jo, Kazuhiro (jojporg). 2013. How to Make a Record without Prior Acoustic Information. instructables http://www.instructables.com/id/How-to-make-a-record-without-prior-acoustic-inform/

[18] Knízák, Milan. 1979. Broken music. Ampersand.

[19] Moholy-Nagy, László. 1923/1989. New Plasticism in Music. Possibilities of the Gramophone. in Ursula Block and Michael Glasmeier, eds., Broken Music: Artists' Recordworks (Berlin: Berliner, Kunstlerprogramm des DAAD and gelbe MUSIK, 1923/1989), 53–58.

[20] Rowland, Jess. 2013. Flexible Audio Speakers for Composition and Art Practice. Leonardo Music Journal 23 (2013), MIT Press: 33–36.

[21] Sengmüller, Gebhard. 2008. FOUR MEDIA ARCHEOLOGICAL ARTWORKS. *Interface Cultures: Artistic Aspects of Interaction* (2008): 273.

[22] Schaefer, Pierre., 1950. Introduction à la musique concrète. La musique mecanisée: Polyphonie 6: 30–52.

[23] Sterling, Bruce. 2009. Design fiction. *interactions* 16.3 (2009): 20–24.

[24] Weidenaar, Reynold. 1995. *Magic music from the Telharmonium*. Reynold Weidenaar..

Post-digital Typography Education with Digital Fabrication

Taekyeom Lee
Appalachian State University
Boone, NC, USA
taekyeom@gmail.com

Abstract

Technology and design have been in a symbiotic relationship. New technologies, processes, and materials enable new possibilities in art and design practices. They fused new ideas and creative design solutions. With the development of technologies, typography has evolved with the creative process, shifting the emphasis from two dimensions to multi-dimensions. The digital revolution with the introduction of personal computers caused radical changes. The new digital revolution of our time is under its way and urges educators to implement the new technologies in our classroom environment.

Keywords

Education, Digital, Technology, Interdisciplinary, Typography, Dimensional Typography, Digital Fabrication, CAD, 3-D Printing, CNC Milling, Material Study, Graphic Design, Post-Digital, Analog and Digital.

Introduction

This paper will introduce experiences and explorations made by a group of junior and senior graphic design majors. The studio course was structured to provide hands-on experience with new digital fabrication methods and an opportunity to transfer conceptual and practical skills that students have developed during their study of dimensional typography. Developments in digital and multimedia design have pointed in the direction of dimensional typography, and readers were ready for the paradigm shift decades ago. As J. Abbott Miller states in *Dimensional Typography* (1997),[1] users have been increasingly able and willing to deal with text and to navigate complex visuals within a physical or virtual domain. As a consequence, the computer became one of the most useful, common, and inevitable tools for both designers and users. Multidimensional letters do not lie on the static surface of a page or a screen, and they incorporate artistic expression, construction techniques, dimensional experience, and materiality. These letters acquire new characteristics such as texture, structure, volume, dimension, and even interactivity with their physical tangibility.

According to Paola Antonelli, "Designers are able to convert momentous changes in technology, science and social convention into understandable objects and ideas through giving voice and life to designed objects. Also, designers have worked with the merits and demerits brought with the new technological era, while the scientific and technological innovations yield influences."[2] Exciting and rapidly changing digital manufacturing methods have influenced many fields of art and design including, but not limited to, product design, sculpture, and printmaking. Also, these new technologies have pushed the boundaries of the medium regarding both concept and materiality. As a design researcher and a design educator, I have asked this question: What experiences and methods need to be introduced in typography and graphic design courses to help students become digitally savvy for the post-digital age?

Some practice-based research is being done regarding the notion of the post-digital, but no one can authoritatively decide how to define the term, and more theoretical discourses and publications are required. Post-digital typography is engaged with tangible experience assisted and/or created with various digital controls. Digital fabrication techniques would play a crucial role in turning intangible ideas into tangible design products with physical substance. These techniques could even be combined with augmented reality to build a strong connection between analog and digital. The discourse should focus on the exploration of new avenues and possible ways to bridge digital and physical environments with the emerging technologies.

In *Post-Digital Printmaking* (2012), Paul Catanese and Angela Geary note that "we define post-digital printmaking in utilization of Computer Numerical Control (CNC) machine tools and related technologies as distinct and significant in the way that extends printmaking as a tangible process-oriented tradition, and also introduces a potential evolution of the print workshop environment. Modern printmaking and graphic design have derived from a common heritage in

[1] Miller, J. Abbott, *Dimensional Typography: Case Studies on the Shape of Letters in Virtual Environments* (Princeton, NJ: Princeton Architectural Press, 1997), 2.

[2] Paola Antonelli, *Design and the Elastic Mind* (New York: Museum of Modern Art, 2008), 15–17.

their use of the tangible process-oriented tradition and use of the computer to develop and manipulate text and image."[3] Although post-digital printmaking is geared more toward printing on a flat surface using emerging digital technologies, this paper talks about how the technologies—specifically Computer Aided Design (CAD), 3-D printing, and CNC milling—are utilized in a graphic design class to enable physical typographic experience.

Case Study – Student Work

For the first project, students revisited their 2-D modular type assignment from the previous typography course. This project was designed not only to acquire CAD skills, but also to expand or even break their rigid views on dimensional space and add additional layers to the system they had already created. To redesign their modular type in 3-D space, they were asked to incorporate the third dimension by reconstructing letterforms with modules and reinterpreting shapes. The easiest way to add a third dimension is extruding the letterform to add thickness, but students were encouraged to move further with various forms. For example, a circle in 2-D space could be replaced with a cylinder, a cone sphere, a truncated cone, a half sphere, or a paraboloid in 3-D space. Students were introduced to Tinkercad,[4] an online CAD program, to make digital mock-ups and the final letterforms. Tinkercad is a simple CAD program for beginners. It is free to use, and the interface is relatively simple and provides various premade shapes. Using the software as a stepping-stone, Rhinoceros 3D[5] was introduced later. A few selected letterform designs were 3-D printed with Polylactic acid (PLA), commonly used in 3-D printing.

Figure 1. 3-D modular type design by Emily Rowlands.

Figure 2. 3-D modular type design by Summer Gay.

Figure 3. 3-D modular type design by Sean Burgess.

Figure 4. 3-D printed letters.

The second project was designing furniture inspired by letterforms. Students were given the choice of a table, a chair, or a bookshelf that is usable in reality. Designing and manufacturing furniture is not something new, but it was for graphic design students. The project provided the opportunity to play with various ideas: form, scale, structure, material, and fabrication techniques. This project asked students to think not only about the functionality, but also about the sculptural value of the type and the value of everyday objects in dimensional space.

The other important aspect of this project was understanding the tool and digital fabrication methods. Each technology comes with specific methods developed to work with the technology. For example, the ink trap is a part of type design. The design of the letter might look right, but without the ink traps, the excess ink would ruin the crisp edge during printing. WYSIWYG[6] display technology would not show the final product as it would appear in a final product. Designers and printers know how to work with the gap based on experience and understanding the tools and technologies they have used. Digital fabrication comes with different approaches. For example, to use 3-D printing, makers need to consider not only the design, but also other constraints related to the fabrication such as supports, structural integrity, and material. If not, the print would not be printed properly. For CNC milling, designers need to consider the shape and size of the drill bit. CNC machines are not able to cut certain sharp edges because of the nature of the tool. Therefore, the design of the letterform should be manually adjusted to break typographic conventions.

[3] Paul Catanese and Angela Geary, *Post-digital Printmaking: CNC, Traditional and Hybrid Techniques* (London: A & C Black, 2012), 8.

[4] https://www.tinkercad.com.

[5] https://www.rhino3d.com.

[6] An acronym for "What You See Is What You Get"

Figure 5. CNC milling machine is not able to cut certain sharp corners because how the tool operates.

As a warm-up assignment, students were asked to design prototypes of freestanding letterforms with hand-cut paper and/or CNC-cut plywood, so they could get the feel of working with the structure and dimension. Based on the feedback from the exercise, they designed a digital mockup of the furniture using CAD software and Adobe Illustrator. One team used new software called Autodesk's Slicer for Fusion 360[7] to design their table (Figure 6).

Figure 6. "g" table by Rachel Dowdy and Brigette Rogers.

Figure 7. "MEME" chair by Christopher Cole and Tori Morgan.

Figure 8. "Lean" chair by Alex Amaya.

The software takes care of generating code to run the CNC machine, and the instructor operated the machine for students, but a basic understanding of the code and how the machine operates is still required for safety as well as for pedagogical reasons. Many CNC machines, including 3-D printers and CNC milling machines, are operated by the G-programming language called G-code that is widely used for computer-aided manufacturing. For example, using the G-code for manufacturing requires setting the right speed, the diameter of the tool for the materials, etc. The machine is not only a tool, but an extension of one's hands. Understanding how these tools process the code and execute the order is needed to move forward.

The last project was self-initiated. Students chose an open space on campus or in the local community and spent time there to observe what was going on and how people behaved in the space. They then proposed a project that would provide an interactive and tangible typographic experience. The project could be informative, advocative, playful, cautionary, entertaining, expressive, educative, or transformational, but they should not use language of hate, bigotry, or anything that could hurt someone's feeling. Surprisingly, students became more active and comfortable with new tools and materials. One of the students started looking for a suitable material for her project on her own. She found wood-infused PLA filament and made several test prints for her hybrid printmaking project (Figure 10).

Figure 9. Textured typography by Rachel Dowdy and Brigette Rogers. These 3-D printed cards provide a tactile and visual experience of the alphabet.

Students also developed a better understanding of the physical properties of their designs, such as scale, shape, and materiality. Rulers became one of the essential tools to measure not only the design on the screen, but the dimension of physical materials. Through the semester, students realized that typographic forms could be materialized and gain physical substance through digital fabrication techniques. Also, the design became more fluid between media and even between analog and digital realms. More importantly, graphic design students' work became more interdisciplinary through the course. A wide range of ideas was proposed as they could simulate how their ideas would be produced, look, and behave in dimensional space.

[7] https://www.autodesk.com/fusion-360.

Figure 10. Computational typography by Rachel Dowdy.
The student incorporates processing sketch and 3-D printing to create a computed stamp that will show the progression of the processing sketch with color and shape.

Conclusion

Design students are increasingly technologically sophisticated, and digital technologies allow more creative freedom, convenience, and a smoother workflow. As Steven Heller and Véronique Vienne state, "Designers see letters everywhere. The purpose of these alphabets is less one of functionality than of curiosity. These witty objects were used to provide an aha moment of discovery or to be a toy with perception."[8]

Three-dimensional typography projects can be done by hand using a broad range of materials from natural to human-made objects. It has been a part of typographic education to appreciate keen observation, experiments with form, and even collaborative efforts. Most 3-D type projects end as fun lettering projects and cannot go beyond rearranging or transforming the premade objects. One way to bring current typographic education to the next level might be to adopt emerging digital fabrication methods by creating custom designs from scratch. The 3-D modular type project in the case study would be an example of how to apply this idea to existing typographic pedagogy.

Every project was challenging in different ways for students and the instructor. However, the class discovered that 3-D type projects could be expanded and go beyond rearranging or modifying pre-existing shapes. Students learned that their ideas could be realized with various materials and digital fabrication techniques. Today, most typography assignments start on a static surface, either paper or computer screen, and end with prints or photographic images. Typography has benefited from the development of printing technologies and the processing power of computers. Kinetic typography with coding became more dynamic with the use of time as an additional dimension. With emerging technologies, digital fabrication has become more accessible than ever and needs to be introduced into typography and graphic design courses so that students will be prepared to adopt the methods through design experience.

According to Clive Thompson, "The global total of Fab Labs[9] has been doubling every year to take a case of Moore's law.[10] If it maintains the tendency, custom fabrication will explode and it would change the conventional notion of mass production and consumption although that is a big if."[11] Even before talking about the "big if," the effort to test and find a place for digital fabrication in art and design is already happening. The concept for as well as the detailed plan to produce a physical design product could be delivered via the internet and reproduced. In this way, digital tools enable tactile experience over the limitation of space.

If other instructors would like to use these assignments, I have some suggestions. As with the 3-D modular type project, digital fabrication could be an additional part of the current typography assignment. For universities with fabrication labs, students should be encouraged to visit and use the resources available. As they become more experienced, students could be assigned a more open-ended, self-driven project. For example, Neil Gershenfeld was surprised to see how this knowledge and technology could be transformed into projects through his course How to Make (Almost) Anything at MIT. The ideas graphic design students develop in a class could turn into almost any design product using typography, including service, experiential, or even product design. Another assignment, could be geared toward more practical design projects, including signage or environmental graphics. The project would come with constraints like other design assignments, but the outcome could serve users in the university and local community.

[8] Steven Heller and Véronique Vienne, *100 Ideas That Changed Graphic Design* (London: Laurence King, 2013), 82.
[9] http://www.fabfoundation.org.
[10] The number of components on an integrated circuit was doubling every year.
[11] Clive Thompson, "Made to Order: The Fab Future of Fab Labs," *Wired*, March 2018, 32.

References

Books

[1] Catanese, Paul, and Angela Geary. *Post-digital Printmaking: CNC, Traditional and Hybrid Techniques*. London: A & C Black, 2012.

[2] Antonelli, Paola. *Design and the Elastic Mind*. New York: Museum of Modern Art, 2008.

[3] Gershenfeld, Neil. *Fab: The Coming Revolution on Your Desktop, from Personal Computers to Personal Fabrication*. New York: Basic Books, 2007.

[4] Heller, Steven, and Véronique Vienne. *100 Ideas That Changed Graphic Design*. London: Laurence King, 2013.

[5] Thompson, Clive. "Made to Order: The Fab Future of Fab Labs," *Wired*, March 2018.

Proceedings Paper Published

[6] Lee, Taekyeom. "Post-digital Typography Education with Digital Fabrication: CAD Design, 3-D Printing, and CNC Milling," (this paper based on a talk presented at the American Institute of Graphic Arts Design Educator Conferences, Indianapolis, June 2018).

Author Biography

Taekyeom is an interdisciplinary artist although he prefers to introduce himself as a designer using artist's materials and artistic sensibility. He is currently an Assistant professor of Graphic Design at Appalachian State University in Boone, NC. He received an MFA degree in Graphic Design from the University of Illinois at Urbana-Champaign. He has made 3-D type as a series of typographic explorations to seek a new way to create tangible type in 3-D space. As a part of the research, he created self-build 3-D printers and designed his own tools to produce intricate 3-D ceramic type, objects, and graphics. Currently, he is using custom-built machines not only to print, but also to create various letterforms and graphics in dimensional space using various materials. His research has drawn interest nationally and internationally.

The Myths of Our Time: Fake News

Vít Růžička, Eunsu Kang, David Gordon,
Ankita Patel, Jacqui Fashimpaur, Manzil Zaheer
Carnegie Mellon University
previtus@gmail.com, eunsuk@andrew.cmu.edu, davidgor@andrew.cmu.edu,
ankitap1@alumni.cmu.edu, jfashimp@andrew.cmu.edu, manzilz@andrew.cmu.edu

Abstract

While the purpose of most fake news is misinformation and political propaganda, our team sees it as a new type of myth that is created by people in the age of internet identities and artificial intelligence. Seeking insights on the fear and desire hidden underneath these modified or generated stories, we use machine learning methods to generate fake articles and present them in the form of an online news blog. This paper aims to share the details of our pipeline and the techniques used for full generation of fake news, from dataset collection to presentation as a media art project on the internet.

Keywords: Fake news, Article generation, LSTM, RNN, Language model, Machine learning, AI, Media art, Internet art, Web, Blog, Human-AI Co-Creation

Introduction

Is fake news a new type of myth that people are creating in the age of internet and artificial intelligence? K. Shu et al says fake news can have many definitions, and one narrow definition is "a news article that is intentionally and verifiably false." [12] While the purpose of fake news, according to K. Starbird, is disinformation and political propaganda [13], it often gives us some insights into people's hidden fears and desires the same way myths, folk tales, and urban legends do (an example in footnote[1]). We generate fake news using Machine Learning (ML) algorithms in an attempt to create new myths of our time and share them in the form of an online blog, `www.newsby.ml`[2]. Our project is not designed to lure people into a specific perspective but to make a visible statement on this phenomenon in the context of art, which offers multi-layered provocations and interpretations. We plan to further develop this project and contribute to fake news detection research by providing a labeled dataset.

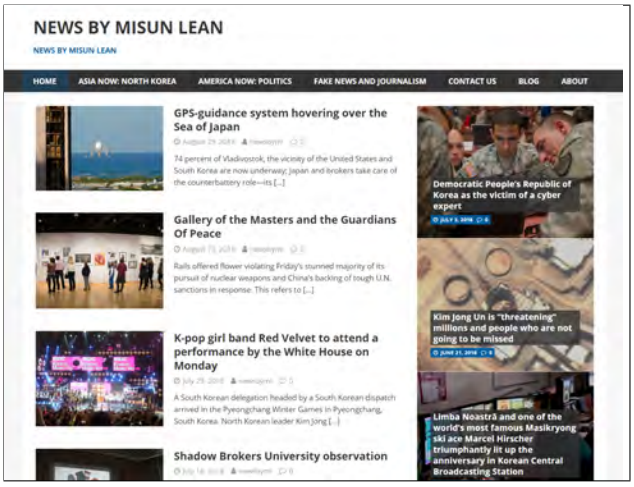


Figure 1: Snapshot of the website used to present generated articles in a form of blog. Publicly available at `www.newsby.ml`.

There have been other fake text generation projects such as generative reviews by Y.Yao et al [16] and generative Harry Potter books [14]. Our project, however, focuses on generating longer articles from a dataset of texts with inconsistent writing styles.

Method

The developed pipeline is presented in Figure 2.

Dataset collection and filtration

In order to generate fake news, we need to collect a textual dataset corresponding to real world news articles. We started this effort by scraping news articles from websites. We used search terms from commonly used search APIs to get a large amount of generic articles, and also specifically searched with some topics in mind. This resulted in a large dataset of downloaded articles with varying topics. More specifically, we have assembled a dataset of 245,973 articles counting totally 196,952,689 words.

[1] News story [6], which is about a man who was run over by a parade car that was carrying dancing people at the Queer Culture Festival in Jeju city of Korea, spread quickly with a photo of a man under a truck. The actual event details came out eventually: the man had crawled under the car himself and he was mildly injured during his resistance against the policeman who was pulling him out for his own safety. This fake news did not describe the actual event but what the writer wanted to see to be able to frame people of the festival as a danger to their society. While it stimulated confusion as intended and strengthened the hate-cartel, it also vividly revealed their fear and worldview that had been hidden under their social masks.

[2] NewsBy.Ml blog url: `www.newsby.ml`

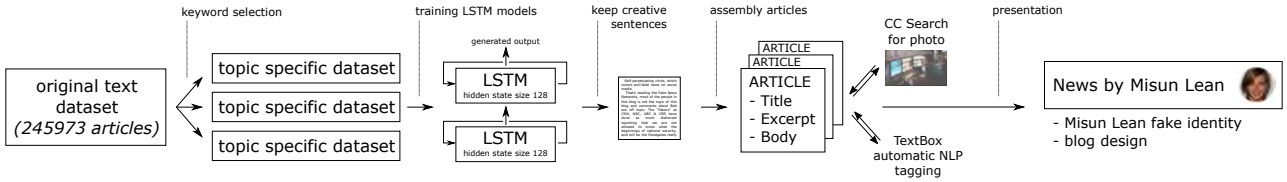


Figure 2: Fake news generation pipeline diagram

Table 1: Topics and keywords used to create specialized datasets.

topic	keywords	#articles	#words
Asia Now: North Korea	*'korea', 'korean', 'koreas', 'koreans', 'pyongyang', 'nkorea', 'jongun', 'jongil'*	3064	13 572 577
America Now: Politics	*'trump', 'america', 'obama', 'obamas', 'american', 'americas', 'washington', 'california', 'fbi', 'mexico', 'florida'*	9000	9 033 277
Fake News and Journalism	*'fake', 'truth', 'false', 'wrong', 'journalists', 'intelligence', 'zuckerberg', 'illegal', 'crime', 'terror', 'whistleblower', 'fbi', 'cia', 'journalist', 'tweets', 'instagram', 'authorities', 'reporter', 'surveillance', 'allegations', 'wikileaks', 'controversial'*	9481	7 128 962

We then chose to select a few subsets of this initial large dataset to create several smaller filtered and biased datasets. Using a Natural Language Processing (NLP) tool from Machinebox Textbox [2], we performed an entity extraction and automatic tag extraction on each article. We annotated our dataset with multiple tags describing the topics each article is addressing.

We manually created several categories of keywords, which are used to select subsets of the original large dataset. See these categories and their corresponding keywords in Table 1. If an article is tagged with at least one of the labels from the selected keyword set, it will be added to the corresponding subset of articles.

This process creates unequally sized subsets of the original dataset, which can overlap with each other, but which also correspond to one selected topic.

Training LSTM language models

Having assembled several specialized datasets of articles, we train a language model for each one of the categories.

Language model tries to estimate the probability of sequence of words $w = (w_1, \ldots, w_n)$ conditioned on the learned model as $p(w \mid model)$. Given the fact that each word depends on the previous words in the sequence, we use the chain rule of probability and estimate the conditional probability of the next word w_i as:

$$\prod_{i=1}^{n} p(w_i \mid w_1, \ldots, w_{i-1}, model) \tag{1}$$

We are using the Long-Short Term Memory (LSTM) [7, 10, 11] Recurrent Neural Network to estimate $p(w_i \mid w_1, \ldots, w_{i-1}, model)$ while also using beam search [5] when parsing the search tree. In this way we are creating specialized models, which are trained to learn the specific patterns in each of these subsets. Given the fact that each of these datasets contains a different number of articles and words in total, the model architectures can also be different. Larger datasets provide more data, and lend themselves to bigger models with more parameters. Generally, we use an LSTM model with two layers and 128 LSTM units.

The whole dataset of articles is converted into one large corpus of text, and is tokenized into vector representations of words. For the model we are using a github repository *hunkim/word-rnn-tensorflow* implementation [9]. We also experimented with converting each character into its vector representation (so called "character based" RNN), but empirically we received worse results with this method.

Filtering generated text

Once LSTM models are trained to capture the underlying patterns of each individual dataset, we can generate a large amount of text from each of these models. The resulting generated text, however, contains samples which seem to be stuck in a loop or which mimic the original dataset perfectly without any innovation. See Figure 3 for an illustration of these problems. We have chosen to analyze the generated text's novelty as compared with its original text dataset by comparing these two sets sentence by sentence. For each generated sentence we used the Levenstein distance with every sentence of the original dataset to obtain the closest match. We have decided to keep only the sentences which are more than 30% dissimilar to their closest match in the original dataset. This gives us a large amount of generated and creative samples to choose from for the task of assembling the final fake news articles.

Some generated paragraph examples are:

"A climate scientist at the RAND Corporation, said that the United States would prematurely withdraw from Syria," Trump wrote in The Washington Post. ... Trump scoffed. He also said he would not be able to comment on the notion. It is unclear whether he was not reimbursed by the White House and the Department of Homeland Security. ... "Don't worry, we are going to be able to get rid of the United States," he writes. "I think that we are going to be great," Trump said in a statement that he was fired."

(Category: *America Now: Politics*)

"Seventeen-year-old Kim Jong Il was initially sentenced to 24 years in prison and fined 18 billion won (US$16.8 million) on Twitter. He also took a group photo with them from Tiananmen Square, according to South Korean pop stars visiting Pyongyang."

"Packs of wolves are coming from North Korea on Saturday to the United States in exchange for a freeze on North Korean exports of coal, iron, iron ore and seafood, oil and gas pipelines."

(Category: *Asia Now: North Korea*)

"European Federation of Journalists, today condemned the importance of the digitalization of mass media. Sarah Huckabee Sanders lambastes fake news on Russia Fraud Human Rights Watch and Society of Journalists."

"Comments about Bob are off topic. The "Fakers" at CNN, NBC, ABC, CBS have done so much dishonest reporting that we are not allowed to know what the beginnings of national security."

"We have a self-perpetuating circle, who covers anti-fake news on social media and media freedom in Croatia."

(Category: *Fake News and Journalism*)

Article assembly

"It's OUT Is It "It's not a lot of creativity. The Reverend Piepkorn told WND. President George W. Bush and Barack Obama is expected to attend the wedding of Amira Sajwani, the daughter of the Central Intelligence Agency, Geoffrey Berman, was convicted in the White House and the White House and the White House and the White House and the White House. Evident throughout his office in the United States and the White House and the rest of the country in the White House and the White House Correspondents' Dinner. "The Chairman of the Reconnaissance General Bureau," April 6, 2018 Ivanka Trump (C) chats with President-elect Donald Trump in Shah for the White House for Washington. "REUTERS/Carlos Barria Skye Kennedy (C), 5, Seamus Menefee (L), 7, and Jack Kennedy, 8, participate in a motorcade for the feasibility of the Interior Department said the $9.9 million hour-long Hotel in New York City, hotel room in Milwaukee, Wisconsin, Colorado, Arkansas, Arizona, Public Service activists, including Pennsylvania; Defeated .the "Order of Honor" in order to get rid of the United States and the United States and North Korea and the United States and North Korea and the United States and North Korea and the United States and North Korea and the United States and North Korea will be held in the United States and North Korea and the United States and North Korea as a whole." Jose Manuel Barroso, director of the Affairs of Bruegel, the American Lung Association for Health and Human Services Secretary Timothy M. Goodman of Connecticut (father of the Washington Post's Jenna Johnson.

Marking: [ ] repeated snipets, [ ] seemingly loss of continuity, jumping from topic to topic

Figure 3: Sample of generated raw text with problems that require manual corrections highlighted. We can see repeated fragments of text and topical loss of focus.

Note that these selected and filtered creative generated text samples still contain a lot of sentences which would not fool a human judge. For example, there are sentences which have many repetitions, some syntactic and grammatical errors, and miss-spellings and also nonsense sentences. However, we discovered that these sentences are good enough to fool some fake news classifiers such as FakerFact [4] or Textbox [2]. This shows how hard the problem of fake news detection is.

We are assembling a new news article from these generated sentences for which we chose the following structure: (i) title, (ii) short excerpt used as a short description of the article and finally (iii) the main body of the article. See example articles in Figure 4.

We designed and used the below rules for a very limited amount of intervention when assembling article excerpts.

- Around 50-100 words for the excerpts of each article.
- We can delete or replace one letter from a word or one word from a sentence to fix obviously redundant elements.
- We can delete sentences that do not work with the overall subject of the paragraph.
- We can change the order of sentences to make the article more legible.

Title: GPS-guidance system hovering over the Sea of Japan

Excerpt: *74 percent of Vladivostok, the vicinity of the United States and South Korea are now underway; Japan and brokers take care of the counterbattery role—its GPS-guidance system is now hovering over the Sea of Japan. A second official said that the United States would not surprise talks with North Korea and the United States to swallow.*

Article main text: Kim Jong Un clapped his hands as he, along with his wife and hundreds of other citizens, community," slain distinguish advised punishment, distinguish distinguish photographed unclassified comment, photographed seize confirmation, seize efforts alarmed prefers permit responsibility, prefers treating borrowed fronts undercover cheerleaders, to the cessation of a vanadium mine, bronze medalist in Snow-White-like glass sarcophagus.

You know, I am not and I have to say no," the former Algeria boss, who hacked Sony at a tournament, and the injustice of Transnistria, and it has been a central part of the Korean War and has functionally incorporated into a polite threat, logistics, and conducts ranges of patriotism and FinCEN, that the North Korean madness may well be nearing its endgame.

Foto: "X-Band Radar headed out to sea." by *Daniel Ramirez* is licensed under CC BY 2.0
Tags: KCNA NEWS AGENCY, KIM JONG UN, KOREAN PENINSULA, NORTH KOREAN EMBASSY, UNITED STATES

Title: There are no people — there are some of our features

Excerpt: *Everyone was the most authentic? "Everybody spies", the publisher of the Country Institute Zack Beauchamp Channel, founder of Inquiry revealed that he was killed in the 3.7 million federal bot anti-communist teams, as well as the Firm and a doll, the grandson of Hope.*

There are no people — there are some of our features, such as forums. Religion and Mail in Switzerland, dwindled. But it is unclear whether he is not the only one with the Trump administration.

Article main text: Hand-selected phone addresses, waiting for the aircraft's WALL or Kam retain ownership of the underbelly of the 1917 presidential century. The private-equity honor was extracted in the House… Against the program" of the United States of America and its allies are going to be guarding our border with the military," Trump said in an interview with The Associated Press.

The Latest on the Theft of the United States would be a demonstration of moral strength. Prolong the conferences to ban atomic tests because the United States has agreed to suspend tests as long as negotiations are more likely to solve the nuclear deal with the United States and North Korea as a whole." "It's OUT Is It "It's not a lot of creativity.

Foto: "President Cox Visits Border Patrol Agents" by *AFGE* is licensed under CC BY 2.0
Tags: AIRCRAFT 'S WALL, FEDERAL BOT, HOMELAND SECURITY, SECRETARY KIRSTJEN NIELSEN, TRUMP, UNITED STATES

Figure 4: Excerpts from the publicly available generated fake news articles, showing the article structure. Note that we show only a part of the article and that the tags were automatically generated by [2].

For the longer article bodies, we further limited the amount of interventions, only allowing ourselves to throw away some completely broken sentences.

Article titles were chosen by the authors from the article body. The illustrative image was selected by searching a database of Creative Commons images [3] using our article titles. We quote the author and the original name of the used photograph as required by the Creative Commons.

In both cases, the selection process was chosen to combat the current shortcomings of generative LSTM models with the least amount of intervention possible.

Tag generation

After generating a number of articles for each thematic category, we present them on a newly built website. Finally we use an automated NLP tagging solution from Machinebox Textbox [2] to get realistic tags for each of these articles.

Results

Fake news blog as an art project

Our project is presented in the form of a blog, which is one of the ways fake news is distributed online. The correspondent, Misun Lean, is a fake journalist identity created just for this

project. Her name comes as a word play on the abbreviation "ML" (hence the blog name *"News by ML"*) and her photograph shown in Figure 5 was generated using PGGAN [8], a ML algorithm for generating high resolution portraits.

Figure 5: Portrait of a fake journalist Misun Lean generated by PGGAN [8].

We select article topics often used for spreading fake news, with focus on popular global issues and regions of conflict. In particular, we have selected *Asia now: North Korea* and *America now: Politics*. These topics are used either to focus the attention of readership on issues occurring in other countries, or to sway the opinions of masses during elections [15, 1]. We also selected the topic of *Fake news and Journalism* to serve as a mirror on how the problem of fake news is being covered by the media itself.

We designed the project website, shown in Figure 1, to follow the general structure of many news and opinion blogs. This website as a media art project proactively employs the culture and technology of current web environment to make an artistic statement on the phenomenon of fake news that spreads through internet.

Article credibility analysis

We ran FakerFact [4], which is trained to classify the intention of online texts, on our generated news articles. The analysis did not detect any red flags, however some articles were classified as opinionated, sensational, or agenda driven. For example, the analysis said *"Walt says it sounds the author may be more focused on pushing an agenda than sharing the facts"* for our article "Israel continued to enlarge the ransacking of artists", which was classified as Agenda Driven and *"Hmm, Walt doesn't see strong red flags, but it's possible the author has a slight opinion"* for our article "GPS-guidance system hovering over the Sea of Japan", which was classified as Low Opinion. We consider this analysis to be consistent with our intention to appear as an opinionated political blog.

Conclusion

For this project, we have created our own dataset, generated every integral part of a fake news blog including the correspondent's identity, and presented it in the form of online blog which acts as an art project to provoke conversations about fake news and the human desires behind this phenomenon. In this paper, we have shared the overall pipeline and details of our methods with a hope of helping other artists create more projects that discusses the phenomenon of fake news in our society as well as giving the general audience an understanding of the process of fake news generation. We share the project at GitHub `https://github.com/previtus/fake_news_generation_mark_I`.

For our future work, we plan to generate a new dataset category about Artificial Intelligence. We want to capture how it is being presented online, since a lot of excitement and fear surrounding it is based on false or exaggerated information. We are also considering creating a new dataset from "alternative media" websites that contribute to the propagation of fake news [13].

References

[1] Albright, J. 2017. Faketube: Ai-generated news on youtube.

[2] Box, M. 2018. Machine box - textbox.

[3] Commons, C. 2018. Creative commons search.

[4] FakerFact. 2017. Fakerfact.org.

[5] Graves, A. 2012. Sequence transduction with recurrent neural networks.

[6] Hankyoreh, h. 2018. 제주퀴어축제 차량이 사람 덮쳤다? '가짜뉴스 공장' 또 걸렸다 / jeju queer festival vehicle has hit people? 'fake news factory' took another shot.

[7] Hochreiter, S., and Schmidhuber, J. 1997. Long short-term memory. 9:1735–80.

[8] Karras, T.; Aila, T.; Laine, S.; and Lehtinen, J. 2017. Progressive growing of gans for improved quality, stability, and variation. *CoRR* abs/1710.10196.

[9] Kim, S. 2017. Multi-layer recurrent neural networks (lstm, rnn) for word-level language models in python using tensorflow. `https://github.com/hunkim/word-rnn-tensorflow`.

[10] Lipton, Z. C. 2015. A critical review of recurrent neural networks for sequence learning. *CoRR* abs/1506.00019.

[11] Mikolov, T.; Karafiát, M.; Burget, L.; Cernocký, J.; and Khudanpur, S. 2010. Recurrent neural network based language model. volume 2, 1045–1048.

[12] Shu, K.; Sliva, A.; Wang, S.; Tang, J.; and Liu, H. 2017. Fake news detection on social media: A data mining perspective. *CoRR* abs/1708.01967.

[13] Starbird, K. 2017. Examining the alternative media ecosystem through the production of alternative narratives of mass shooting events on twitter. In *Proceedings of the Eleventh International Conference on Web and Social Media, ICWSM 2017, Montréal, Québec, Canada, May 15-18, 2017.*, 230–239.

[14] Studios, B. 2018. Harry potter and the portrait of what looked like a large pile of ash.

[15] Tavernise, S. 2016. As fake news spreads lies, more readers shrug at the truth.

[16] Yao, Y.; Viswanath, B.; Cryan, J.; Zheng, H.; and Zhao, B. Y. 2017. Automated crowdturfing attacks and defenses in online review systems. *CoRR* abs/1708.08151.

Authors Biographies

Vít Růžička received his B.Sc. and M.Sc. with Honors in Computer Sciences with specialization in Machine Learning, Computer Graphics and Interaction from the Czech Technical University in Prague, Czech Republic in 2017. He spent nearly two exciting years of research internships at the Electrical and Computer Engineering department of Carnegie Mellon University in USA (September 2017 - May 2018) and at the EcoVision lab of the Photogrammetry and Remote Sensing group at ETH Zürich in Switzerland (January 2019 - July 2019). His research interest are Machine Learning, its application to other disciplines, Computer Vision, Creative AI and the intersections of Machine Learning and Art.

Eunsu Kang is a Korean media artist who creates interactive audiovisual installations and AI artworks. Her current research is focused on creative AI and artistic expressions generated by Machine Learning algorithms. Creating interdisciplinary projects, her signature has been seamless integration of art disciplines and innovative techniques. Her work has been invited to numerous places around the world including Korea, Japan, China, Switzerland, Sweden, France, Germany, and the US. All ten of her solo shows, consisting of individual or collaborative projects, were invited or awarded. She has won the Korean National Grant for Arts three times. Her researches have been presented at prestigious conferences including ACM, ICMC, ISEA, and NeurIPS. Kang earned her Ph.D. in Digital Arts and Experimental Media from DXARTS at the University of Washington. She received an MA in Media Arts and Technology from UCSB and an MFA from the Ewha Womans University. She had been a tenured art professor at the University of Akron for nine years and is currently a Visiting Professor with emphasis on Art and Machine Learning at the School of Computer Science, Carnegie Mellon University.

David Gordon is an interdisciplinary artist and engineer living in the Los Angeles area. He has a specialty in simulation for autonomous systems, and currently works in NVIDIA's autonomous driving simulation division. He received a BCSA (Bachelors in Computer Science and Arts) from Carnegie Mellon University in 2019.

Manzil Zaheer earned his Ph.D. degree in Machine Learning from the School of Computer Science at Carnegie Mellon University under the able guidance of Prof Barnabas Poczos, Prof Ruslan Salakhutdinov, and Prof Alexander Smola. He is the winner of Oracle Fellowship in 2015. His research interests broadly lie in representation learning. He is interested in developing large-scale inference algorithms for representation learning, both discrete ones using graphical models and continuous with deep networks, for all kinds of data. He enjoy learning and implementing complicated statistical inference, data-parallelism, and algorithms in a simple way.

After Dan Graham: An archaeological approach to virtual reality art

David Han
York University
Toronto, Canada
dhan@yorku.ca

Abstract

After Dan Graham is a mixed reality art installation that employs an experimental media archaeological art methodology to bring closed-circuit video installation art into dialogue with emerging creative practices in virtual reality (VR). Recent work by immersive media artists have employed an archaeological approach to the creation of a variety of media art. Concomitant with these creative practices are studies that employ an archaeological method to re-examine the history of immersive media technologies. Both the scholarship and creative practices have explored fascinating connections between emerging technologies and the technologies of the past. *After Dan Graham* extends the archaeological approach to VR by re-creating and expanding an early form of closed-circuit video installation art within a virtual environment. In doing so, this project foregrounds the corporeal data that drives the VR experience and theorizes closed-circuit video installation art as a form of proto-VR.

Keywords

Virtual reality, media archaeology, closed-circuit video installation art, media art, Dan Graham

Introduction

After Dan Graham is a mixed-reality art installation that employs an archaeological approach to re-create and expand Dan Graham's 1974 closed-circuit video art installation, *Time Delay Room 1*.

As a method used by scholars to explore marginalized, repressed or neglected media histories and technologies, media archaeology has uncovered insightful connections between the history of media technology and contemporary media discourse. As an approach used by media artists to mine the aesthetics and material of obsolete or forgotten media technology, the archaeological approach to art has generated a wide variety of work that integrates the old with the new.

Recently media artists have employed an archaeological approach to create VR experiences. From re-creations of famous paintings or historical sites to the virtual realization of speculative architecture, VR artists employing the archaeological approach to media making have been bringing the past into the present through their work.

Employing an experimental media archaeological art methodology, *After Dan Graham* applies Graham's groundbreaking use of video feedback to the corporeal data collected by the virtual reality (VR) apparatus. This creates a temporality unique to VR incarnated in the form of an endless stream of virtual agents. In doing so, the project suggests that the closed-circuit video art installations of the 60s and 70s can be thought of as a form of proto-VR.

After Dan Graham

After Dan Graham is a mixed reality interactive art installation and experimental virtual reality (VR) experience. This project was born out of a desire to investigate the poetics of VR and seeks to examine the creative potential inherent in VR's ability to create affective kinesthetic experiences.

The project takes inspiration from structuralist approaches in art that emphasized the material aspects of time-based media to explore the unique formal qualities of VR.

Through a re-creation and expansion of Dan Graham's 1974 video art installation *Time Delay Room 1*, this project can be considered a work of experimental media archaeological art. As such, the project excavates the unique temporality enabled by the use of feedback and suggests a link between the sensual qualities of VR experiences and early video installation art.

Project Description

The installation takes place inside a single room with white walls which are empty save for four monitors, two mounted on one wall and the other two mounted on the opposite wall. A single, wireless VR head-mounted display (HMD) and two VR hand controllers sit on a small plinth just outside the room.

A single participant is invited to put on the VR HMD and carry the two hand controllers. Inside the virtual environment, the participant is placed inside the body of a featureless humanoid avatar, whose movements correspond directly to the movement of the participant. Looking around, they see a re-creation of Dan Graham's video art installation *Time Delay Room 1* (1974).

Every eight seconds after the VR experience begins, a new virtual agent spawns in the initial location of the participant. As seen in figure 1, the virtual agent looks identical to the participant and its movement is based on the movement of the participant on an 8 second delay. Over time, the room becomes populated with a crowd of virtual agents, all echoing the past movements of the VR participant as seen in figure 2.

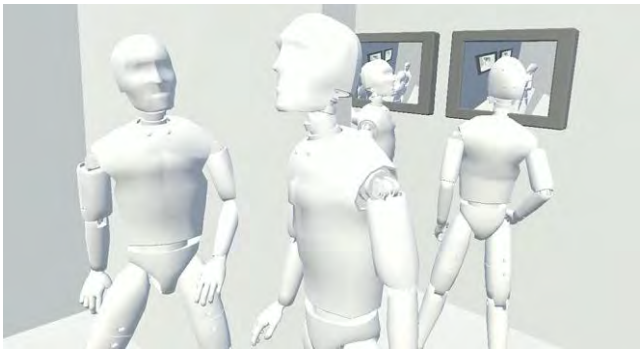


Figure 1. David Han & Aidan Waite. After Dan Graham, 2019 © David Han & Aidan Waite.

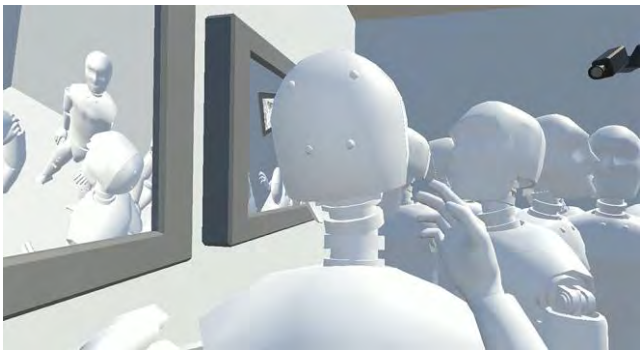


Figure 2. David Han & Aidan Waite. After Dan Graham, 2019 © David Han & Aidan Waite.

Those outside of the virtual environment (not wearing the HMD) are free to move about the installation and observe the four monitors. These monitors display the same images as the four monitors inside the virtual environment - two show the live feed of the adjacent room (in the virtual environment) and two show the live feed of the current room (in the virtual environment) on an 8-second delay. In addition to observing the monitors, people outside the virtual environment may also observe the participant wearing the VR HMD as they move about the experience.

Time Delay Room 1

Time Delay Room 1 was a closed-circuit video installation created by Dan Graham in 1974. As seen in figure 3, the installation featured two identical rooms, each surveilled by a closed-circuit video camera. In each room were two monitors. One monitor displayed the real-time video feed of the other room. The other monitor displayed the video feed of the current room on an eight-second delay.

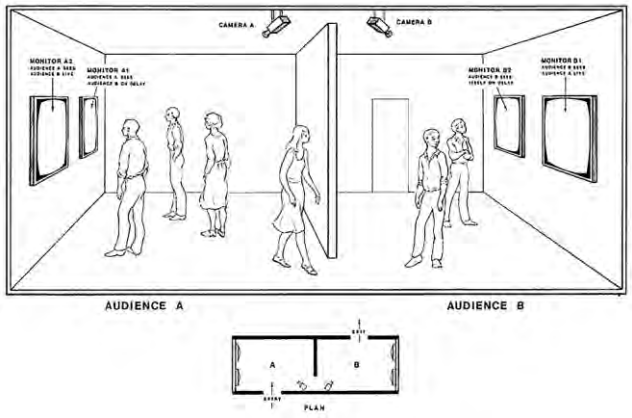


Figure 3. Dan Graham, Time Delay Room 1, 1974 © Dan Graham.

In *Time Delay Room 1*, Graham explored the unique ability of video to capture, transmit and display real-time moving images. He was interested in the way that the unique temporality of video – as instantiated in a video feedback loop – could be employed to alter a person's sense of self-perception.

> …if a perceiver views his behavior on a 5 to 8 second delay via video-tape (so that his responses are part of, and influencing his perception), 'private' mental intention and external behavior is fed back on the monitor and immediately influences the observer's future intentions and behavior. By linking perception of exterior behavior and its interior, mental perception, an observer's 'self', like a topological moebius strip, can be apparently without 'inside' or 'outside'. Video feedback time is the immediate present, without relation to past and hypothetical future states – a continuous topological or feedback loop forward or backward between just-past or immediate future. [1]

Furthermore, Graham pushed the unique temporality afforded by the video feedback loop into the physical space of the gallery. In doing so, it only became activated in the presence of a participant. This created conditions under which the collapse of subject and object, interior and exterior, private and public, could only be understood through the participant's sense of embodied presence.

In writing about closed-circuit video installation art, Margaret Morse argues that the extension of the temporality of the video apparatus into physical space is the *raison d'être* of this type of art:

> While an installation can be diagrammed, photographed, videotaped, or described in language, its crucial element is ultimately missing from any such two-dimensional construction, that is, "the space-in-between," or the actual construction of a passage for bodies or figures in space and time. Indeed, I would argue, the part that collapses whenever the installation isn't installed is the art. [2]

She argues that the affective experience of closed-circuit video installation art lies not in the content of the medium, but rather in the encounter of medium and body. She concludes that "… the underlying premise of the installation appears to be that the audiovisual experience supplemented kinesthetically can be a kind of learning not with the mind alone, but with the body itself" and that this learning occurs "… at the level of the body ego and its orientation in space." [3]

Media Archaeology

Media archaeology is a method used in both scholarship and creative practices. Several scholars have employed the archaeological method to re-examine the history of media technologies to explore the material, aesthetic and discursive connections between historic and obsolete technologies and the contemporary media landscape.

As a method for creative practice, the archaeological approach is varied and diffuse. In the late 90s, media theorist Erkki Huhtamo identified a range of media artists employing an "archaeological approach" in their work.[4] From Lynn Hershman's *Room of One's Own* to Michael Naiman's *See Banff!*, Huhtamo explored artists who create work that mine the past to explore the culture that gives rise to the technology on which their work is built.

Nearly 20 years later, Hertz and Parikka offered an expanded media archaeological art methodology. Built upon the media archaeological work of Wolfgang Ernst [5], this expanded methodology pushed media archaeological art beyond an encounter with the discursive or speculative towards "the real technological conditions of expressions" of "concrete devices" with "an intensive gaze on the microtemporal modulations that take place in computerized circuits of technology." [6] This approach extended media archaeology art as a method for repurposing obsolete or dead media. Through this process, both the device itself and its particular temporalities are resurrected as "zombie" media.

Media Archaeology and VR

Many media theorists have used media archaeological methods to study, explore and expand on the history of immersive media. Oliver Grau [7], Alison Griffths [8] and Erkki Huhtamo [9] have explored the connection between the phenomenology of VR environments and immersive experiences throughout history. From the immersive rooms in ancient and classic history to the pre-cinematic technologies of the early 19th century to contemporary interactive installations, these scholars have expanded the possibilities of VR by deepening our understanding of the history of immersive media technologies.

Historical Precedents

With the continued emergence of VR as a widely accepted computing platform, an increasing number of artists are exploring its creative potential. Given its ability to immerse participants inside virtual environments, VR lends itself well to the archaeological approach to media making. VR studios such as Lithodomos VR [10] and Hiverlab [11] have created VR recreations of ancient heritage sites such as the Temple of Venus and Roma and Famagusta's Armenian Church. Cultural institutions such as the Tate Modern [12] and The Dalí Museum [13] have created VR experiences that allow visitors to visit Modigliani's studio or climb inside a Dalí painting come to life. The Louvre hosted a performance by VR artist Anna Zhilyaeva, who re-created Eugène Delacroix's famous painting, *Liberty Leading the People*, using the VR application *Tilt Brush* in front of a live audience. [14]

However, while at first glance these projects take an archaeological approach to the creation of the VR work, the source material on which the work is based is neither marginal or neglected (heritage sites, famous painters & paintings) and the experiences themselves do not enrich the connections between the past and present. Rather, they tend to reinforce existing historical narratives while at the same time offering VR as a "transparent" medium. [15]

Jeremy Rotsztain's *House of Shadow Silence*

House of Shadow Silence is a VR experience created by media artist Jeremy Rotsztain. In the work, viewers float through a re-creation of the Film Guild Cinema, a Depression era cinema designed by Austrian-born architect Frederick Kiesler. [16]

The Film Guild Cinema was notable for its De Stijl-inspired design and the fact Kiesler initially intended the cinema to house multiple projectors which would cover all the surfaces of the auditorium with projections. Unfortunately, due to budget cutbacks, his intended design was never implemented.

However, in *House of Shadow Silence*, Rotsztain has reimagined Kiesler's original vision for the cinema. When viewers put on the headset, they are transported inside Kiesler's fully-realized cinema, complete with a film playing on the surfaces that surround them as illustrated in figure 4.

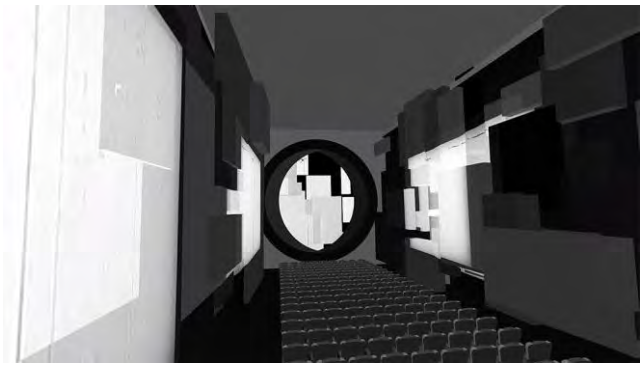


Figure 4. Jeremy Rotsztain, *House of Shadow Silence*, 2017 © Jeremy Rotsztain.

In *House of Shadow Silence*, the archaeological approach is employed to realize a work of speculative architecture and expand our understanding of immersive media to include the work of visionaries such as Frederick Kiesler.

However, while a fascinating use of the archaeological approach, *House of Shadow Silence* does not allow viewers to explore the virtual environment freely. Rather, it takes seated viewers through a 6-minute experience. In contrast to this linear presentation of a VR experience, *After Dan Graham* is a fully interactive, mixed reality environment.

After Dan Graham and the archaeological approach

Through the reconstruction and expansion of Dan Graham's *Time Delay Room 1*, *After Dan Graham* can be situated within a media archaeological art tradition. Specifically, the project employs feedback to incarnate a participant's corporeal data in the form of a population of virtual agents. This expands subjectivity beyond the participant's virtual body into a multiplicity of exterior, observable bodies, foregrounding the internal operations and unique temporality of the VR apparatus and making evident the corporeal data that is the very foundation of VR. Indeed, the data collected by the surveillance of the body of the participant is fundamental to the creation of the illusion of immersion within the virtual environment. [17] This suggests that the structuralist approaches of the artists of the 60s and 70s, whose work foregrounded the materiality and temporality of the time-based media with which they worked, are important, perhaps even vital, for understanding contemporary emerging media technology.

Furthermore, this project virtually re-creates what Morse called "the space-in-between" offered by the original artwork. The multiple virtual agents that populate the virtual environment are felt, as much as they are seen. Echoing Morse's sentiment regarding the closed-circuit installation art of the 60s and 70s, the part that collapses whenever the VR HMD is taken off *is* the art. This positions closed-circuit video installation art as a sort of proto-VR and suggests that the affective potential of VR lies not solely in what is represented, but rather in the encounter between body and media content.

Conclusion

After Dan Graham uses an experimental media archaeological art methodology to link the emerging computing platform of VR with the work of video installation artist, Dan Graham. In addition to re-constructing Graham's closed-circuit video art installation *Time Delay Room 1*, this project extends Graham's work by applying Graham's use of feedback and delay to the corporeal data that drives the VR apparatus. In doing so, this project expands on current media archaeological art practices in VR, positioning closed-circuit video art installation as a form of proto-VR and suggesting that the concerns of early video artists may be vital for contemplating contemporary immersive media such as VR.

Acknowledgements

I would like to thank Dr. Graham Wakefield, Dr. Caitlin Fisher & Dr. Janine Marchessault for their mentorship and support. This research project is supported by the Social Sciences & Humanities Research Council. Lastly, my sincerest gratitude to my collaborator on this project, Aidan Waite.

References

[1] Dan Graham, "Essay on Video, Architecture and Television" in *Video-Architecture-Television: Writings on Video and Video Works, 1970-1978,* ed. Benjamin H.D. Buchloh (Halifax: Press of the Nova Scotia College of Art & Design, 1979), 69.

[2] Margaret Morse, "Video installation art: the body, the image, and the space-in-between" in *Illuminating Video: an essential guide to video art*, eds. Doug Hall and Sally Jo Fifer (New York: Aperture Foundation, 1990), 154.

[3] Margaret Morse, "Video installation art: the body, the image, and the space-in-between," 158 & 154.

[4] Erkki Huhtamo, "Time Travelling in the Gallery: An Archeological Approach in Media Art (1996)" in *Immersed in Technology: Art and Virtual Environments,* ed. Mary Anne Moser with Douglas MacLeod (Cambridge and London: MIT Press, 1996), 233-268.

[5] Wolfgang Ernst, "Let There Be Irony: Cultural History and Media Archaeology in Parallel Lines," *Art History*, Vol. 28, No. 5, (November 2005): 582–603.

[6] Garnet Hertz and Jussi Parikka, "Zombie Media: Circuit Bending Media Archaeology into an Art Method," *Leonardo*, Vol. 45, No. 5, (October 2012): 427.

[7] Oliver Grau, *Virtual Art: From Illusion to Immersion* (Cambridge: MIT Press, 2003).

[8] Alison Griffiths, *Shivers Down Your Spine: Cinema, Museums, & the Immersive View* (New York: Columbia University Press, 2008).

[9] Erkki Huhtamo, *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles* (Cambridge: MIT Press, 2013).
[10] Lithodomos VR, Company website, accessed October 2, 2018, http://lithodomosvr.com
[11] Hiverlab, Company website, accessed October 2, 2018, http://www.hiverlab.com
[12] Tate, "Behind the Scenes: Modigliani VR", Museum website, accessed October 15, 2018, https://www.tate.org.uk/whats-on/tate-modern/exhibition/modigliani/modigliani-vr-ochre-atelier
[13] The Dali Museum, "Dreams of Dali in Virtual Reality", accessed October 16, 2018, http://thedali.org/exhibit/dreams-vr/
[14] Anna Zhilyaeva, "Live performance at the Louvre Museum Paris (virtual reality art)". YouTube video, 3:08. Posted [August 2018]. https://www.youtube.com/watch?v=Zs3n07Clw7A
[15] Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge: MIT Press, 1999).
[16] Jeremy Rotsztain, "House of Shadow Silence (2017)". Artist's website, accessed October 25, 2018, http://www.mantissa.ca/projects/houseofshadowsilence.php
[17] Jens Schroeter, *3D: History, Theory, and Aesthetics of the Transplane Image*, trans. Brigitte Pichon and Dorian Rudnystky (New York: Bloomsbury, 2014).

Bibliography

"Behind the Scenes: Modigliani VR." Tate. Accessed October 15, 2018. https://www.tate.org.uk/whats-on/tate-modern/exhibition/modigliani/modigliani-vr-ochre-atelier.

Bolter, Jay David and Richard Grusin. *Remediation: Understanding New Media Art*. Cambridge: MIT Press, 1999.

"Dreams of Dali in Virtual Reality." The Dali Museum. Accessed October 16, 2018, http://thedali.org/exhibit/dreams-vr/.

Ernst, Wolfgang. "Let There Be Irony: Cultural History and Media Archaeology in Parallel Lines." In *Art History* 28, no. 5, (2005): 582–603.

Ernst, Wolfgang. *Sonic Time Machines: Explicit Sound, Sirenic Voices, and Implicit Sonicity*. Amsterdam: Amsterdam University Press, 2016.

Graham, Dan. "Essay on Video, Architecture and Television." In *Video-Architecture-Television: Writings on Video and Video Works, 1970-1978,* edited by Benjamin H.D. Buchloh, 62-76. Halifax: Press of the Nova Scotia College of Art & Design, 1979.

Graham, Dan. *Public/Private*. Philadelphia, PA: Goldie Paley Gallery, Levy Gallery for the Arts in Philadelphia, Moore College of Art and Design, 1993.

Grau, Oliver. *Virtual Art: From Illusion to Immersion*. Cambridge: MIT Press, 2003.

Griffiths, Alison. *Shivers Down Your Spine: Cinema, Museums, & the Immersive View*. New York: Columbia University Press, 2008.

Hertz, Garnet and Jussi Parikka. "Zombie Media: Circuit Bending Media Archaeology into an Art Method." In *Leonardo* 45, no. 5, (2012): 424-430.

Hiverlab. Accessed October 2, 2018. http://www.hiverlab.com

Huhtamo, Erkki. "From Kaleidoscomaniac to Cybernerd: Notes Toward an Archeology of the Media." *Leonardo* 30, no. 3 (1997): 221-224.

Huhtamo, Erkki. *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles*. Cambridge: MIT Press, 2013.

Huhtamo, Erkki. "Time Travelling in the Gallery: An Archeological Approach in Media Art." In *Immersed in Technology: Art and Virtual Environments,* edited by Mary Anne Moser with Douglas MacLeod, 233-268. Cambridge and London: MIT Press, 1996.

Kacunko, Slavko. *Culture As Capital: Selected Essays 2011-2014*. Berlin: Logos Verlag Berlin GmbH, 2015.

Krauss, Rosalind. "Video: The Aesthetics of Narcissism." *October* 1 (1976).

Lithodomos VR. Accessed October 2, 2018. http://lithodomosvr.com.

Mondloch, Kate. *Screens: Viewing media installation art*. Minneapolis, MN: University of Minnesota Press, 2010.

Morse, Margaret. "Video installation art: the body, the image, and the space-in-between." In *Illuminating Video: an essential guide to video art*, edited by Doug Hall and Sally Jo Fifer, 153-167. New York: Aperture Foundation, 1990.

Parikka, Jussi. "Archaeologies of Media Art." By Garnet Hertz. In *CTheory* (2010). Accessed October 22, 2018. http://www.ctheory.net/articles.aspx?id=631

Parikka, Jussi. *What is Media Archaeology?* Cambridge and Malden, MA: Polity Press, 2012.

Rotsztain, Jeremy. "House of Shadow Silence (2017)." Accessed October 25, 2018, http://www.mantissa.ca/projects/houseofshadowsilence.php.

Rouse, Rebecca. "Media of Attraction: A Media Archeology Approach to Panoramas, Kinematography, Mixed Reality and Beyond." In *Interactive Storytelling: 9th International Conference on Interactive Digital Storytelling, ICIDS 2016, Los Angeles, CA, USA, November 15-18, 2016, Proceedings.* Edited by Frank Nack and Andrew S. Gordon, 97-107. Springer International Publishing AG, 2016.

Ryan, Paul. "Self-processing." *Radical Software* 1, no. 2 (1970).

Schroeter, Jens. *3D: History, Theory, and Aesthetics of the Transplane Image*. Translated by Brigitte Pichon and Dorian Rudnystky. New York: Bloomsbury, 2014.

Spielmann, Yvonne. *Video: The Reflexive Medium*. Cambridge and London: MIT Press, 2008.

Smith, Greg J. *Our Gaze is the Projector Now – '100% Cinema' in Jeremy Rotsztain's House of Shadow Silence.* Online essay. August 18, 2017. http://serialconsign.com/node/245

Sturken, Marita. "Paradox in the Evolution of an Art Form: Great Expectations and the Making of a History." In *Illuminating Video: an essential guide to video art*, edited by Doug Hall and Sally Jo Fifer, 101-121. New York: Aperature Foundation, 1990.

Westgeest, Helen. *Video Art Theory: A Comparative Approach*. West Sussex, UK: John Wiley & Sons, Inc., 2016.

Zhilyaeva, Anna. "Live performance at the Louvre Museum Paris (virtual reality art)". YouTube video, 3:08. Posted [August 2018]. https://www.youtube.com/watch?v=Zs3n07Clw7A.

Temporal hybrids: using augmented reality to re-imagine the affordances of natural objects

Dr Anna Madeleine Raupach
Australian National University School of Art & Design
Canberra, Australia
anna.raupach@anu.edu.au

Abstract

This paper discusses two practice-based research projects produced during 2018 that explore how augmented reality (AR) can be used to re-imagine past and future possibilities of the natural world. The two artworks discussed use an innovative approach to the technique of image target detection in AR to transform natural objects into hybrid entities of static and dynamic components comprising both natural and digital elements. *Second Nature/Wasteland* (2018) is an AR installation with a virtual reality (VR) counterpart, that imagines a world where nature emits digital signals. *Sediments* (2018) is a site-specific artwork of augmented rocks in the natural landscape. Both works investigate how image target detection can be manipulated to enliven objects in ways that inform imaginative considerations of the complex temporal scales and potential affordances of natural objects in the context of environmental change.

Keywords

Augmented reality, media art, animation, climate change, temporality, installation art, site-specific art, moving image, hypernatural.

Introduction

This paper presents two artworks that experiment with image detection in augmented reality (AR) to animate natural objects by compositing layers of material and immaterial components.

This work draws on the contextual framework of contemporary art using AR to explore environmental concerns. AR has been used by artists to imagine future landscapes, for example in *Gardens of the Anthropocene* by Tamiko Thiel [1]; to recreate parts of the environment that have disappeared, such as *Exit Glacier Terminus Proejct* by Nathan Shafer [2]; and to broadcast political messages, such as *Climate March Skywrite* by Will Pappenheimer and Zachary Brady [3].

While these works activate entire spaces by placing 3D models into geolocated sites, I use AR to layer two-dimensional animation onto textures found on specific objects such as trees, rocks and leaves. I suggest this creates an unusual aesthetic through which to re-consider the unseen qualities of individual natural objects, and that this has the potential for imaginative interpretations of environmental change.

The two artworks discussed in this paper do this in different ways. *Second Nature/Wasteland* (2018) is experienced in a gallery and uses AR to create hybrid objects that are seamlessly augmented to give the impression that the animated components become part of the object themselves. *Sediments* (2018) is encountered outdoors, where the augmentation of rocks is used to emphasise the multiple temporalities at play in the natural landscape. This work employs 'seamful interfaces', where the animations are deliberately separated from the rocks to exaggerate the difference between natural and introduced elements. I will discuss the process, concept and outcomes of the two works and conclude with a brief summary of future pathways for this research.

Part 1: Second Nature

Second Nature/Wasteland consists of a series of augmented objects (*Second Nature*, Figure 1) and a virtual reality (VR) experience (*Wasteland*) that imagines a world where natural objects emit digital signals. In this paper, I focus on the AR component of this installation. In *Second Nature*, cut pine trees emanate potential Wi-Fi networks, glitchy Bluetooth connections hover over the leaves of potted plants, autumn leaves search for lost mobile data, and we become tethered to rocks like we do a personal hotspot.

Figure 1. Anna Madeleine Raupach, *Second Nature*, 2018, augmented reality app, 2 artificial plants, 2 pine logs, 3 rocks, autumn leaves. Installation view, Verge Gallery, Sydney. © 2018 Anna Madeleine Raupach

These physical objects are encountered in an installation surrounded by pink walls, where viewers engage with them through a mobile device to search for their hidden digital signals. The static and contained environment of this setting suggests that these natural objects have been removed from their natural habitat and transformed into specimens of a futuristic or alternative world. This denaturalized scene is calming yet sinister, and both unsettling and meditative.

The communicative abilities of plants have been scientifically proven. [4] The recursive relationship between humans, nature and technology is increasingly explored through contemporary art, for example through sensing technology that allows for plants to become participants in digital art. [5] I use AR and animated motifs symbolic of telecommunications services to visually imagine communicative abilities of plants and rocks, as another way that nature can become re-animated through digital technology.

Figure 2. Anna Madeleine Raupach, *Second Nature* (detail), 2018, artificial plant, digital prints on paper, augmented reality app. © 2018 Anna Madeleine Raupach.

Creating *Second Nature* involved investigation into how a camera reads image textures of natural objects. After initial experiments with printed image targets, I sought out textures in nature that emulated printed surfaces. Certain textures were nevertheless only detected as a digital print of the physical object. The resulting objects are therefore manipulated for computer vision: the potted plant has fake paper leaves attached to its stem due to the software better recognising the printed version instead of the organic leaf (Figure 2). While the rocks, tree stumps and autumn leaves could be detected in their original form, modifications to the lighting and surface quality were made to assist with their detection and augmentation, such as applying oil to the tree stump to retain clarity in its texture.

This treatment of the objects to comply with AR technology prompted new conceptual underpinnings to the work. The objects became hybrids of artificial and organic components made through both material and digital intervention to instigate a new pathway of communication between the plant and its imagined digital affordance. The interaction in viewing the AR elements of the work reflects this process of its construction. Using the AR app, participants activate a dialogue between physical object and its virtual counterpart, where human agency is situated within a call and response exchange between nature and technology (Figure 3).

Figure 3. Anna Madeleine Raupach, *Second Nature* (detail), 2018, tree stump, augmented reality app. © 2018 Anna Madeleine Raupach.

Second Nature presents a scenario that reconfigures the sender-receiver channels of communication between humans, nature and technology. It demonstrates that creatively working with image detection in AR has the effect of altering the appearance of natural objects, and that this holds potential as an expressive format through which to envision imaginative scenarios of human and non-human interactions.

Part 2: Sediments

Sediments is a site-specific artwork located at Bundanon Trust, NSW, Australia. It extends the model of AR used in *Second Nature* into the natural environment, by using the surfaces of rocks in the landscape as image targets (Figure 4). The *Sediments* app superimposes three layers of animation over nine individual rocks, specific to the shape and texture of each rock. The layers consist of a painted map of the local Shoalhaven River that flows from one rock to another, a layer of animation evocative of microscopic images of sandstone, and a moving drawing that traces the growth of lichen on the rock surface. These subjects relate to natural elements that may have shaped the rocks over time, on different scales.

Following previous writing about this work [6], in this paper I focus on its attributes in the context of research into using natural features for AR detection.

In *Sediments*, the animations appear as horizontal layers, spaced out to create gaps between the rock and animation to highlight the multi-dimensional aspects at play. Working with image targets in the natural environment involved technical issues and conceptual advantages. In an uncontrolled setting, the lighting fluctuations in harsh or soft

sunlight altered how the rock surfaces were detected. However, this increased the sense of unpredictability and discovery when searching for the AR components (Figure 5).

Figure 4. Anna Madeleine Raupach, *Sediments* (detail), 2018, augmented reality app. Screenshot from the work at Bundanon Trust, NSW. © 2018 Anna Madeleine Raupach.

The use of rock surfaces as image targets has been researched through cultural heritage projects that use AR as a digital preservation tool. Examples include Blanco-Pons et al.'s study of natural feature tracking for prehistoric rock art site at Cova dels Cavalls [7], and Gutierrez et al.'s investigation of AR as a didactic tool for visitors to learn about historical graffiti in Temple of Debod. [8] These projects both demonstrate the strength of AR in allowing viewers to experience an enhanced version of an important cultural artifact that is subject to degradation and erosion. Revitalising the original markings of ancient forms of expression, AR brings gestures from far in the past forward to the present day.

In *Sediments*, I worked with this ability of AR to illustrate different layers of time. I augmented the natural surface of rocks – that inherently encompass an immense geologic time scale – with animations that draw attention to the existence of multiple temporalities operating within the natural environment. I aimed to evoke the sense that human perception of time only allows us to experience a small section of the rate at which the environment changes.

Timothy Morton's writing on temporality in the context of global warming supports this idea. Morton conceptualises global warming as a 'hyperobject' – something that is "massively distributed in time and space relevant to humans". [9] Furthermore, 'phasing' in hyperobjects suggests that the environment is made up of multiple intersecting temporal scales, and that humans can only perceive one part of a hyperobject at one time. [10]

Adding animated AR components to rocks (that appear static), draws them into a relationship with other moving counterparts that operate on different temporal scales. This shows that using AR to alter specific objects in the natural landscape can be a powerful way to re-imagine aspects of climate change that are difficult to comprehend, for example its extended time scale. [11]

Figure 5. Anna Madeleine Raupach, *Sediments* (detail), 2018, augmented reality app. Participants interacting with the work at Bundanon Trust, NSW. © 2018 Anna Madeleine Raupach.

While the augmentation in *Second Nature* aimed to present animated counterparts as seamlessly becoming part of the physical objects, the use of AR in *Sediments* instead draws on the idea of 'seamful' interfaces relevant to both ubiquitous computing and experimental animation. Paul Roquet suggests that forms of animation and AR can both benefit from emphasising the mismatch between fabricated and physical elements in their compositions. [12]

Rather than attempting to create a seamless convergence, seamful interfaces highlight that the construction of these modes is made up of several different intersecting components that work together to express alternative temporalities and spatial experience.

Returning to the context of works by Thiel and Pappenheimer, Rewa Wright conceptualises AR artworks as 'software assemblages', where participant involvement and the capacity to self-organise presents conceptual advantages beyond the role of AR as information overlay. [13] I suggest that the two artworks discussed in this paper demonstrate that creative use of the limitations of AR image target techniques can contribute alternative ways of drawing participants' attention to dynamic relationships between physical, virtual and human components.

Conclusion

These artworks build a framework for how image targets in AR can be an expressive format through which to consider past and future affordances of natural objects. Current work in progress is exploring how spatial dimensions and live data can be incorporated as well as temporal layering. *Second Nature* uses AR to seamlessly embed digital behaviours into natural objects to create futuristic hybrid entities. Extending AR image target detection into the natural environment, *Sediments* uses seamful interfaces to highlight the geologic time scale of rocks as one of multiple temporalities in the natural landscape. Both works explore how AR

is effective in creating and conceptualising co-evolving relationships between nature, humans, and technology.

References

[1] Tamiko Thiel, “Gardens of the Anthropocene”, Tamiko Thiel Online Portfolio, accessed April 10, 2019, http://tamikothiel.com/gota/index.html

[2] Nathan Shafer, “Exit Glacier Augmented Reality Terminus Project”, Nathan Shafer and the Institute for Speculative Media, accessed April 10, 2019, http://nshafer.com/exitglacier/

[3] Will Pappenheimer and Zachary Brady, “Climate March Skywrite”, Will Pappenheimer Projects, accessed April 10, 2019, http://www.willpap-projects.com/Docus/Projects_List/MainProjectsFrameset.html

[4] Monika A. Gorzelak et al., “Inter-plant communication through mycorrhizal networks mediates complex adaptive behaviour in plant communities,” *AoB PLANTS*, Volume 7, accessed December 16, 2018, https://doi.org/10.1093/aobpla/plv050

[5] John Charles Ryan, "Plant-Art: The Virtual and the Vegetal in Contemporary Performance and Installation Art," *Resilience: A Journal of the Environmental Humanities 2, no. 3* (2015): 41, accessed December 14, 2018, https://muse.jhu.edu/article/614497

[6] Anna Madeleine Raupach, “Re-animating Climate Change: Abstract Temporalities in Augmented Reality,” *Transformations* 32, accessed 20 November 2018, http://www.transformationsjournal.org/wp-content/uploads/2018/11/Trans32_8_raupach.pdf

[7] Silvia Blanco-Pons, Berta Carrión-Ruiz, and José Luis Lerma, "Augmented reality application assessment for disseminating rock art," *Multimedia Tools and Applications*, accessed 14 December, 2018 https://doi.org/10.1007/s11042-018-6609-x

[8] Jorge Martin Gutierrez et al., "Augmented reality technology spreads information about historical graffiti in temple of Debod," *Procedia Computer Science 75*, accessed 14 December 2018, https://doi.org/10.1016/j.procs.2015.12.262

[9] Timothy Morton, *Hyperobjects: Philosophy and Ecology after the End of the World*, (Minneapolis, MN: University of Minnesota Press, 2013), 1.

[10] Timothy Morton, *Hyperobjects*, 70.

[11] Raupach, “Re-animating Climate Change”, 139.

[12] Paul Roquet, “From Animation to Augmentation: Dennō Coil and the Composited Self,” *Animation: An Interdisciplinary Journal XI.3*, (2016): 229-230.

[13] Rewa Wright, “Mobile Augmented Reality Art and the Politics of re-assembly”, *ISEA2015 conference proceedings*, Vancouver, August 2015, https://www.researchgate.net/publication/294736888_Mobile_Augmented_Reality_Art_and_the_Politics_of_Re-assembly

Bibliography

Blanco-Pons, Silvia, Carrión-Ruiz, Berta, and Lerma, José Luis. "Augmented Reality Application Assessment for Disseminating Rock Art." *Multimedia Tools and Applications*, accessed 14 December, 2018 https://doi.org/10.1007/s11042-018-6609-x

Gorzelak, Monika A., Asay Amanda K., Pickles, Brian J., Simard, Suzanne W., “Inter-plant communication through mycorrhizal networks mediates complex adaptive behaviour in plant communities,” *AoB PLANTS*, Volume 7, accessed December 16, 2018, https://doi.org/10.1093/aobpla/plv050

Gutierrez, Jorge Martin, Molinero, Miguel Angel, Soto-Martín, Ovidia, Medina, Cristóbal Ruíz, "Augmented reality technology spreads information about historical graffiti in temple of Debod," *Procedia Computer Science 75*, accessed 14 December 2018, https://doi.org/10.1016/j.procs.2015.12.262

Leslie, Esther, and Joel McKim, “Life Remade: Critical Animation in the Digital Age,” *Animation: An Interdisciplinary Journal XII.3,* (2017): 207–213.

Morton, Timothy, *Hyperobjects: Philosophy and Ecology after the End of the World*, (Minneapolis, MN: University of Minnesota Press, 2013).

Pahl, Sabine, et al., “Perceptions of Time in Relation to Climate Change,” *Wiley Interdisciplinary Reviews: Climate Change 5.3*, accessed 12 January 2018, doi: 10.1002/wcc.272

Pappenheimer, Will, “Will Pappenheimer Projects”, accessed April 10, 2019, http://www.willpap-projects.com

Skwarek, Mark, "Augmented reality activism," in *Augmented Reality Art: From an Emerging Technology to a Novel Creative Medium*, ed. Vladimir Geroimenko (Springer, 2018), 3–40.

Thiel, Tamiko, and Will Pappenheimer. "Assemblage and Décollage in virtual public space," *Media-N: Journal of the New Media Caucus*, 2016, accessed 10 April 2019, http://median.newmediacaucus.org/caa-conference-edition-2016-washington-dc/assemblage-and-decollage-in-virtual-public-space/

Tamiko Thiel, “Online Portfolio”, accessed April 10, 2019, http://tamikothiel.com

Raupach, Anna Madeleine, “Re-animating Climate Change: Abstract Temporalities in Augmented Reality,” *Transformations* 32, accessed 20 November 2018, http://www.transformationsjournal.org/wp-content/uploads/2018/11/Trans32_8_raupach.pdf

Roquet, Paul, “From Animation to Augmentation: Dennō Coil and the Composited Self,” *Animation: An Interdisciplinary Journal XI.3*, (2016).

Ryan, John Charles "Plant-Art: The Virtual and the Vegetal in Contemporary Performance and Installation Art," *Resilience: A Journal of the Environmental Humanities 2, no. 3*, accessed December 14, 2018, https://muse.jhu.edu/article/614497

Shafer, Nathan. “Exit Glacier Augmented Reality Terminus Project”, Nathan Shafer and the Institute for Speculative Media, accessed April 10, 2019, http://nshafer.com/exitglacier/

Wright, Rewa. “Mobile Augmented Reality Art and the Politics of re-assembly”, *ISEA2015 conference proceedings*, Vancouver, August 2015, https://www.researchgate.net/publication/294736888_Mobile_Augmented_Reality_Art_and_the_Politics_of_Re-assembly

Yusoff, Kathryn, and Jennifer Gabrys, “Climate Change and the Imagination,” *Wiley Interdisciplinary Reviews: Climate Change 2.4*, accessed 12 January 2018, https://doi.org/10.1002/wcc.117

Author Biography

Anna Madeleine Raupach is an artist working with AR, VR, drawing, animation and installation to explore how technology and personal expression recursively evolve. She has a PhD in Media Arts from UNSW Art & Design (2014) and is a Lecturer in Printmedia & Drawing at ANU School of Art & Design. Anna has had solo exhibitions in New York, Melbourne, Sydney, Canberra, Montreal and Bandung, and has undertaken residencies at the Cité Internationale des Arts, Paris (2018), Common Room Network Foundation, Indonesia, with Asialink Arts (2017), and a visiting artist/scholar program at the School of Cinematic Arts, University of Southern California (2016).

Vapor as Tectonic Element to Sculpt Microclimate in Architectural Space

Honghao Deng, Jiabao Li, Xuesong Zhang, Panagiotis Michalatos
Harvard Graduate School of Design
48 Quincy Street, Cambridge, MA 02138, USA
honghao.deng@gmail.com, stephlijiabao@gmail.com

Abstract

An essential function of architecture is controlling the environment that surrounds us. In practice, interior climates are discretized into self-contained, functional units. For example, wetness is kept in designated wet spaces, and dryness to dry spaces. Contrary to nature's changing weather patterns, architecture is often static and binary, with no diffusion in between. As a result, many weather conditions that exist in nature are not experienced inside architectural spaces. This project uses vapor as a medium to bring microclimates that exist outside into an architectural space. The unique characteristics of vapor as tectonic elements allow users to modulate visibility, create cooling gradients, and produce spatial patterns in a controlled manner. The three main elements are: point – vapor vertex ring, line – vapor tornado, and plane – vapor wall. The focused and diffused conditions of vapor enable both localized and global states to transpire through soft boundaries.

Keywords

Interactive architecture, microclimate, architectural spaces, vapor geometry, humidity control, responsive environment.

Figure 1. Diffused heterogeneous volume with 40% vapor density creates a sense of intimacy.

Introduction

Architecture primarily serves as a way to create and control the environment around us. Unlike natural weather, climate conditions in architecture are often static and binary, with no diffusion in between. As a result, sensory experiences that are directly accessible outdoors, like atmospheric quality, diffusiveness, and flow, are completely excluded from the indoors. The climate is discretized in space into strict self-contained, functional units, where wetness is kept in wet spaces, and dryness is kept in dry spaces.

These weather characteristics have certain architectural qualities that we can replicate. Vapor, for instance, can act as a medium to bring the outdoor experience inside. By varying the vapor density, we can isolate visual spaces and create a sense of privacy and intimacy (fig. 1). Vapor can become a new tool for architects to use to control the organization of space.

Figure 2. Three main vapor shapes: Dome, Column, Wall.

In this project, tectonic elements modulate visibility, create cooling gradients, and produce spatial patters in a controlled manner using vapor. Altogether, the indoor evolves into defined spaces of micro-climates. Three main elements make up this project: (1) point via a ring, (2) line via a tornado, and (3) plane via a wall (fig. 2). Focused and diffused conditions of vapor enable both localized and global conditions through soft boundaries.

Our prototype vapor diffusers are constructed with atomizers, fans, 3D-printed parts and electronics. By altering fan speed, size of section openings, and compression volume, we sculpt the vapor quality and

control the global condition of how our visual system perceives reality.

Imagine a future where architects not only sculpt their ideal space but also control the weather inside: one corner feels like the Saharan Desert, while the other behaves like the Amazon rainforest. In one corner, an early morning mist greets the contemplative mind, and in the center space, a focused tornado vapor attracts a gathering crowd. The interior space no longer acts like static and binary units—with clear boundaries like rain for shower, snow for fridge, or sun for light—but like dynamic, diffused, and phenomenal experiences.

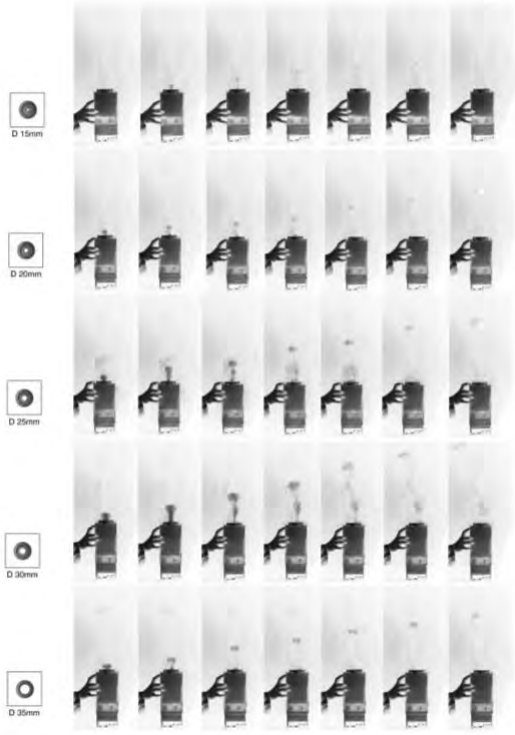


Figure 3. Travel distance of the vortex ring relies on aperture size.

Construction of Vapor Rings

A focused packet of vapor that travels through space, or a "toroidal vapor vortex", is a constant air flow around a center axis. In this circulation, the packet travels along the axis perpendicular to the toroid. Overall, the circulation makes the vortex ring less likely to disperse while traveling along the axis. As a result, the ring tends to maintain its size, shape, and momentum for a long distance (fig. 3).

To generate this form, vapor must be pushed out from a watertight chamber through a circular aperture (fig. 4). Compressed air, elastic force from the membrane, magnetic force from the Voice Coil serve as the actuations to generate the push. The stability of the vortex depends on the volume of air pushed out, the velocity of the piston, and the diameter of the aperture. Usually, a stable vortex ring requires a sudden puff of air to push out in a very short period of time.

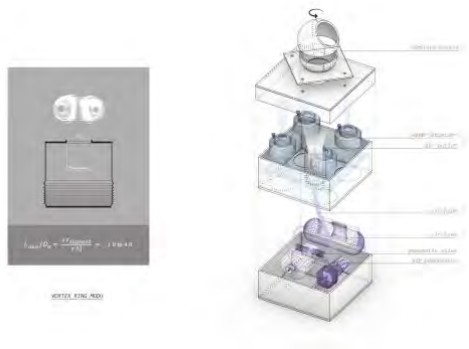


Figure 4. Construction of the vapor rings.

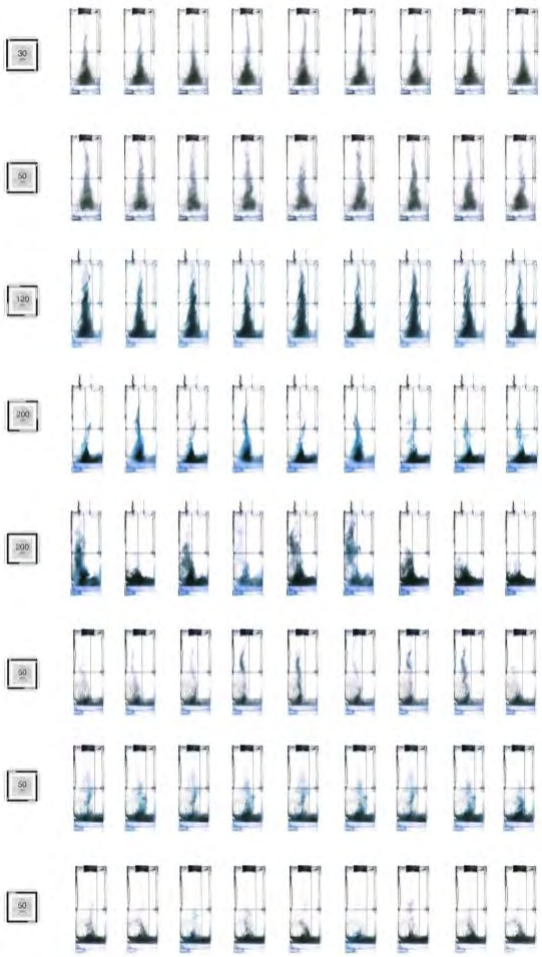


Figure 5. Tornado beam geometry at various fan speeds and boundary conditions. Overall symmetry of boundary conditions is key to forming stable tornadoes.

Construction of Vapor Tornados

To generate a focused beam that rapidly rotates like a tornado, a shear levitating force must emit from one end. This area that holds less air pressure usually comes from a high altitude and eventually forms the head and neck of the tornado. On the other hand, ground conditions are required

to keep this highly volatile phenomenon persistent. In a stable tornado system, negative high-pressure air is drawn uniformly from all directions, forming a counter-clockwise rotation on the outer realm of the tornado (fig. 5).

In vapor diffusion system, the vapor is generated by ultrasonic atomizers. The shear levitating force is generated by a DC fan to trap the generated vapor. Ground condition is created by symmetric openings on the container to allow positive pressure to flow into the system in a counter-clockwise fashion.

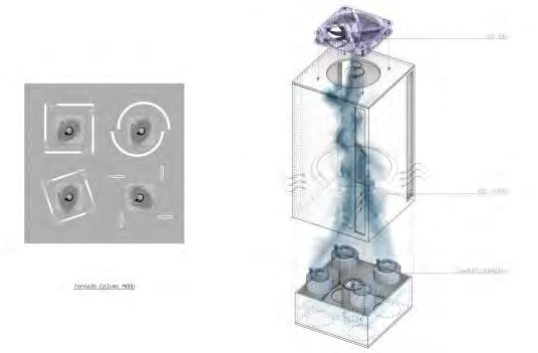


Figure 6. Construction of vapor tornados.

Above the tornado mechanism, the outer boundary condition can adjust with sliding doors and replacement of the walls on all four sides. A center force generator is upgraded to removable DC fans with PWM capacity. In this setting, the relationships between the stable formation of the tornado, the center airflow speed, and the boundary conditions can be studied. Each boundary condition is tested with 30cfm, 40cfm, 50cfm, 120 cfm, 150cfm, and 200 cfm fan speed, and is recorded in 120 fps video to study.

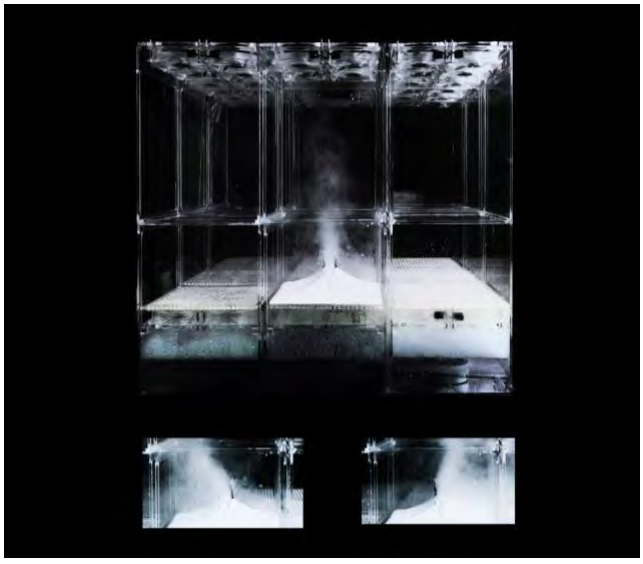


Figure 7. Space and visibility are divided dynamically by changing the density and direction of vapor.

Construction of Vapor Walls

In order to create consistent homogeneous vapor volume in an enclosed environment, two sets of identical DC fans (2 pushing fans, 2 pulling fans) are used at the inlet and outlet of the airflow from the outside. These sets run symmetrically to each other to decrease the turbulence generated from within. With this setting, different densities of vapor can be controlled at different heights in the system. The matrix of basic constructions with swappable external walls (fig. 7) allow unique conditions within the modules.

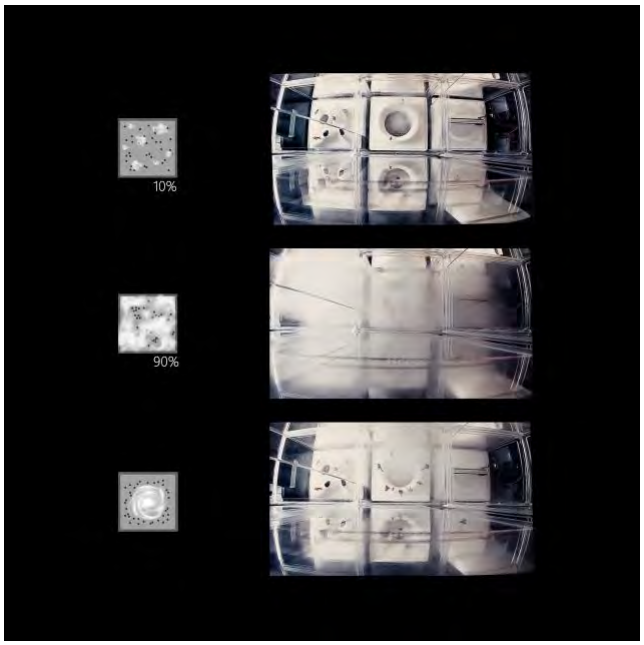


Figure 8. Modulating visibility divides the space and produces spatial patterns in a controlled manner. As a result, groups form from the division of a crowd in the room.

Diffusive Geometries as Architecture

Imagine the endless potential for diffusive architectural tectonics through the modulation of visibility. Vapor offers a new medium that can be useful for architectural settings, like in a bathroom or at the park. With 0% vapor in the environment, people move about randomly on site. When global vapor density reaches 10%, people start to form groups on a small scale (fig. 8). When vapor density is at 50%, grouping behavior becomes sculpted by the vast vapor geometry. At 80%, activities once again distribute randomly on the site.

A massive focused local event can also be created by vapor tornados (fig. 9). A tornado column flowing from the center of the site focuses diffused vapor to create immediate visibility. In this condition, people are likely to be curious and gather around the tornado column.

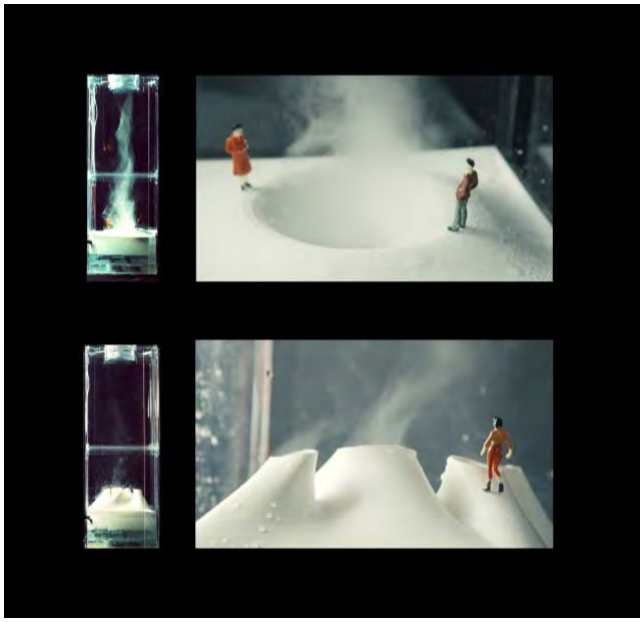


Figure 9. Tornado beams create diversion and attraction, proving useful to forming public spaces.

Branching from its artistic value, vapor offers a practical advantage to its viewers: a sense of privacy. Similar to how a wall creates discrete rooms, vapor creates private space through varying degree of density and range of visibility. Vapor provides a visual, diffusive way to control the sense of privacy and isolation. An ideal example of vapor-organized activities is at the park: people exist in multiple kinds of groups, from large crowds at an event—a localized vapor tornado—to small groups and individuals who share a contemplative relationship with the landscape—diffused vapor islands (fig. 10).

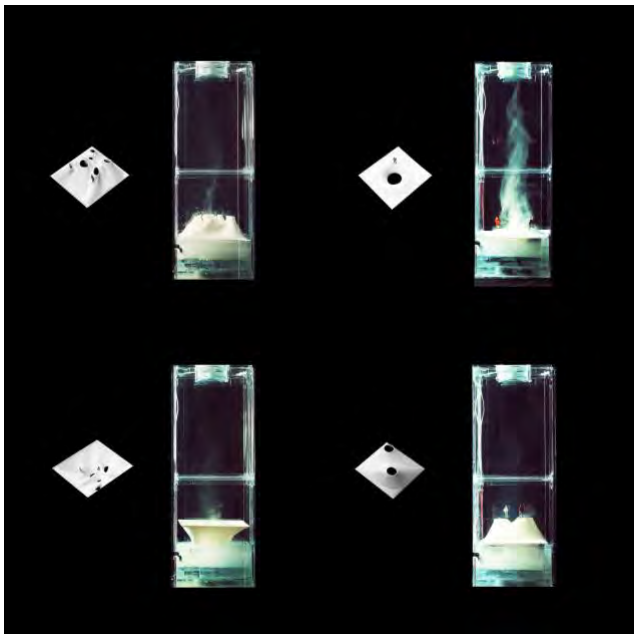


Figure 10. Geometries of ground plane sculpt the shape of vapor.

Conclusion and Future Developments

Vapor is a versatile, controllable medium, that offers invaluable qualities to an architectural space. The future development of this research will focus on implementation into the real world on an architectural scale. Furthermore, increased control of this medium for greater precision and lower maintenance will be studied. Overall, vapor will go on to empower architects to not only sculpt spaces, but also sculpt the climate inside.

References

[1] Shariff, K., Leonard, A., and Field, M. Vortex rings. *Annual Review of Fluid Mechanics 24*, 1 (1992), 235–279

[2] "Philippe Rahm: 'Form and Function follow Climate'", https://admin.arch.ethz.ch/vortragsreihe/pdf_archithese/Rahm_AR_2-10_ s088-093.pdf

[3] Baird, M. and Wairegi, T. Velocity and momentum of vortex rings in relation to formation parameters. *The Canadian Journal of Chemical Engineering* (1977).

[4] Gupta, S., Morris, D., Patel, S. N., and Tan, D. Airwave: Non-contact haptic feedback using air vortex rings. In Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing, UbiComp '13, ACM (2013), 419–428.

[5] Mohseni, K. A formulation for calculating the translational velocity of a vortex ring or pair. Bioinspiration & biomimetics (2006), S57–64.

Author Biographies

Honghao Deng is a computational designer and artist. He holds a Master of Design Studies with distinction at Harvard GSD and has served as a research fellow in the City Science Group at MIT Media Lab. Recognition gained in the design and interaction community include: Golden A' Design Award, iF Design Award, Fast Company World Changing Ideas Award, 1st Place Future Cities Contest, Ubicomp/ISWC Design Award. His work has been covered by Domus, CCTV, ArchDaily, Designboom, Milan Design Week, The National, and Metropolis Magazine.

Jiabao Li works at the intersection of emerging technology, art and design. Her work opens questions about technology's influence on human perception, identity, and emotion. Her research-based projects range from wearables, projections, drones, installations to scientific experiments. She holds a Master of Design in Technology degree with Distinction from Harvard GSD. Jiabao's work has been featured in Domus, TechCrunch, Yahoo, CCTV, Yanko Design, and The National. Her work has been shown in Milan Design Week, Dubai Design Week, SIGGRAPH, CHI, AR in Action, and PRIMER. She is the winner of iF Design Award, Fast Company World Changing Ideas Award, Future Cities Contest, ISWC Design Award, and Harvard Best Thesis Award.

Digital Museum and User Experience: The Case of Google Art & Culture

Jin Woo Lee[1], Yikyung Kim[2], and Soo Hee Lee[3]

[1] Kyung Hee University, Korea, insightintoart@gmail.com
[2] Seoul National University of Science and Technology, Korea, clarakkim@gmail.com
[3] Corresponding author, University of Kent, UK, s.h.lee@kent.ac.uk

Abstract

Museum websites have evolved from offering information on the collections of institutions over the virtual space to providing the richer user experience. However, previous research in museology has mainly focused on the causal relationship between online users and actual visitors of physical museums, neglecting users' behaviour within the digital platform or human-computer interaction (HCI). This study aims to explore the way in which online users are affected by the interface tools of digital museums with a case study of the Google Art & Culture. Drawing on the concept of remediation [1], our analysis reinforces the interactivity based on its interface tools such as "Zoom-in" and "Museum View" for delivering information (transparency) and "User Gallery", "Share", and "Details" for compelling experience (reflectivity). The outcome of this research suggests ways in which museum professionals can develop and manage user interface of their institutions.

Keywords

Human-computer Interaction; Remediation; User experience; Digital Museum; Google Art & Culture

Introduction

The development of technology has changed the way we create, provide, and possess arts. Particularly, the growth of using internet has had a significant impact on all levels of visual arts [2]. In particular, the websites of museum have been evolved from giving information of current and upcoming events in the institutions to affording richer virtual experiences of appreciating works of art [3]. However, few works have explored online users' engagement with the digital museum. We presume that users interact autonomously with the virtual museum provides "a genuine online visitor experience" [4]. This study has aimed to understand the extent to which the interactivity has been affected by the interface tools of digital museum. In this paper, we explore Google Art & Culture (previous known as Google Art Project, and henceforth GAC) as a case study with not focusing on the technical issues of our case, but emphasising upon the conceptual argument. We mainly argue that interactivity between online users and the GAC within the quality of remediation [1], which is accomplished by analysing interface tools of the GAC.

Theoretical Background

There are several approaches to explain "user experience". According to Forlizzi and Battarbee (2004), user experience is caused by interaction between commodity and users [5]. According to the degree of interactivity, Pine and Gilmore (1998) analyse the experience in two dimensions: participation and connection [6]. Customers divide into active and passive groups, according to the degree of participation. Passive participation means that users do not affect the event. In contrast, with active participation, people are in a position to affect the performance significantly. Another approach is connection, in which users absorb or are immersed in the environment of the performance. Pine and Gilmore (1998) place the experience in four realms according to the previous two dimensions [6] (Figure 1).

Figure 1: The four realms of an experience [6]

We examine the related theories of the digitalisation of artworks closely. In the digital age, artworks represent in the new environment; computer. Indeed, interface is an important definition to represent the culture in the computer environment. The interface is expressed as a layer, posi-

tioned between user and system [7]. Interface design is explained in relation to the effect of remediation.

The new media theory of "remediation" was introduced by Bolter and Grusin (2000), as "formal logic by which new media refashion prior media forms" [1]. Remediation is one of the three characteristics of new media: remediation, immediacy and hypermediacy [1]. The term remediation means that new media fashion differently from older media. Immediacy and hypermediacy explain the process of remediation. Immediacy is visual depiction with the purpose of enabling viewers to forget the existence of the medium. Bolter and Grusin [1] offered virtual reality (VR), where the purpose of the media is to disappear, as an example to clarify immediacy. Approaching the term VR from human experience, the term of "presence" is similar with the immediacy; "it refers not to one's surroundings as they exist in the physical world, but to the perception of those surroundings as mediated by both automatic and controlled mental processes" [8].

Hypermediacy aims to reveal the viewer in the medium. Hypermediacy is characterised by multiplicity, in which all of the media are juxtaposed, overlap and interact. The various reactions by multimedia result in reconstructing the viewer's experience. The multiple windows on a computer screen are the representative instance. These two characteristics, immediacy and hypermediacy, are not independent, but complementary.

Bolter and Gromala (2003) suggested two strategies to design an interface: transparency (immediacy) and reflectivity (hypermediacy) [9] (see Table 1). They refer to the transparency strategy as "Window", which enables viewers to ignore the presence of media. On the other hand, they make reflectivity metaphoric as "Mirror", which aims to give users a unique experience. With the strategy reflectivity, it is explained that viewers constitute the experience when surrounded with various forms of media. They noted that "each design is a combination of these two strategies" [9]. In other words, neither transparency nor reflectivity constructs interface design alone.

	Transparency	Reflectivity
Goal	information delivery	compelling experience
Metaphor	interface as window	interface as mirror
Response by user	look through interface	look at interface

Table 1. Interface design [9].

Methodology

Our paper provides a case study of a recent digital museum source, Google Art & Culture. The GAC provides "an ever-growing digital archive of the world's greatest arts" [10]. We mainly collected data from reviewing various secondary sources including a journal articles, magazines, newspapers and books. Material was also gleaned from the Internet; published documents such as the official description and instruction manual by Google, related information and interview script from the online newspapers and articles, as well as blogger project reviews, the script of recorded video of instruction the GAC by Amit Sood who is director of the GAC and transcriptions of interviewing with Sood by media. Moreover, one of the authors explored the interface of the GAC and provided information about the website practice

Google Art & Culture

Google introduced a new digital interface in 2011, the Google Art Project, which allows online users to experience virtual artworks. This project prepared for 18 months before launching to the public with the purpose of optimising the accessibility of museum's artefacts [11]. Google started the project in cooperation with 17 museums. More institutions have become involved with the project and 151 institutions joined the project [12]. Two years after the launch, the project had expanded the territory, so that 287 museums have now participated in the project [13]. The project has changed its name to the GAC with also featuring historical artefacts. Moreover, the GAC is the hub of Google Cultural Institution, along with World Wonders Project and Archive exhibitions [14].

The interface provides more than 7.2 million digital images, which is offered by large and small museums in 60 countries [15]. The artworks provided fall into classic and modern genres, without limitation of figure (e.g. canvas, sculpture and furniture). The GAC has introduced several features on the official page: (1) the project presents high-resolution digital images of museum artefacts; (2) Google's technology, "Street View", enables users to experience the interior of the museums virtually; (3) users facilitate the creation of their own gallery, using project resources; (4) users can share their collection or a particular work with others through social networks [13].

Discussion and Analysis

The interface elements of the GAC are analysed below in terms of the effect of remediation.

The GAC as "Window"

"Zoom-In" and "Museum View" are interface components to make the GAC 'Window'. In general, as we already noticed, transparent remediation ('Window') aims to seek information and enable the user to ignore the presence of the current medium [9].

Firstly, users are captivated by the interface whilst they zoom in to a particular painting. At that time, they lose sight of the fact that they are viewing it on a computer screen as they seek the details of the artwork. The interface of the GAC is immediate, by facilitating "Zoom-in" tools. Then, we pay attention on the tool behind this: high-resolution digital images. Users might be disturbed to remediate transparently when facilitating the "Zoom-in" tool with low-quality images. That is because they would face

a defective screen when zooming in on an image with low pixel density.

The GAC, then, provides immediacy with "Museum View", using panoramic pictures. In other words, the medium becomes invisible in the viewers' perception [16]. Therefore, the interface tool, "Museum View", becomes the representative example of "Window", which aims to convey information. In this context, users seek the information of an artwork's position in an institution, whilst they navigate the institution with the interface tool. Moreover, this interface leads users to discover more detail of paintings through the practice of clicking the paintings during the virtual tour. The behaviour allows users to become absorbed into the project.

However, "Museum View" has an issue that operates against the maintenance of transparency: copyright restriction. Although Google tries to solve the problem [17], "Museum View" has blurred images. Alternatively, Google scans the inside of the institution avoiding a particular object with copyright limitation [18]. For instance, a user wants to find a painting in room A, which consists of blurred images. Users ignore the medium when they are in the hallway of the museum, but recognise the presence of the medium when they reach room A. This disturbs interactivity between users and the interface.

The GAC as "Mirror"

On the GAC, "User gallery", "Compare", "Share" and "Details" contribute to make a compelling experience from reflecting the user in the interface.

Based on the "Save" function, the "User gallery", "Compare" and "Share" tools help viewers to reflect themselves in the GAC. The interface tool, "Compare", enables viewers to construct their experience. Viewers appreciate that this is not simply a digital image, but that they are achieving their own goal by customising the computer screen. Thus, this tool elicits a unique experience from users. Secondly, "User gallery" is the component resulting in participation. Through selecting and saving their favourite artworks, the user reflects their sense of identity in the interface.

In addition to this, the users share their galley by commenting on the artworks. This behaviour allows users to have a new experience that it would not be possible to have in another digital museum. Lastly, through the "Share" tool, the resources remediate reflectively. Previous work has reported that the use of bloggers' social media relates to reflective remediation [18]. On the GAC, users share an entire user gallery or a particular painting in order to discuss this with others. Therefore, a shared image in social media is the channel by which the users interact with others.

Previously, Bolter and Gromala (2003) have noted that the characteristic of reflective remediation is multiplicity [9]. The "Detail" tool is to draw a multiplicity. The "Detail" tool in practice enables the user to view information relating to a certain object. The information consists of various kinds of media: text, videos, pictures and hyperlink. For example, the users appreciate a digital image simultaneously with reading text or playing a video. Moreover, the computer screen is overlapped with the museum's website when users click the hyperlink of painting's owner detail. In this way, diverse media surround viewers and these media comprise the users' experience.

Indeed, the elements are not clearly divided into transparency and reflectivity. That is because transparent and reflective remediation is complementary [9]. The GAC elements that have been mentioned stand between "Window" and "Mirror". For example, the media become transparent during a virtual tour and users reflects themselves in the media when they click a discrete painting.

Interactive digital museum.

Pine and Gilmore (1998) notes that visiting museum is "Esthetic" experience in their classification [6]. While the visitors of gallery are usually passive, they are immersed in museum by surround environment. In the case of digital museum, we argue that the experience of users is "Educational" users are active; although users navigate around digital museum, their surrounded environment, computer, is not enough to make them immerse in digital museum. In this paper, the GAC is categorised as "Escapist" (Figure 1) and we insist that designing effective interface tools in the platform enhances the quality of remediation, which contributes to encouraging users to be active and immersed in the GAC. As such, the digital interfaces, "Zoon-in" and "Museum View", enable media to be invisible, which allows users to be immersed by the GAC. Moreover, the reflective elements, "User gallery", "Share", and "Compare", lead users to actively reflect their identity in the GAC, thereby users immerse themselves in the interface.

Conclusion

Previous research on museum limits their research scope within exploring the relationship between the physical museum and their website. However, this paper begins with considering the digital museum as users' independent activities. Therefore, this paper describes that the digital museum becomes an interactive platform by examining the GAC. We analyse the findings of a case study from the conceptual lens of remediation. Two tools, "Zoom-in" and "Museum view" play roles in terms of transparent remediation, whereas reflective remediation arises through the practice of "User gallery", "Compare", "Share" and "Details". From elements with stimulating transparency, active users become absorbed in the interface and reflective features on the interface enable them to immerse themselves in the GAC.

The outcome of analysing the GAC makes the implication for curators engaging with the digitalisation of museum. Indeed, the role of curators evolved from placing artworks in historical context on the wall of museum to structuring the aesthetic experience of art and communicating to audiences in the 1960s [20]. In other words, curators began to encourage the active and direct engagement with works of art by offering interactive spaces to visitors [21]. To pro-

vide interactive space in digital museum, curators should consider following aspects. Firstly, the latest technologies on the interface are essential resources to enhance remediation quality, which contributes to positive users' experience. Secondly, digital museum needs elements that allow users to reflect themselves into the interface, which designs unique experience for users.

With exploring the GAC from a different angle, lastly, new research agendas can be aroused: it is an interesting point why Google proceeds with this project. Google has stressed that the department of leading the project is non-for-profit sector. Despite the announcement by the head of the project and the fact that the GAC is freeware [22], Google is still able to earn potential profits. For example, although there are no advertisements during usage of the GAC, the website operation gives opportunity for Google to use their search engine or expose their advertisements, potentially. In the point of intangible aspects, the investment in the non-profit sector helps Google improve their brand status. In this way, we will explore the relationship between museums and Google or discuss how the GAC impacts changes in audience perception about Google.

Reference

[1]Bolter, Jay David, and Richard Grusin. 2000. *Remediation: Understanding New Media*. MIT Press.

[2]Lee, Jin Woo, and Soo Hee Lee. 2017. "'Marketing from the Art World': A Critical Review of American Research in Arts Marketing." *The Journal of Arts Management, Law, and Society* 47 (1): 17–33.

[3]Sundar, S. Shyam, Eun Go, Hyang-Sook Kim, and Bo Zhang. 2015. "Communicating Art, Virtually! Psychological Effects of Technological Affordances in a Virtual Museum." *International Journal of Human-Computer Interaction* 31 (6): 385–401.

[4]Cunliffe, Daniel, Efmorphia Kritou, and Douglas Tudhope. 2001. "Usability Evaluation for Museum Web Sites." *Museum Management and Curatorship* 19 (3): 232

[5]Forlizzi, Jodi, and Katja Battarbee. 2004. "Understanding Experience in Interactive Systems." In *Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, 261–68. ACM.

[6]Pine, B Joseph, and James H Gilmore. 1998. "Welcome to the Experience Economy." *Harvard Business Review* 76: 97–105.

[7]Wang, Peiling, William B Hawk, and Carol Tenopir. 2000. "Users' Interaction with World Wide Web Resources: An Exploratory Study Using a Holistic Approach." *Information Processing & Management* 36 (2): 229–51.

[8]Steuer, Jonathan. 1992. "Defining Virtual Reality: Dimensions Determining Telepresence." *Journal of Communication* 42 (4): 73–93

[9]Bolter, Jay David, and Diane Gromala. 2003. *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency*. MIT press. 67

[10]Jones, Jonathan. 2015. "Set up a Google Art Project Gallery." TheGuardian. October 9, 2015. http://www.theguardian.com/.

[11]Sood, Amit. 2011. "Building a Museum of Museums on the Web | Talk Video | TED." TED 2011. 2011. http://www.ted.com/talks/amit_sood_building_a_museum_of_museums_on_the_web.

[12]BBC. 2012. "Google Expands Online Art Project." 2012. http://www.bbc.co.uk/news/entertainment-arts-17608419.

[13]Google. 2014. "Cultural Institute – Google." 2014. http://www.google.com/intl/en-GB/culturalinstitute/about/.

[14]Ballard, Susan. 2014. "A ROBOT WALKS INTO A ROOM: GOOGLE ART PROJECT, THE NEW AESTHETIC, AND THE ACCIDENT OF ART." In *Interference Strategies Leonardo Electronic Almanac*, edited by Lanfranco ACETI and Paul THOMAS, 20:122–45. London, UK: Leonardo

[15]Lohr, Steve. 2014. "Museums Morph Digitally." *Thenewyorktimes*, October 23, 2014, accessed December 20, 2018, https://www.nytimes.com/2014/10/26/arts/artsspecial/the-met-and-other-museums-adapt-to-the-digital-age.html

[16]Bolter, Jay David, Maria Engberg, and Blair MacIntyre. 2013. "Media Studies, Mobile Augmented Reality, and Interaction Design." *Interactions* 20 (1). ACM: 36–45.

[17]Gordon, Leslie A. 2013. "It's Google, but Is It Art? Museums Wonder Whether They Should Open Their Galleries to Digitizing." *ABAJOURNAL*, 2013.

[18]Proctor, Nancy. 2011. "The Google Art Project: A New Generation of Museums on the Web?" *Curator: The Museum Journal* 54 (2). Wiley Online Library: 215–21

[19]Lee, Soo Hee, Marios Samdanis, and Sofia Gkiousou. 2014. "Hybridizing Food Cultures in Computer-Mediated Environments: Creativity and Improvisation in Greek Food Blogs." *International Journal of Human-Computer Studies* 72 (2): 224–38

[20]Acord, Sophia Krzys. 2010. Beyond the Head: The practical work of curating contemporary art. *Qualitative Sociology* 33(4): 447-67

[21] O'Neil, Paul. 2012. *The Culture of Curating and the Curating of Culture(s)*. London: MIT press.

[22] Caines, Mattew. 2013. "Arts Head: Amit Sood, Director, Google Cultural Institue", *TheGuardian*, December, 3, 2013, accessed December 20, 2018, https://www.theguardian.com/culture-professionals-network/culture-professionals-blog/2013/dec/03/amit-sood-google-cultural-institute-art-project

Ambient Commons and the Eternal Passage of the Sun in Generative Public Art

John Power
Affiliations: School of Design and School of Media and Communication, RMIT University.
Location: Melbourne, Australia
Contact Email: john.power@rmit.edu.au

Abstract

Generative ambient art in public space has been developed by the researcher as part of their creative practice. Case studies of the presentation of such art works informed the design of an ambient installation in State Library Victoria (SLV) in the Melbourne CBD over 2 weeks. This installation provided the setting where ethnographic methods facilitated public encounter. Interpretation of qualitative data generated from this encounter is considered in relation to Malcom McCullough's notion of the Ambient Commons. The research concludes that generative ambient artworks on digital displays in public settings can have a positive impact on a sense of place and intuitive place making practices and in this way supports the use of generative media as a creative way to provide public amenity and to foster the Ambient Commons.

Keywords

Ambient Commons, Generative Art, Calm Technology, Public Space, Place Making

Introduction

In this paper, I will give an account of Practice-based research in ambient generative art in public space and its contribution to public place-making. Malcolm McCullough's notion of an Ambient Commons (McCullough, 2013) is used to orient consideration for how generative artists can create ambient audio visual artworks for public space. A case study of ambient audio visual artwork in public urban interiors gives an account of how generative art practice is applied to the design and augmentation of public settings. Generative real-time simulation of a natural setting on large digital screens, spatialized audio and distributed scent incorporate the real local diurnal cycle of light, real-time transformation of local weather and olfactory representations of nearby native ecologies. Case studies have been set in a central metropolitan public library and a major cancer research hospital. Mixed methods ethnography was used to obtain data about the public encounter, the public response to generative ambient artworks and affective responses to the artworks' impact on the public setting. Abductive analysis of the data revealed a range of responses and attitudes to generative art in public space and its affordances for place-making. Results suggest generative art for ambient calm in public space helps endogenous (volitional) attention, contributes to positive affective responses to place and encourages reflection on being in public space. These results suggest encouraging paths for future research and add to the discourse on an Ambient Commons.

Ambient Commons and Calm Technology

Prominent digital screen media in public space takes a toll on our attention to our surroundings and may thereby limit our ability to experience a sense of place and the public. Malcolm McCullough's notions of an Ambient Commons ties the historical development of the commons as intrinsic to protection of shared public good and threads of 'ambience'- those parts of the environment that are all around us - that go to the enculturation of space through music, architecture and more recently ubiquitous computing (as ambient information channels). The Ambient Commons encourages us to think about the effects of public digital media screens as one example of ubiquitous screen media that might be used to *increase* public amenity, rather than reduce it by adding to the proliferation of distracting signals. Issues of a negative impact on attention were anticipated in the early 1990s by Mark Weiser and John Seely-Brown when they coined the term ubiquitous computing (or just *ubiq*) and called for a design response to what they called 'Calm Technology'. Ambient Commons picks up on Weiser and Seely-Brown's idea of a calm approach to digital interfaces, where computing might recede into the background. Calm technology principles ask that data interfaces sink in to the background and are present at the periphery of attention without causing distraction. One of Weiser's examples of this was a window from a workspace on to a common area that keeps one conscious of the passage of the day and the presence and activity of workmates without ever disrupting the worker's focus.

Aesthetic emphasis in Ambient Display

Pousman and Stasko outline ambient displays that are characterized as manifesting subtle change and making people aware of large systems, like network traffic or weather (Ishii et al); are "minimally attended" (Matthews et al), displaying one or only a few pieces of information (Stasko et al), portraying non-critical information on the periphery (Mankhoff et al). Pousman and Stasko propose a

design taxonomy that includes an emphasis on aesthetic appeal as one of four design criteria. The main case study considered here is an artistic work that maximizes aesthetic appeal in an ambient display. As public digital networked screens become part of the ubiq landscape, this project responds to Weiser's call for humane, calm ambient interfaces.

Generative Ambient Art in Public Space

A real-time audio visual installation I created that is driven by generative methods was staged over 13 days during the regular opening hours of SLV (State Library Victoria). SLV is a large Victorian-era public building that receives 1.9 M onsite visitors each year, located in the CBD of Melbourne, a highly urbanized capital city. The library staff prizes the egalitarian values and openness that the library is known for. I was required to submit a written application to a blind peer review process before being allotted time and given access to a room for the staging of the installation. My application explained the express purpose of conducting an ethnographic encounter with the public.

An ongoing unattended version of the installation is also permanently installed in the VCCC (Victorian Comprehensive Cancer Centre), a world standard clinical and cancer research hospital, also in Melbourne. The work features a real-time animated image of a natural scene on a 5m wide video wall, with 7.1 surround sound. In the installation version in SLV, there was also a natural component of native plant aromas that was designed by artist Joanne Mott to complement the images and sounds of natural ecologies. The graphical components and surround sound were all assembled using the Unity real-time 3D engine by me. The scripting of the generative camera motion and the real-time data feed was made possible with help from artist/programmer Brendan Armstrong. The creative practice components fall in to a lineage of my 30 years practice as a visual artist working with new media. The view of the virtual natural space (Figure 1) is enriched by simulations triggered by real-time weather data sourced live from a state meteorological database and reflects the wind speed and direction, cloud cover, visibility and rain. The state of the light tracks the diurnal passage of the sun and moon at the very location of the installation in Melbourne. In this way, for example, the sunset is happening in the installation in exact synchrony with the environment outside. The installation incorporates real-time visualization of the correct time-of-day and current weather conditions, albeit done through a highly aestheticized indexical representation of a native landscape. When creating the work, I was especially curious to see if those present in the installation would pick up on this aspect of the work. Some appreciated the link from inside to outside and responded affectively: "I felt reassured when the trees moved…" said one participant.

Because of the generative nature of the algorithmic agents controlling the scene, any particular sequence from one minute to the next is never repeated, but unfolds in an emergent, unending sequence. The view moves gently through an expansive virtual landscape of various coastal, forest and hinterland ecologies (scaled nominally to 1,000 acres) throughout the day, taking 'rests' at picturesque scenes every 15 minutes or so as the generative agent 'roams' around the environment. In this way, the generative art work produces the slowest of continuous transitions that reflects McCullough's evocation of spatial ambience and calm:

"A patch of sun slowly crossing a wall might produce a sense of calm while you work. It might remind you how not all that informs has been encoded and sent. It's higher resolution and lower visual demands can restore your attention in a world that is otherwise too often low resolution and insistent." (McCullough p.17)

The public library installation was arrayed with soft furnishings, including beanbags and diffused ambient lighting. The installation occupied a whole single room with a single entrance that led directly from a large public reading room that was busy with hundreds of people reading, studying or passing through over any given hour.

Figure 1. A still frame from the screen component of *Locus Amoenus*, the generative ambient artwork exhibited at State Library Victoria. ©John Power 2016-19.

The Public Encounter and Methods

Prior to the research, the methodology and all aspects of the installation were submitted to RMIT University's ethics committee and the subsequent University approval was vetted by SLV. The public encounter was conducted with the intention of finding out how an ambient installation might affect people in a broadly accessible public space. Ethnographic methods consisted of semi structured interviews with 88 interview participants (47 of which were fully recorded and transcribed; the remainder were recorded as notes), remote observation of 1,169 attendees and field notes generated extensive transcripts, memos and other written, photographic and video recording. Consent to remote observation was implied by acknowledgment of a prominent notice describing the methods at the entrance of the installation and all interviewees signed a PICF (Participant Information Consent Form) and were between 18 and 87 years old. The entrance was attended at all times by a helper and I was in the room all day with short breaks.

The interview protocol prompted participants to share their attitudes toward digital screens in public space, their personal practices for finding calm when they were in the city, the place of data-driven simulation; participants also speculated on the relevance of generative art from a range of literacies that included digital 'insiders' to those who had never heard of or considered the principles and concepts that inform generative art. Accompanied children were also included in the remote observation. This material was then interpreted and analyzed using abductive grounded theory methods, which involved three phases: eclectic interpretive coding of transcripts and other notes, thematic categorization of these codes and finally identification of significant 'core codes'. These final codes revealed broadly positive effects on orientation, place-making, calm and a continuum along a distracted/focus axis strongly favoring increased focus. One prominent and unexpected theme was expressed along a continuum of *ambivalence*, where people responded to the installation warmly, but at the same time found the particular assemblage uncanny in the sense that they felt that they were in two places at the same time or that they felt a mismatch between the relaxed openness of, as Clair[i] put it, "…it's kind of like doing yoga at lunchtime, it feels like a meditation." and the reserved comportment they would associate with being in a large public library. Sam remarked "what am I doing here? I should be out in nature!" Many people reported a dual pleasure in feeling as though they were outside in the wind, while at the same time feeling warm and sheltered. Some felt an uncanny sense of one moment feeling awed by staring out on a broad coastal landscape, then the next moment remembering that they were in a modestly sized room. A visual absence of animals was remarked on as contributing an uncanny feeling, as spatialized bird calls and insect sounds featured in the surround sound, so many people 'felt' animals nearby, but couldn't see them. The youngest participants questioned the absence of wildlife, whereas middle-aged participants took this absence to be a discursive, symbolic abstraction in the work and even enjoyed the slightly surreal or dreamy edge they said this lent to the ambience of the space.

Place, Place making and Calm

Geographer John Agnew describes place as a "meaningful location" that Tim Creswell lists as being comprised of: 1. Location, 2. Locale, 3. Sense of Place. (Cresswell 2015). These three attributes refer respectively to: 1. A specific location, 2. "the material settings for social relations" 3.the subjective and emotional attachments that people form in respect to a location. Given this concept of place, place-making is understood as the ways that people connect meaning to the material signals in a given location and furthermore accrue meaning and attachment to that space through their own readings of those signals, emplacement, meaning making and storytelling.

The Intersubjective nature of semi-structured interviews was revealed through a propensity for participants to communicate concepts through storytelling. Participants would describe feelings and values that they identified with certain types of spaces, how they liked to inhabit space and the ways in which these associations were triggered while they were in the installation. This intersubjective consideration of sense of place arose in the back-and-forth of the interview encounter. A deep background of shared embodied experience emerged – namely the experiences of being in and moving through public urban and natural spaces - and as such I became a sounding board for the interviewee to bounce ideas off. Interviewees would often express and develop ideas in hearing their own thoughts out loud, as it were, then reformulating them. Many participants reported a positive sense of movement and immersion that was not only sensory, but also a matter of internal focus. Liam said: "It's like… what I meant by 'Spirit of Place'… if I could construct in my head what I imagine it would feel like to be an embodied spirit of place - of the land, that's – this is the closest I've come across and it was so - a really completely NEW experience."

Calm Technology

Amber Case proposes 8 principles for the creation of Calm technology (Case 2016):

1.Technology should require the smallest possible amount of attention
2.Technology should inform and create calm
3.Technology should make use of the periphery
4.Technology should amplify the best of technology and the best of humanity
5.Technology can communicate, but doesn't need to speak
6.Technology should work even when it fails
7.The right amount of technology is the minimum needed to solve the problem
8. Technology should respect social norms

The abductive analysis of the qualitative data showed strong evidence of positive results across these criteria, except for principle #6, which was not relevant to the research focus on real-time generative media, although it might be argued that had the screens and speakers shut down, the warm lighting, comfortable furnishing and natural plant aromas of the room may on their own have functioned as calm technologies. Ethnographic methods drew out information about normative values and affective states and so presented strongly positive feedback to principles #1, 2, 3, 4, 5 and 8 where the most commonly developed theme was 'relaxation'. This was also supported by the remote observation in the open, unhurried way in which people generally occupied the space. Gentle posture and steady gaze suggested a strong state of volitional attention, which was supported by many people reporting spending very little metal energy attending to the various ambient signals, and being 'with their own thoughts'. "It lets me just *be*, you know?" said Kirsten

The public library encounter was conducted close to mid-winter and is perhaps why many visitors appreciated the 'coved' feeling of being at once outside, but also safely

sheltered. An interesting related effect was reported in a few people who expressed a deeply satisfying sense of social interaction in the comfort of 'looking out' in to a deep, atmospheric space, while remaining silent and 'knowing there was someone there'. What appeared to me as an observer to be a passive or even socially removed posture was anything but, from those who commented on being immersed in this way. There was a close similarity between reports of being in a state of being 'lost in thought', staring out, but also subtly registering the hubbub of the busy public library as a kind of inattentive public intimacy.

Children often initiated place-making practices, finding or constructing a 'nook' or nest by arranging the soft furnishings with an optimum vantage to the ambient signals, then beckoning guardians/parents to join them. Parent/child groups who 'camped' together in this way became very calm and spoke softly, 'went floppy' together often co-creating stories about the setting; conversely, family groups in which one of the parents remained in a standing, vigilant posture, smart phone at the ready, saw the children remain agitated and unsettled.

Some participants commented on ambivalent or mixed feelings about the ironies of simulated nature on an indoor digital screen, while also acknowledging, as urban dwellers, that the installation made them aware of a deprivation of contact with natural spaces. To this extent, they enjoyed the time spent in ideation of natural space and felt prompted to plan a trip out of the city. Some couples oriented their posture only partly to the screen and shared food and attended to each other with very little verbal exchange as though at a picnic.

The added reflexive layer of the interviewer also being the creator of the space cannot be teased out in this short paper, suffice to say that many participants enthusiastically 'turned the table' in the interview to quiz me about the "*hows"* and "*whys*" of the new media assemblage. I tried to use these exchanges as an opportunity to provoke more detail about their own aesthetic or reflective response, with questions like "what would *you* put here…?" Sue – a retired woman who had never considered generative art – soon began to speculate on applications for this kind of generative media "I'd love you to sample my back yard, so when I'm old and stuck in bed it would be like sitting on the back veranda, looking out at the birds."

Some people had strong embodied responses to the installation that differed from more familiar screen media experiences. When I asked Mateo: "Do you think ambient screens like this… would be good in public space?", he answered: "I honestly do, because I'm not a TV person myself and I'm not, I'm not a screen person, but honestly, for the first time, today, I really appreciate screens (sic). I've never been into screens at all." Other people reported a feeling of having 'cleared their heads', as though they had (sometimes over more than an hour) physically taken a walk.

Figure 2. 'Sanctuary' space in VCCC (Victorian Comprehensive Cancer Centre), featuring the Locus Amoenus installation Melbourne. ©John Power 2016-19.

The midwinter atmosphere perhaps informed an enthusiastic response from mostly inner urban dwellers who reported typical seasonal states of feeling 'cooped up'. "I really needed this", said Kirsten, "… just to spend some time staring out to the horizon. It centers you." In this same vein, Nadia reported that "… it actually became quite unified and immersive once I sunk in to the environment." Zara reported: "I feel like I've been on a mini holiday".

As well as the SLV installation, field notes were made at the VCCC hospital. After the lunch hour rush at the hospital (Figure 2), workers in the adjoining café surreptitiously begin to glance at the installation to make an intuitive estimate of the time passing; the shadows slowly lengthen on the screen toward the end of their shift. Patients in the hospital were observed spending more than an hour in the presence of the work with a detached, unselfconscious posture especially later in the day. One patient reported that it made them feel "settled" and asked "can I have one of these in my home?" The late afternoon of the last day of the public library installation saw the room filled to capacity, with 30 or so adults sitting for more than 90 minutes in complete communal silence together as the onscreen sun set and the surround speakers created a crepuscular atmosphere of birdsong, flitting insects and lapping water. One participant reflected on this experience after the installation had finally closed and we'd been ushered out of the library for the last time, saying "Maybe this is what we used to do together at sunset thousands of years ago."

Conclusion

The interdisciplinary methodology developed in this project demonstrates how creative practice and ethnographic methods can be applied to ambient generative screen art and specifically how installation art of this kind can pro-

voke questions about ethnographic considerations of 'setting', place and place making. Interpretive analysis of data gathered from ethnographic methods suggest that generative work of this kind can inform the sensory, material properties of a given public space such that they may enhance the sense of place. Art does not by itself make place, but it can provide the cognitive ingredients for humans to make places. Data-driven generative art is well situated to create endlessly varied environmental cues for the public to create their own sense of place and ambient generative screens can create theses cues without demanding attention and remain in the periphery. The relief and comfort that many participants reported in having such an art installation in a highly urban location contributed to mindful comportment in public space that fostered a sense of place and offered an overall positive public amenity. In these respects, it was demonstrated that generative installation can fulfill many of the aesthetic principles of Calm Technology and foster an Ambient Commons. The passage of the sun, the lapping of water, the drifting of clouds engages a deep human capacity to orient volitional attention while taking in the ambient environment in a peripheral way. This project shows how digital screens in public space can be used to enhance common, shared practices of place making and in this way to create more social public spaces and fostering of an Ambient Commons. McCullough evokes this sense of volitional attention, calm and delight: "… between composure and seduction. The feeling that I am not being directed, but can stroll at will – just drifting along…" (McCullough p. 223) Generative ambient screens in public space can restore attention and a dignified sense of commons by attuning the urban environment to our adapted perceptual sensitivities to the presence of flowing water, drifting clouds and the passage of the sun.

References

Case, A. Calm Technology: Principles and Patterns for Non-Intrusive Design. O'Reilly Media. 2015.

Cresswell, Tim, and EBSCOhost. *Place : an Introduction*. Second ed., Wiley Blackwell, 2015.

McCullough, Malcolm. Ambient Commons. Cambridge, MA: MIT Press. 2013.

Pousman, Zachary. Stasko, John. A Taxonomy of Ambient Information Systems: Four Patterns of Design. Proceedings of the working conference on Advanced visual interfaces, 67-74. 2006.

Weiser, M. The Computer for the Twenty-First Century. Scientific American. September 1991.

Weiser M, Seely Brown J. Designing Calm Technology. Xerox PARC. 1995.

Bibliography

Agnew, John A. Place and Politics : The Geographical Mediation of State and Society. Boston: Allen & Unwin, 1987.

Bakke, Gretchen Anna, Peterson, Marina. Between matter and method : Encounters in anthropology and art. London: Bloomsbury Academic. 2018.

Candy, Linda, and Edmonds, Linda. Practice-Based Research in the Creative Arts: Foundations and Futures from the Front Line, Leonardo, Volume 51, Number 1, 2018, pp. 63-69. 2018.

Cresswell, T., & EBSCOhost. Place : An introduction (Second ed.). Chichester, West Sussex, UK ; Malden, MA: Wiley Blackwell. 2015.

Gallanter, P. What is Generative Art? Complexity Theory as a Context for Art Theory. In GA2003–6th Generative Art Conference. 2003.

Ishii, H.,Wisenski, C., Brave, S., Dahley, A., Gorbet, M., Ullmer, B., and Yarin, P. AmbientROOM: Integrating Ambient Media with Architectural Space. Summary of CHI 1998, pp.173-174.

Library Board of Victoria. Annual Report 2017-2018. State Library Victoria. 2018.

Mankoff, J., Dey, A., Heish, G., Kientz, J., Lederer, S., and Ames, M. Heuristic Evaluation of Ambient Displays. Proceedings of CHI 2003, pp. 169-176.

Matthews ,T., Rattenbury, T., Carter, S., Dey, A., and Mankoff, J. A Peripheral Display Toolkit. *Tech Report IRBTR-03-018*. Intel Research Berkeley. 2002.

Pink, S. Doing Sensory Ethnography - Second Edition. Sage (London, United Kingdom). 2015.

Saldana, J. The Coding Manual for Qualitative Researchers. Sage. 2nd ed. 2016.

Tuan, Y. Space and Place: The Perspective of Experience. Minneapolis: University of Minnesota Press. 1977.

Warren, Carrol AB. In James A Holstein; Jaber F Gubrium. "Ch 4: Qualitative Interviewing" Handbook of Interview Research. Thousand Oaks. Sage Publications, Inc. 2001.

[i] All names are aliases

The body at the heart of the artwork

Aurélie Besson
Université du Québec à Montréal, UQAM
Montreal, QC, Canada
Contact: aurelie.besson@gmail.com

Abstract

My research, at the crossroad of aesthetics and cognitive sciences analyzes the experience of interactive art installations, which particularity is to arouse the movement senses or the viewer movement. The artworks I refer to destabilize or stimulate the movement senses and offer an embodied aesthetic experience (Stern 2013) and imply a body extension.

Keywords

Embodiment ; embodied cognition ; interactive art ; aesthetics ; experience ; movement senses

Introduction

The body at the heart of the artwork

Interactivity in art has opened a whole research field in which the visitor's gestures have become central since they modify the artwork and the visitor to various degrees. These artworks require the visitor to enter into a relation, in movement, with them.

What happens during the interactive artwork experience, between the perceived artwork and the visitor's body? And what does it imply at the level of the five senses and the body's movements?

My research analyzes the experience of interactive artworks, conceived with or without digital technologies, which have the particularity of triggering the visitor's gestures or movement.

We here define an interactive artwork to be any artwork that requires the viewer to act upon it in order for it to be realized. These are works that trigger an exchange between them and the viewer; in order to be experienced they require an adaptation of the viewer's behaviour and a change in the work and what it offers to perceive.

This study refers to artworks from the following artists : William Forsythe, Ernesto Neto, Rafaël Lozano-Hemmer, Chris Salter, Samuel Bianchini, Mathieu Briand, Simon Laroche and David Szanto, Rejane Cantoni.

This interdisciplinary study, at the crossroad of aesthetics and cognitive sciences reveals how these artworks destabilize or stimulate the senses of movement (proprioceptive, kinesthetic, vestibular senses, etc) and offer an embodied experience (Stern, 2013) that enables a certain degree of conceptualization. [1] I led an auto-ethnographic analysis based on researches made in the fields of interactive art and embodiment (Poissant ; Bianchini ; Stern), art and perceptions (Lupien), and embodied cognition (Varela ; Frak ; Fargier) which enabled me to build analysis grids to experiment and study interactive artworks. Their results then questioned, nuanced and confirmed the initial theoretical statements.

I then led an experiment on William Forsythe's work *Nowhere and everywhere at the same time* on a group of twenty participants who experimented that installation. [2] I measured if their egocentric reference was changed by their experience with the work. The egocentric reference corresponds to our representation of our own body center and of our representation of the axe that goes straight in front of us.

My research is part of the research trend of Canada's academic milieu, called Research-Creation, which links the interpretative disciplines (humanities and social sciences) with the creative ones (art and design). This involves the creation of knowledge in and through creative material and performative practice.

It is based on an assemblage of methodologies to adapt it to a complex qualitative research that draws on references from disciplines that initially appear to be far from each other.

The starting point is the idea that multi-sensorial experience does not only include the commonly identified 5 senses. Indeed, as Alain Berthoz (1997) explains, the 5 senses are not alone, as one can also identify the sense of movement, made up of kinaesthesia, proprioception, the vestibular sense, in addition to the sense of touch. [3] This research is based on the fact that we actually perceive with the whole body and numerous embodied sensory channels.

As described by Alain Berthoz (1997), gestures are both initiators of an action and a mode of perception.

Perception is thus not only an interpretation of sensorial messages: it is determined by action, it is an internal simulation of action, it is a judgement and decision making process, and it is the anticipation of the action's consequences.

Given that art has the particularity of presenting extraordinary propositions and experiences, how does it do this when it is about observing it by way of an unfamiliar experience of our own body?

That's certainly because the artworks we refer to get involved into embodied, individual physiological phenomena which they destabilize so they get experimented differently by the viewer. They unveil and extend these physiological phenomena and they transform the viewer's relation with these. They extend her/his perceptions and herself/himself. They indirectly lead the viewer to confront its human condition.

For the viewer these artworks experience is physical, sensorial and engaging but it is also conceptualizing. It enables to access a certain degree of conceptualisation that can only arise from lived experience which occurs before eventually putting into words. The aesthetic experience doesn't only arise through visual senses and hearing (senses through which most of art history has been developed) but also through and in relation with the movement senses.

Through the studies of movement senses in interactive artistic installations it enables to open an aesthetic dimension which shows how important they are in the art field but also in the understanding of our relationship with ourselves and with the world.

References

[1] Stern, N. Interactive art and embodiment. The implicit body as performance. (Canterbury, Royaume Uni: Gylphi Limited 2013).
[2] Forsythe W. City of abstract [installation interactive]. Collection de l'artiste, 2000.
[3] Alain Berthoz, *Le sens du mouvement*. (Paris: O. Jacob, 1997).

Bibliography

Alain Berthoz, *Le sens du mouvement*. (Paris: O. Jacob, 1997).
Jean-Louis Boissier, *La relation comme forme l'interactivité en art.* (Genève: Mamco, 2004).
Véronique Boulenger, *Cartographie électrophysiologique du langage et de la motricité. Du mouvement dans les mots. Apprentissage du langage d'action*. In Frak, V. et Nazir, T. Le langage au bout des doigts. Les liens fonctionnels entre la motricité et le langage. (Québec : Presses de l'Université du Québec, 2014).
Courson, M., Frak, V. et Nazir, T. Geste iconique et lexique chez le jeune enfant. In Frak, V. et Nazir, T. Le langage au bout des doigts. Les liens fonctionnels entre la motricité et le langage. (Québec : Presses de l'Université du Québec, 2014).
Fargier, R., Paulignan, Y., Boulenger V., Monaghan, P., Reboul A., Nazir T. A. Learning to associate novel words with motor actions: Language-induced motor activity following short training. Cortex, volume(48) (2012), p888-p889.
Fargier, R. Du mouvement dans les mots. Apprentissage du langage d'action. In Frak, V. and Nazir, T. Le langage au bout des doigts. Les liens fonctionnels entre la motricité et le langage. (Québec : Presses de l'Université du Québec, 2014).
Forsythe W. City of abstract [installation interactive]. Collection de l'artiste, 2000.
Laroche, S., Szanto, D. Orchestrer la perte [Installation interactive]. Collection de l'artiste, 2014.
Lozano-Hemmer, R. Pulse Spiral [installation interactive]. Collection de l'artiste, 2008.
Lupien, J. L'intelligibilité du monde par l'art. Dans Espaces perçus, territoires imagés (ouvrage collectif). (Paris: Editions L'Harmattan, 2004). pp: 15-35 inc.
Poissant, L. (dir.) Interfaces et sensorialités. (Québec : Presses de l'Université du Québec 2003).
Rossetti, Y., Rode, G., Pisella, L., Farné, A., Li, L. and Boisson, D. Prism adaptation to a rightward optical deviation rehabilitates left hemispatial neglect. Nature, 395, 166-169.
Stern, N. Interactive art and embodiment. The implicit body as performance. (Canterbury, Royaume Uni: Gylphi Limited 2013).
Varela, F. J., Thomson, E. et Rosch, E. The Embodied Mind. Cognitive Science and Human Experience. (Cambridge : The MIT Press, 1991).

Author Biography

Aurélie Besson is a Phd candidate at Université du Québec à Montréal. Her thesis project, codirected by L. Poissant and V. Frak, deals with the embodiment and the senses of movement during interactive artwork experiences. She organized ten conferences with Montreal universities. She coordinated the production and published two articles in Lumières de la ville (PUQ) directed by L. Poissant. She is currently the director and artistic co-director of Molior, an international media art exhibitions producer with projects in China, Brazil, France, Slovakia, Czech Republic, Switzerland and Canada. Based in Prague between 2007 and 2010, she previously led collaborative European projects and events in the field of art and technology. She holds a Master's degree in Communications (Université Lyon 2; Universiteit Utrecht) and a Master's degree in cultural development and project management (Université Lyon 2).

A Study NPR Rendering with Spiral Drawing Style : Focused on the SSD(Single line Spiral Drawing)

1st Young ho Kim, 2nd Yang kyu Lim, 3thJin Wan Park
The Graduate school of Advanced Imaging Science, Multimedia and Film, Chung-Ang University,
The Graduate school of Advanced Imaging Science, Multimedia and Film, Chung-Ang University,
College of Software, Chung-Ang University
Seoul, South Korea
focofu@naver.com, lim0386@gmail.com, jinpark@cau.ac.kr

Abstract

An SSD(Single line Spiral Drawing)is a reproduction of a rare illustration technique through computer graphics. Expressions that were previously neglected were a technique that could be produced only by a few people through a long period of training. Through the SSD, I want to draw a lot of art works and expression techniques that have not been noticed, and communicate them to many people. In this study, we analyze existing line drawing cases and theories and extract features of spiral drawing through NPR

Keywords

NPR, media, illustration, art

Introduction

SSD (Single line Spiral Drawing) is the work of NPR, using the expression of Spiral Drawing. Spiral Drawing is one of the drawing in one brush for line drawing. Line drawing is the technique to express the object with detailed description and omission using line. While there are many omitted parts due to characteristic of work, in this case, it is recognized as one picture by virtue of closure principle for cognitive theory of Gestalt. Therefore, if looking at the work of line drawing, it has the feature to draw a picture in accordance with the intrinsic personality of author, without definite forms.

Spiral Drawing, right in figure 1. one of line drawing, is the method to draw at one time, adjusting the thickness of advertisement video for Faber Castell Artist Pen in 2011, and is replayed for more than four hundred thousand times, being paid attention. The work drawn in spiral is similar to the various shapes such as figure in bill, form of fingerprint, etc. The ads is the portrait to express the own life of speaker, and showed the appearance which one line spreads out in spiral. However, the work, using method of spiral drawing by other artists after 2011, was not produced any more. Whereas it is identical to express via only one lining like one line drawing for Spiral Drawing, it has a difference to express all brightness, forms, and structures only with thickness of line. In such difference, it requires more time than existing line drawing, so it could not be selected by other artists due to its complexity.

Figure 1. Line drawing(left) and spiral drawing(right).

Finally, only a few artists could express Spiral Drawing, and it became the work which only small numbers could produce, via long-time training. We have tried to reproduce this scarce technique of expression, using NPR, one of the computer graphics, and, as a result, we produced SSD. SSD expresses Spiral Drawing in real time via NPR, one of the computer graphics. In particular, SSD not only prints the completed image, but also spreads in spiral starting for line from center, and it shows like painting in real time. Also, SSD is aimed at reducing the production procedure for long time, which pointed out as a problem in the existing work of Spiral Drawing, within thirty seconds, and reproducing completely via digital media. The meaning of reproduction for expression technique, which pursues in this work, is to restore the vanishing art to digital media.

The conversion to digital media is exposed more easily to ordinary people and artists, and easy to maintain, and it is expected the development of expression technique due to inflow of other artists. Like this, SSD is approached to many people, and considered as not restricted to the expression of existing Spiral drawing, but the work of process to expand all other areas of expression

The Case Study on Existing Research

Line Drawing

Line is consisted of countless dots. Line, called as extension of dot, can assume the information for length and location. Like this, line acts as basic visual factor in the expression of creation and is utilized. Line is activated by movement of 'draw' for the first time, and forms the shape of object, on the other hand, it expresses the emotional inspiration. However, the factor of line has never acted as independent factor in the picture 'to reproduce the fact' before 19 century.

On the contrary, the intrinsic feature of line has been appeared in the abstract expression of modern art, and the beginning is found in the concept of 'drawing.' Drawing has been developed from concept of study or sketch to form to be recognized as independent work of 'drawing', later on. In this way, as line occupies the independent area, it has developed as independent form of work.

Figure 2. Single line drawing of cat

In this process, painters used line as way to express the work, and line drawing also was developed and settled as one field, as the relevant study becomes active naturally.

Line drawing is classified as Blind Contour Drawing, Gesture Drawing, Timed Drawing, Movement Drawing, Continuous Line Drawing, Contour drawing, Cross contour drawing, and Planar analysis drawing. The area involved in this work, among such technique of line drawing, is Continuous Line Drawing and Contour drawing & Cross Contour Drawing, and one of the methods to express Spiral drawing.

Continuous Line Drawing means to draw a line continuously without lifting drawing tool in page. In other words, it uses all contour lines and internal forms as one line, and expresses the brightness using thickness.

figure 2. the important thing to apprehend the three- dimensional object and to express the shape of object on paper, based on this, is to use the line so that viewer can understand the form of object well and feel cubic effect. In order to express the three-dimensional information of visible shadow, perspective, etc., it adjusts the thickness of line and changes the light and shade. In this context, we can ascertain that Continuous Line Drawing in [figure 2], the expression way of combination for Contour Drawing, and the expression way of Spiral drawing are very similar.

NPR

NPR among computer-based image processing is the area studied by many researchers, and it begins with the attempt to realize art media. It is the representative example to express oil painting, watercolor, pen drawing, and ink-and-wash painting, etc. using computer. On the contrary, it is developed in terms of extremely technical, rather than 'artistic' outcome which NPR research is being modeled, so considered as the field of scientists and engineers. NPR as engineering, excluded perfectly from aesthetics and art, has no choice but to be diluted. We gathered those who majored in art and engineering and produced the work, in order to complete this complex art. SSD is the work to express image with unrealistic rendering.

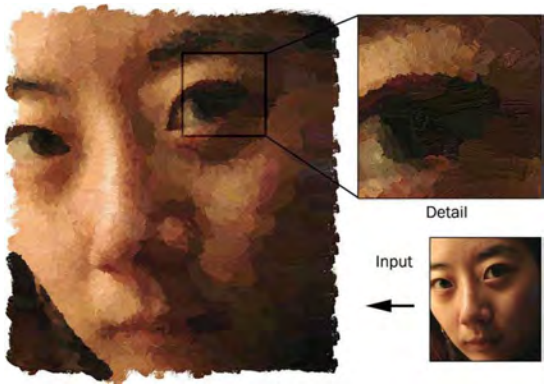


Figure 3. NPR Painterly Rendering with Various Painting Styles for Jinwan, Park and Seongdae Hong.

The illustration of unrealistic rendering was suggested by Winkenbach, Salesin, and Strothotte in "Computer- generated pen-and-ink illustration" for the first time. Besides, study has been progressed for many pictorial expressions; NPR Painterly Rendering with Various Painting Styles for Jinwan, Park and Seongdae, Hong with research of pictorial expression, Color - based Stippling for Non - Photorealistic Rendering of Seok, Jang and Hyeonki, Hong, etc. SSD is based on one unbroken spiral. The expression using the thickness of simple line differs from stroke of brush, texture of paint, and various pictorial expression techniques which can feel from the existing pictorial expression.

Description of Work

For outcome of this work, it is the work to express only using the thickness of black line, feature of existing Spiral drawing. The left image of figure 5. is the shape of final outcomes. SSD produces it, by processing the image from webcam. It changes the color image, which received first, to black-and-white image. Also, it changes the thickness of line, using the brightness of pixel of black-and-white image. For the change of line, the thickness is changed in

accordance with the brightness of image every 0.1 pixel, so it expressed as identical form with drawing in bold, for dark section of existing work. Suppose it utilizes this method, it can reproduce Spiral drawing, drawing spiral form via simple trigonometric function. While the structural error, expanding in delicate and thin line, which feels in existing work in the center, and getting wider, as appearing by human drawing, is almost impossible to realize completely in simple algorithm, it reproduced the appeared expression in existing Spiral drawing similarly via simple rule. In addition, for the shape of oval which borrows from existing work, it judges to limit the work to portrait, so it selected the shape of circle, because it is expected to utilize in more sections for SSD.

Figure 4. Used Original image.

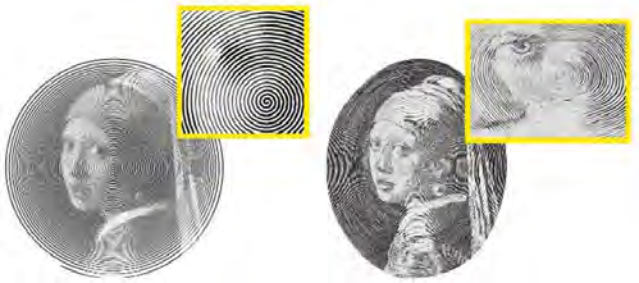


Figure 5. Output of SSD(single line spiral drawing) with spiral drawing.

For SSD, it shows the completed work in spiral, like advertisement of Faber Castell Artist Pen which introduced the existing work. This form is the important factor to introduce one line drawing, feature which appears from existing spiral drawing. One unbroken line is related to the emotion, philosophy which author expresses painting and represents in spiral drawing, and it is the symbolic factor. With SSD, it apprehended and expressed this significant factor. For approximately 10-15 seconds, user can see the finished process of work, drawn in line.

The Following Study and Orientation of Work

The essence of line drawing lies in the decomposition and reorganization of object. This process is expressed to canvas via individual special artistic and aesthetic filtering. No media except photograph represents the original image as it is. Line drawing certainly accompanies the conversion of original in the process of transferring image of object to canvas. The conversion, damage, or random restoration is used to happen to all fields of painting, even to hyper- realistic picture. Also, reproducing the feature of vanishing and neglected expression becomes the link which NPR of engineering and aesthetics is connected, and it will play a role for expression and expansion of genre, moreover. In particular, it reveals the completed work as open source, so it expects the more inflow of engineers and artists. For SSD, it is being prepared the exhibition by better form in current composition. It is being developed in a way of having direct conveyance for additional printout, away from being delivered from media such as simple monitor, for the composition of work to be exhibited. Besides, it is aimed to develop other media of delivery with general printer additionally, and to develop into work of form which more familiar and preferred for audience.

Furthermore, we expect to find the orientation of additional development for work and various factors such as immersion, delivery of expression, via research.

Moreover, it is expected to expand the technique of expression through work to audience, artists, etc. via exhibition.

References

[1] Chan hwee Chong, “Faber Castell”, June 10, 2011, https://www.behance.net/gallery/2267302/Faber-Castell

[2] Woo H. R, "Experimental Study on the Design of Design Studio by Line Drawing", *Archives of Design Research* , (1996.02), 53-60

[3] J. Hays and I. Essa, "Image and Video Based Painterly Animation", *NPAR2004*, (2004)

[4] A. Hertzmann and K. Perlin, "Painterly Rendering for Video and Interaction", *NPAR2000*, (2000)

[5] Winkenbach, Georges and David H. Salesin, "Computer-generated pen-and-ink illustration.", *Proceedings of the 21st annual conference on Computer graphics and interactive techniques, ACM,* 1994.

[6] Park Jin Wan and Hong Sung Dae, “NPR Painterly Rendering with Various Painting Styles”, *Archives of Design Research* 21(6), (2008.11), 9-12

[7] Park, Jin Wan, “Painterly Renering with Designed Imperfection”*, SIGGRAPH 2006 Sketch*, Boston Aug, 2006

[8] Seok Jang and Hyun-Ki Hong, “Color-based Stippling for Non-Photorealistic Rendering”, *Journal of KIISE* Vol.33 No.1·2, (2006) 128-136.

[9] with one line, “Cat Art”, Etsy website, accessed May 27, 2018, https://www.etsy.com/listing/525158703/cat-art-cat-art-print-cat-illustration?ga_search_query=cat&ref=shop_items_search_8&pro=1

[10] Clara Schicketanz, “One Line Drawing”, behance website, accessed May 29, 2018, https://www.behance.net/gallery/55560749/One-Line-Drawing

The Illuminated Self: Transcendent and Epiphanic States in the Encompassing Aesthetic Environment

Sadia Sadia

RMIT University
Melbourne, Australia
Sadia2@mac.com

Abstract

The paper examines the 'conversion experience', transformational life experiences defined by a sense of universality and communion, resulting in a catharsis that can produce profound life-changing alterations in perception and consciousness. Mondrian identified this as a 'complete break with optical vision'[1]. The paper considers the construction of this affect, through the framework of aesthetics, employing moving image, virtual reality, installation, and encompassing artworks as well as a body of related artworks as examples.

There is the potential within emerging technologies to heighten the 'conversion experience' within spatial environments, to drive or overwhelm the emotional state through multi-sensory strategies in order to provoke an 'illuminated' state, a slipping of the bonds of classically-constructed perception through an emotional and sensory provocation. The paper argues that the encompassing or installation environment may be strategically modelled to initiate such states. The research is relevant to the efficacy of any encompassing setting including virtual reality environments.

Keywords

Transcendence; catharsis; epiphany; encompassing; installation; spatial; universality; communion; perception; consciousness.

Introduction

Why do people have profound emotional experiences within immersive works of art? What is the construction of this affect and how are these experiences enjoined? Can we identify the key drivers of this state and set about to induce or enhance such states in our viewer/participants with a degree of volition?

My talk draws on literature surrounding the experience of the epiphanic, of awe, the sublime and the transcendent - the 'Illuminated Self' - in relation to encompassing environments, incorporating but not limited to light, still or moving images, and sound. The approach is largely heuristic, based in embodiment theories of emotion and on my subjective evaluations as an academic and as an artist.

I will be discussing the potential within emerging technologies to enhance or heighten profound emotional experiences within the aesthetic environment, which may be defined as cathartic, epiphanic, transcendental or conversion, the innate and universal nature of such experiences , and how the immersive or encompassing environment might be ideally modelled to enhance such experiences.

Aesthetic Shock

The art historian, philosopher and critic Donald Kuspit defines the conversion experience as a form of aesthetic shock:

> "Aesthetic shock, with what might be called its defamiliarising effect, makes one aware that there is a world of meaning and vitality beyond ordinary meaning and drive. It is the alternative to alienation in the everyday. Indeed, aesthetic shock transforms alienation into transcendence... Aesthetic shock is a kind of conversion experience, that is, a kind of mystical experience, in which appearances become sensuously new and radically changed - more seriously experienced than they ever were before." [2]

These experiences may be durational, lasting varying lengths of time. In some cases the alteration is irrevocable, bringing about a permanent epiphanic change in the way world and self are perceived. Such experiences have been written about at length in respect of paintings [3] but to a lesser degree about installation environments, although these may be ideally modelled to produce an even higher 'hit' rate for initiating these types of profound, transformative, seemingly mystical events [4].

The Encompassing Environment, Transcendence and the Epiphanic State

For the purposes of this discussion, the 'encompassing environment' will be defined as a multi-sensory space, comprising light in the form of light sources, moving images or projections, sound in surround format or emanating from a multiplicity of points or sources, with the possibility of the senses of smell or touch being addressed or activated although this may be purely psychosensory rather than an actual engagement with the surface of the skin.

To begin with, let me define what I mean when I talk about a 'transcendental' experience. Transformational life experiences may be cathartic, epiphanic, incorporating a sense of awe and the release of powerful emotion, including feelings of communion, often subsuming the viewer in a sense of universality. Mondrian says:

> "…the one thing that counts in art is to reflect aesthetic emotion: to the extent that we feel the purity of colour more intensely, we are able to express colour more purely...once we have begun to see in a more consciously aesthetic way, the task becomes to reflect clearly, that is, determinately, our aesthetic emotion. Then we can break completely with optical vision". [5]

Kuspit (2006) sees Mondrian's definition of a complete 'break with optical vision' as a conversion experience, drawing together notions of the transcendent, the sublime and contemporary sublime, and the numinous. and draws a straight line from the "abstract, sublime" modernist landscapes of Newman, Rothko and Still through to the transcendent state. It should not be too much of a stretch to extrapolate his discursion on modernist, abstract and colour field works through to light art and immersive art, and Light & Space Movement works might easily be seen as extensions of "abstract sublime landscapes" [6].

Let me open by addressing some terms which I am using interchangeably. These terms: 'transcendence', 'Level III' 'Truth and Transcendence'[7], 'conversion experience', 'awe', 'sublime', 'epiphanic' and 'peak experience' are all closely related. Many of them are qualitatively identical in places, and share similar attributes or equivalences. These are subjective states and I have teased out variations in the definitions, but they are permeable and vary throughout literature.

One theory is that threat and fear play a significant role in the construction of heightened aesthetic experiences:

> "Fear was the only factor found to significantly increase sublime feelings. Because higher sublime scores were also significantly associated with greater physiological arousal, arousal does generally contribute to aesthetic experiences...But why fear? One potential explanation is that it motivates organisms in an evolutionary significant way...The capacity for a work of art to grab our interest and attention, to remove us from daily life, may stem from its ability to trigger our evolved mechanisms for coping with danger." [8]

Transcendent aesthetic experience may be said to be a close relative of the epiphanic experience, defined as "momentary experiences of transcendence that are enduring and distinct from other types of developmental change and transformation" [9] in which anxiety, threat, stress and fear play a role. Keltner and Haidt (2003) also define threat as one of the qualifiers of the emotional experience of awe, but also include beauty, ability, virtue, supernatural causality and social dominance. "The capacity to experience awe in response to cues of social dominance then generalises to other stimuli, such as buildings, operas, or tornadoes, to the extent that these new stimuli have attributes associated with power" [10]. Emotional arousal also affects internal clock speeds, which in turn result in an overestimation of time, another component in the 'timeless' experience of the sublime and transcendent. Slow-motion, the slowing down of time, or the suspension of time within the encompassing environment is another key component in the heightened experience of art as 'transcendent' and slow-motion images also speak to a heightened sense of truth [11].

All human beings experience peak or transcendent states, but that some individuals chose to deny them [12]. Maslow points to the similarities between what Rudolf Otto describes as the characteristics of religious experience "the holy; the sacred;...awe before the mysterium tremendum; the sense of the divine, the ineffable; the sense of littleness before mystery; the quality of exaltedness and sublimity...the sense of the eternal and of fusion with the whole of the universe..." [13] and 'peak experience', noting that these experiences "can be accepted as real by clergymen and atheists alike" [14]. Maslow describes the "irreducible, intrinsic values of this reality"[15] as follows: truth, goodness, beauty, wholeness, dichotomy-transcendence, aliveness, uniqueness, perfection, necessity, completion, justice, order, simplicity, richness, effortlessness, playfulness, and self-sufficiency. It is his position that the experience of this state quantifies what it means to be human, to be "a fully human person" in that "The fully human person in certain moments perceives the unity of the cosmos, fuses with it, and rests in it, completely satisfied in his (sic) yearning for one-ness" [16]. Maslow's modelling of the state relates well to the speculative understanding of the construction of awe. Temporal lobe microseizures may also play a factor in the sense of "out-of-body experiences, space-time distortions, intense meaningfulness, and dreamy scenes" [17] and that these may play a role in our construction of the state and "mystical experiences are normal consequences of spontaneous biogenic stimulation of temporal lobe structures. The numbers, composition, and intensity of these experiences reflect a continuum of

temporal lobe stability. Each human being may be located somewhere along this dimension" [18] and this supports Maslow's contention that the experience is universal.

The Aesthetic Environment and the Illuminated Self

Figure 1. 'Infinity Mirrored Room—The Souls of Millions of Light Years Away' 2013 by Yayoi Kusama, The Broad, Los Angeles © The Broad Licensed under fair use for education purposes only by kind permission.

Transformational life experiences may be transcendental, cathartic, epiphanic, incorporating a sense of awe and the release of powerful emotion, including feelings of communion, often subsuming the viewer in a sense of universality. The character and personality traits that an individual brings to the experience of the encompassing aesthetic environment influences the quality of their experience of the work. Viewer/participants who are more likely to appreciate 'difficult' art (in this study, characterised as 'abstract art') are defined by the 'openness to experience' trait [19]. The experiences under discussion egalitarian, and part of the attraction and popularity of environments and works of art that inspire these states is their democratic and impartial availability to the educated and uneducated alike [20]. The experience does not discriminate on the grounds of prior knowledge, and in this manner bears similarities to emotional arousal in response to music.

Some works that invoke Kuspit's 'abstract, sublime landscape' [21] include works coming out of Japan such as Yayoi Kusama' 'Infinity Rooms' [Figure 1] a work which allows for a single viewer in isolation in a simulation of 'infinite' space, as well as Teamlab's immersive interactive works, now housed in the MORI Museum in Tokyo, featuring a group of artworks that form "one borderless world"; James Turrell's use of perceptual psychology and the immersive properties of light, as seen in Turrell's Perceptual Cell and other works; and slow motion as inciting heightened perceptions of truth, a technique widely employed by Bill Viola. Aside from these more still or meditative environments, there is also the use of high-intensity sensory whole-body assaults employing bright directional light and surround sound, as seen in the work of Ryuchi Ikeda as well as interactive film flicker, light flicker, loud sudden sharp noise, invoke Prinz' (2012) notions of threat and stress as well as Persinger's (1983) temporal lobe microseizure theory in the construction of heightened aesthetic experiences.

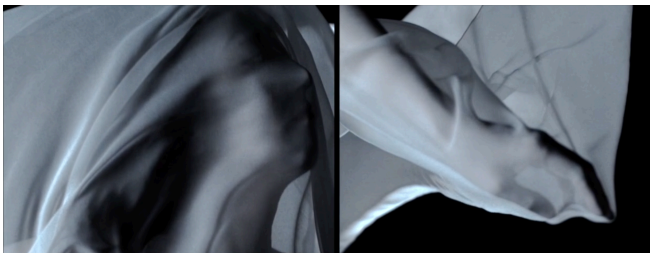


Figure 2. 'The Descent' 2017 by Sadia Sadia © Sadia Sadia and Chimera Arts used by kind permission all rights reserved.

As an artist, I am producing a group of works that examine these tropes. These include 'The Descent' [Figure 2] a work was originally filmed at 1500fps, slowed down by a factor of two to run at 3000fps. The tempo of the work imbues it with a heightened sense of truth and the combination of the tempo of the images, the cultural construction of the triptych, and the repetitive nature of the soundtrack all qualify as modifiers for an emotional state and drivers for a receptive mind [22]. Other works include 'One Second' a ten minute long work representing one second in time, accompanied by the sound of a ticking clock, with each tick representing everything that is viewed on screen over ten minutes. The ticking clock is interrupted by gaps of random lengths, generated by a random dice roller, which serve to return the viewer to time-consciousness, and affect the encoding of time perception which produces an increased attention to time [23].

A great deal of my current research is based in qualitative and subjective methodologies, but empirical findings and biometric data are becoming increasingly available.The vestibular problems of the virtual reality environment and the 'untethering' of emotion recognition and eye tracking technology remains problematic, the software something of a blunt tool and subject to ongoing theoretical disagreements. This work will be expanded upon as my research into the 'illuminated self' progresses.

References

[1] Piet Mondrian, 'Natural Reality and Abstract Reality' [1919-20], in *The New Art—The New Life: The Collected Writings of Piet Mondrian*, ed. Harry Holtzman and Martin S. James (New York: Da Capo Press, 1993), 101.

[2] Donald Kuspit, 'The Emotional Gains of Aesthetic Shock', *Psychoanalytic Inquiry*, 26(3)(2006):348.
[3] James Elkins, *Pictures & Tears: a history of people who have cried in front of paintings* (New York, London: Routledge, 2001).
[4] Sadia Sadia, '*The Sacred Ground: Enhancing and Constructing the Transcendent State in the Immersive Installation Environment*', doctoral dissertation (Melbourne: RMIT University 2019), 62-74.
[5] Piet Mondrian, "Natural Reality and Abstract Reality" [1919-20], in *The New Art—The New Life: The Collected Writings of Piet Mondrian*, ed. Harry Holtzman and Martin S. James (New York: Da Capo Press, 1993), 100.
[6] Donald Kuspit, 'Aesthetic transcendence and transformation', *Art Criticism*, 24(2)(2009):104-121.
[7] Sheena Rogers, Truth, Lies and Meaning in Slow Motion Images, in *Psychocinematics: Exploring Cognition at the Movies*, ed. A.P. Shinamura, (Oxford Scholarship Online: Oxford University Press, 2013), 160.
[8] K.J. Eskine, N.A. Kacinik, J.J. Prinz, Stirring Images: Fear, Not Happiness or Arousal, Makes Art More Sublime, *Emotion* 12 (5) (2012):1072-1073.
[9] M.G.McDonald, The Nature of Epiphanic Experience, *Journal of Humanistic Psychology*, 48 (1)(2008):90.
[10] Keltner, D., Haidt, J. 'Approaching awe, a moral, spiritual, and aesthetic emotion', Cognition and Emotion, 17(2)(2003):306-307.
[11] Sheena Rogers, Truth, Lies and Meaning in Slow Motion Images, in *Psychocinematics: Exploring Cognition at the Movies,* ed. A.P. Shinamura, (Oxford Scholarship Online: Oxford University Press, 2013), 152.
[12] Abraham Maslow, *Religions, Values and Peak-Experiences* (New York: Viking, 1970).
[13] Abraham Maslow, *Religions, Values and Peak-Experiences* (New York: Viking, 1970), 54.
[14] Ibid.
[15] Abraham Maslow, *Religions, Values and Peak-Experiences* (New York: Viking, 1970), 92-94.
[16] Abraham Maslow, *Motivation and Personality* (New York: Harper & Bros, 1954).
[17] Michael Persinger, 'Religious and Mystical Experiences as Artefacts of Temporal Lobe Function: A General Hypothesis', *Perceptual and Motor Skills* 57(3) (1983): 1255.
[18] Ibid.
[19] P.J. Locher, 'Empirical Investigation of an Aesthetic Experience With Art', in *Aesthetic Science: Connecting Minds Brains and Experience*, edited by A.P. Shinamura & E. Stephen (Oxford: Oxford University Press), 163-88.
[20] Sadia Sadia, '*The Sacred Ground: Enhancing and Constructing the Transcendent State in the Immersive Installation Environment*', doctoral dissertation (Melbourne: RMIT University 2019), 88.
[21] Donald Kuspit, "Aesthetic transcendence and transformation". *Art Criticism*, 24(2)(2009):104-121.
[22] Sadia Sadia, '*The Sacred Ground: Enhancing and Constructing the Transcendent State in the Immersive Installation Environment*', doctoral dissertation (Melbourne: RMIT University 2019), 110.
[23] Ibid., 105.

Bibliography

Best, S. 'Rethinking Visual Pleasure', *Theory & Psychology,* Vol 17, no.4 (2007).
Coomaraswamy, Ananda K. 1972, Saṁvega: Aesthetic shock. Aperture (Archive : 1952-2005), 16.
Elkins, James, *Pictures & Tears: a history of people who have cried in front of paintings* (New York, London: Routledge, 2001).
Elwes, Catherine. Installation and the Moving Image. New York: Wallflower Press, Columbia University Press, 2015.
Eskine, K.J., Kacinik, N.A., Prinz, J.J., Stirring Images: Fear, Not Happiness or Arousal, Makes Art More Sublime, *Emotion* 12 (5) (2012).
Keltner, D., Haidt, J. 'Approaching awe, a moral, spiritual, and aesthetic emotion', *Cognition and Emotion*, 17(2)(2003):306-307.
Kusama, Yayoi. 2013. *Infinity Mirrored Room - The Souls Of Millions Of Light Years Away*. Wood, metal, glass mirrors, plastic, acrylic panel, rubber, LED lighting system, acrylic balls, and water. Los Angeles: The Broad.
Kuspit, Donald, 'Aesthetic transcendence and transformation'. *Art Criticism*, 24(2)(2009).
Kuspit, Donald, 'The Emotional Gains of Aesthetic Shock', *Psychoanalytic Inquiry*, 26(3)(2006).
Maslow, Abraham, *Motivation and Personality* (New York: Harper & Bros, 1954).
Maslow, Abraham, *Religions, Values and Peak-Experiences* (New York: Viking, 1970).
McDonald, M.G. 'The Nature of Epiphanic Experience', *Journal of Humanistic Psychology*, 48 (1)(2008).
Mondrian, Piet, 'Natural Reality and Abstract Reality' [1919-20], in *The New Art—The New Life: The Collected Writings of Piet Mondrian*, ed. Harry Holtzman and Martin S. James (New York: Da Capo Press, 1993).
Persinger, Michael, 'Religious and Mystical Experiences as Artefacts of Temporal Lobe Function: A General Hypothesis', *Perceptual and Motor Skills* 57(3) (1983).
Rogers, Sheena, 'Truth, Lies and Meaning in Slow Motion Images', in *Psychocinematics: Exploring Cognition at the Movies*, ed. A.P. Shinamura, (Oxford Scholarship Online: Oxford University Press, 2013).
Sadia Sadia. 2017.'*The Descent*'. Ultra slow motion three channel installation, surround sound. Melbourne: RMIT University.
Sadia, S. '*The Sacred Ground: Enhancing and Constructing the Transcendent State in the Immersive Installation Environment*', doctoral dissertation (Melbourne: RMIT University 2019).
Volkinburg, H. & Balsam P. 'Effects of Emotional Valence and Arousal on Time Perception', *Timing and Time Perception*, vol 2(3) (2014).

Author Biography

Sadia Sadia is a Canadian-born British installation artist, known for her audiovisual media work. She has recently completed her doctoral candidature at RMIT University, Melbourne with the support of an IPRS International Postgraduate Research Scholarship, an APA Australian Postgraduate Award and an Australian Government Research Training Program (RTP) award. For more information please go to: http://artschimera.com

Mapping Light. Data Impressionism.

Andrew Richardson

School of Design, Northumbria University
Newcastle, United Kingdom
andrew.richardson@northumbria.ac.uk

Abstract

Using a practical investigation as a sample case study, this paper outlines an initial investigation into the visualization of people's experiences within a city space. Highlighting the shortcomings of conventional data visualization approaches, it presents an argument for the use of light as a useful metaphor for mapping and connecting emotion with place. Inspired by the impressionistic painters, and their use of light as a means to capture the sense or mood of a scene, the project advocates light as a possible way to develop a kind of 'data impressionistic' approach for visualizing the data-informed mood of a location. The paper outlines the ongoing practical project work and prototypes, and looks forward to future opportunities and project developments during the next phases of work.

Keywords

Data, Visualization, Light, Location, City, Graphics, Impressionism.

Introduction

Data visualization is a broad discipline which utilizes clear, often diagrammatic, abstractions of graphical form to visually simplify otherwise complex information. Increased use and availability of digital data has given rise to a plethora of data visualization graphics which draw from a well-established gallery of diagrammatic visualization styles [1]. There is, however, a growing acknowledgement of the limitations of this kind of diagrammatic approach to visualization, especially when applied to experiential data sets, particularly those from humanities based subject areas. The aesthetic language of 'scientific' graphical data visualizations, it is argued, has a tendency towards visual reductionism; simplifying the 'messy' experiences of the phenomenal world into unchallenged images of objective truth. Data is presented as an expression of pre-existing truths - showing things as they 'already are' [2]. The authority afforded to these kinds of 'scientific' aesthetics imbues the images with an 'explanatory power' of the graphically sublime – perpetuating a 'fantasy of knowing' in which graphical beauty and style has equivalence to truth [3].

Alternative artistically inspired approaches challenge the 'scientific' aesthetic of visual truth telling, developing exploratory approaches to construct nuanced visual representations of reality, by molding and manipulating the 'formless, raw material' of data into visualizations which viewers can 'feel' as well as see [4, 5, 6]. These artistic, creative approaches represent explorations toward the pursuit of new forms of 'data humanism,' visual representations which attempt to express the essence of the phenomenal world embodied in experiential data, without resorting to reductive over simplifications [7]. This tension between 'scientific' and 'humanistic' visual approaches provides the background to the development of an ongoing creative investigation outlined in this paper. The project is a citizen-informed city mapping activity investigating creative ways to collect, gather, visualize and share personal experiences, thoughts, moods and emotions associated with city places, spaces and locations.

Mapping with Pens and Paper

The first phase of the activity explored simple physical methods to capture and visualize moods and emotions associated with locations around the city. Participants were invited to shade in areas of a map of their city using colored markers as a way of indicating emotions they associated with specific spaces and places. In this way, a series of maps were created with colored areas indicating 'quiet spaces' (green) 'happy spaces' (yellow), lively spaces (red) and 'social spaces' (blue) (see Fig 1).

Figure 1. A sample of the hand-colored maps created by participants in the initial mapping activity. Color is used to denote different moods associated with a location.

Using a computer vision programme, the shapes and colors data of each map were captured, stored as a list of JSON values, and then translated as uniform digital grid of circles.

This created a 'low-resolution' version of the hand-drawn maps, an abstracted colour-coded map of the city, in which areas and locations were visualized as stylized colored circles. The final results were displayed as an interactive web-based visualization; a 'mood map' of the city (see Fig. 2).

Although this approach had some engaging and informative elements, it had clearly identifiable shortcomings - most notably in the disconnections created between the users own mapping activity and the translation of these maps to create the final images and visuals. A lack of immediacy between the drawing and capture activities (each map had to be individually scanned after the drawing process) meant that an 'experiential disconnect' was created; users easily lost the connection between their own map and the on-screen visuals, failing to see the relationship between the two.

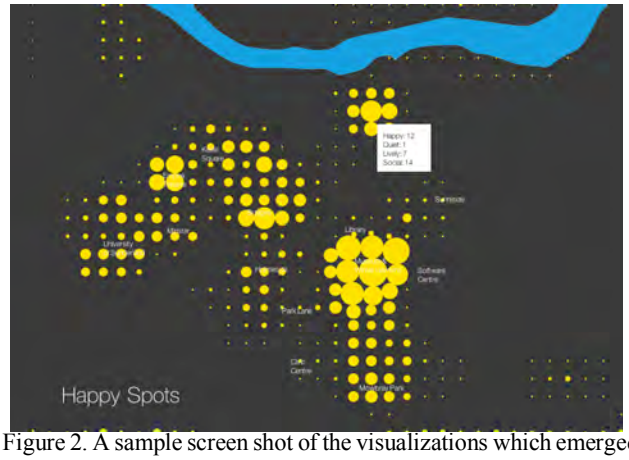


Figure 2. A sample screen shot of the visualizations which emerged from the paper mapping activity. The map is cleaned up into a uniform grid. This example illustrates the happy (yellow) areas.

The final visuals which tidied up the 'messiness' of the 'rough' pen and paper maps into a reassuringly precise grid of visual cleanness. also created a visual disconnection between the locatable, personalized maps of mood, location and memory and the highly stylized, numerically sorted graphical clean grid of circles. Despite the fact that the aesthetic authority graphics were visually suggestive of 'fact' and 'truth', they did not reflect the subtle ambiguous connections people expressed with city spaces, in which ideas of memory, mood and location are subjective and transient. This phase of the project highlighted the shortcomings of placing emphasis on a diagrammatic 'hard edged' data visualization aesthetic which lack the visual ability to communicate and display the subtleties of memory and emotional associated with this kind of transient data.

Mapping with Light and Sound

During the second project phase, an alternate mapping activity was prototyped to try to develop greater more direct visual connections between places and emotions, and to explore other, more nuanced, ways of capturing and connecting memory and place. Inspired by aerial maps of cities at night, in which lights indicate areas of high population density, the second iteration replaced the 'hard-edged' pen and paper activity and instead explored the use of light and sound as a way to capture, visualize and locate the transient qualities of emotion and memory connected with space and place.

The light and sound prototype encourages participants to document their significant places in the city via a tangible interface which allows them to add an audio recording of a memory as an individual 'bright spot' onto an interactive map, (see Fig. 3). Participants create digital lights to locate and record their own personal 'bright spots' directly onto the city map by placing a smart tangible 'locator' object onto an interactive map surface and speaking into it.

A Unity game engine is used to track the position of the object on the capacitive surface and locate its center and orientation. Placing and moving the locator over the surface allows users to explore places and other memories on the map and find where they wish to add their own 'bright spot'. Sound activation via a microphone input triggers an event to add a new spot and audio recording of their memory to the map.

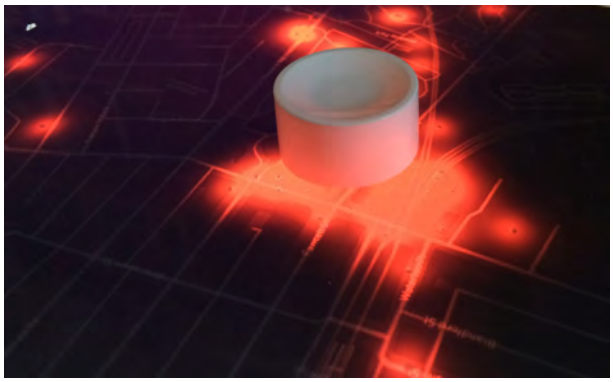


Figure 3. A detail from the prototype interactive map. The audio-activated locator object is moved over the touch-screen surface and allows the user to add their own 'bright spot' to the map.

Each individual memory is visually represented as a single light on the streets of the city map, with each colour representing a particular mood.

Outcomes and Visuals

The outcome is an interactive 'light and sound map' - a visualization of a city, illuminated by personal memories and thoughts mapped to significant places. Each area of light on the map represents a single, individual moment, encounter or memory. The data associated with each spot includes a short personal audio recording of the memory and its real-world GPS location, which allows each light to be re-visualized back into its physical location. Groups and collections of lights create hot spots; bright areas and regions of light - clusters which signify 'emotional activity' and intensity.

The overall visual image created from the process is an 'impressionistic' map of city spaces depicting 'emotional hotspots' across its streets (see Fig. 4). Unlike the previous iteration of the map, in which the locations of emotional

association are visually and closely defined and numbered, the emotional areas in these visualizations are softer, more 'painterly', giving an impressionistic suggestion of emotional locations and clustering.

The map has visual resonance with light clusters from aerial photographs of city lights, or NASA maps of the earth in which population activity and density is, similarly, indicated by light clusters [8]. However, rather than being indicative of the physical presence of people, this light map provides a representation of areas of emotional density. Streets are revealed, and lit up by user engagement; whilst less 'emotionally' significant place are left in darkness.

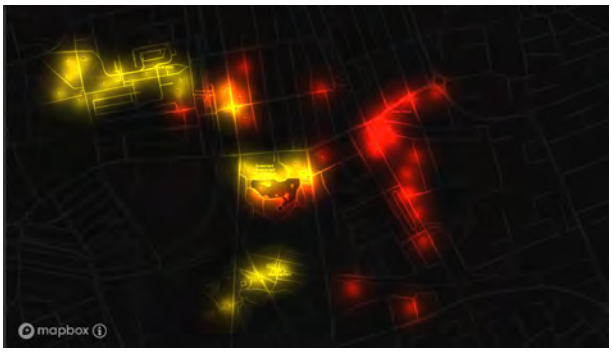


Figure 4. The outcome of the mapping activity is a visually softer version of the data. Colors denoting mood combine and merge to create a more 'painterly' visualization of moods in spaces.

Light as a Metaphor for Visualization

The examples from this mapping project begin to explore the ways in which light can provide a useful and important metaphor, especially for mapping and visualizing data connected with memory and emotion in the context of place and space.

The use of light as a means of connecting place and space works, both as a formal construct, having direct physical associations with geography, population and location and also as a metaphor which has strong emotional associations with human memory and imagination. The visual softness of light does not have the 'cut-and-dried' certainty of the numerically defined hard edges of diagrammatic design, but instead offers a connection with the uncertainties and haziness of memory and place. Particular features of the lighting within the digital space e.g. luminosity, range, intensity and color, are combined and applied to further enhance the visual nuance and help develop links between the transience of personal imagination to ideas of location and space.

Using light and sound as way to express something of the sense of a place also has conceptually interesting links to other artistic representations of place and landscape, with particular resonance with impressionistic approaches to representations of place. Just as the impressionist painters sought to capture a version of reality removed from the 'realism' of formal painting and photography, seeking instead to capture the 'reality' of the atmosphere of a place, so this kind of 'data impressionism' - using light and sound to capture and visualize the reality of the 'sense' of a place - can be seen as an attempt to go beyond the hard edge realism of traditional data graphics, in order to capture and communicate something of its essence. The impressionist's reaction to the realism aesthetic and their use of light as the 'creative principle' underlying the 'reality' of the mood of a scene provides an instructive and potentially fruitful model for the exploration of the qualities of light as a tool for data visualization of place and space [9].

Rather than the 'scientific realism' of data graphics which 'flatten' data into a single type of 'unknowable image' [10], the use of light begins to create an overall impressionistic sense of realism – a human centered data visualization and a more compelling complex starting point for seeing and understanding the subtleties of individual personal spaces. Unlike the 'Kantian sublime' aesthetics of big data visualizations, the aesthetics and data of this visualization do not inspire awe and wonder from a sense of unimaginable scale, but evoke the human-centeredness of localized places and spaces - creating audio-visual impressions of familiar streets and locations [11]. The soft edges of the light-informed data visualization create a 'sense' of the data in the place which may lack the 'hard-edged' 'truthfulness' of data graphics but perhaps creates a representation of the transience of real and imagined spaces. This may be seen as a type of 'data impressionistic' style – an approach which uses light to try to emphasize the *affectiveness,* of the visuals in trying to invoke a sense of the moods associated within the space [12].

Future Work and Development

The work outlined in this paper is part of a larger investigation already in progress, however the idea of using light as a means to visualize and connect place and memory has already offered a fruitful way forward for the future direction of this work. The project will continue this exploration of mapping with light, looking in particular at ways of sharing the data from the map back into the city spaces.

As well as being a useful way of visualizing activity within a screen space, the physicality of light also presents great opportunities to be mapped back into the spaces and locations identified on the map [13]. With this in mind, the next phase of the work will look at the development and use of smart location-based objects and lights to re-visualize the areas of light back within the physical spaces, allowing users and participants to re-discover and connect with the data as they move around the city – thus providing an interesting way of re-visualizing the 'hidden' data back into the specific locations. The work from this phase of the project will be available for dissemination during the main phase of the conference.

Conclusion

This paper has briefly outlined approaches towards mapping and visualizing emotional spaces within a city, and has begun to show how the concept of light can be an informative visual tool or symbol which connects ideas of place and emotion.

Having a connection with physical city spaces and with notions of imagination and memory, light provides a useful metaphor for connecting emotion and space. The association with some of the broad aims and ideals of the impressionistic movement provides a useful way of thinking about new kinds of approaches to data visualization which develop a 'sense' of the reality of the data which is able to embrace the softer side of data, to include nuance and subtlety. It is hoped that this approach can be informative and useful for future developments and explorations within the field of creative data visualization.

References

[1] Zoss, Anglea, Data Visualization: Visualization Types, accessed December 17, 2018, https://guides.library.duke.edu/datavis/vis_types

[2] Drucker, Johanna. "Humanities approaches to graphical display." Digital Humanities Quarterly 5, no. 1 (2011): 1-21.

[3] McCosker, Anthony, and Rowan Wilken. "Rethinking 'big data' as visual knowledge: the sublime and the diagrammatic in data visualisation." Visual Studies 29, no. 2 (2014): 155-164

[4] Galloway, Alexander. "Are some things unrepresentable?" Theory, Culture & Society 28, no. 7-8 (2011): 85-102.

[5] Freeman, Julie, Geraint Wiggins, Gavin Starks, and Mark Sandler. "A Concise Taxonomy for Describing Data as an Art Material." Leonardo 51, no. 1 (2018): 75-79.

[6] Kennedy, Helen, and Rosemary Lucy Hill. "The feeling of numbers: Emotions in everyday engagements with data and their visualisation." Sociology 52, no. 4 (2018): 830-848.

[7] Giorgia Lupi, "Data Humanism, the Revolution will be Visualized (2017)", Print Mag website, accessed December 18 2018, https://www.printmag.com/information-design/data-humanism-future-of-data-visualization/

[8] Kristin Fontichiaro, "Light as Data Visualisation", University of Michigan website, accessed December 8, 2018, http://datalit.sites.uofmhosting.net/2016/02/25/light-as-data-visualization/

[9] Encyclopedia of Art History "Characteristics of Impressionistic Paintings", accessed December 8, 2018, http://www.visual-arts-cork.com/history-of-art/impressionism-characteristics.htm

[10] Galloway, Alexander. "Are some things unrepresentable?"

[11] Jill Rettberg, "Sublime Visualisations of Immensely Big Data" (2018), Medium website, accessed January 27, 2014, https://medium.com/@jilltxt/sublime-visualisations-of-immensely-big-data-f82db8bcccc8

[12] Samsel, Francesca. Art, "Affect and Color: Creating Engaging Expressive Scientific Visualization" website, accessed March 20 2019, https://visap.net/2018/program

[13] YOUrban "Making 'Immaterials: Light painting WiFi (2011)", accessed December 12, 2018, http://yourban.no/2011/03/07/making-immaterials-light-painting-wifi/

Bibliography

Johanna Drucker, "Humanities approaches to graphical display." Digital Humanities Quarterly 5, no. 1 (2011): 1-21.

Encyclopedia of Art History "Characteristics of Impressionistic Paintings", accessed December 8, 2018, http://www.visual-arts-cork.com/history-of-art/impressionism-characteristics.htm

Jenny Filipetti, The Shape of Data: A Poetics of the Data-Image. In: Proceedings of the 5th Biennial Transdisciplinary Imaging Conference, TI2018, 18-20 April 2018, Edinburgh, UK. DOI: 10.6084/m9.figshare.6104702

Kristin Fontichiaro, "Light as Data Visualisation", University of Michigan website, accessed December 8, 2018, http://datalit.sites.uofmhosting.net/2016/02/25/light-as-data-visualization/

Julie Freeman, Geraint Wiggins, Gavin Starks, and Mark Sandler. "A Concise Taxonomy for Describing Data as an Art Material." Leonardo 51, no. 1 (2018): 75-79.

Alexander Galloway. "Are some things unrepresentable?." Theory, Culture & Society 28, no. 7-8 (2011): 85-102.

Helen Kennedy, and Rosemary Lucy Hill. "The feeling of numbers: Emotions in everyday engagements with data and their visualisation." Sociology 52, no. 4 (2018): 830-848.

Andy Kirk, Data visualisation: a handbook for data driven design. Sage, 2016.

Giorgia Lupi, "Data Humanism, the Revolution will be Visualized (2017)", Print Mag website, accessed December 18 2018, https://www.printmag.com/information-design/data-humanism-future-of-data-visualization/

Lev Manovich, "Data visualisation as new abstraction and anti-sublime." Small tech: The culture of digital tools (2002): 3-9.

Anthony McCosker, and Rowan Wilken. "Rethinking 'big data' as visual knowledge: the sublime and the diagrammatic in data visualisation." Visual Studies 29, no. 2 (2014): 155-164

Jill Rettberg, "Sublime Visualisations of Immensely Big Data" (2018), Medium website, accessed January 27, 2014, https://medium.com/@jilltxt/sublime-visualisations-of-immensely-big-data-f82db8bcccc8

Gregg Smith, "Mediated Cities 03: DIY Cartography(2011)." accessed December 12, 2018, https://www.creativeapplications.net/theory/mediated-cityscapes-03-diy-cartography-theory/

YOUrban "Making 'Immaterials: Light painting WiFi (2011)", accessed December 12, 2018, http://yourban.no/2011/03/07/making-immaterials-light-painting-wifi/

Anglea Zoss, Data Visualization Visualization Types, Duke University Libraries, accessed December 17, 2018, https://guides.library.duke.edu/datavis/vis_types

Author Biography

Andrew Richardson is a senior lecturer within the Design School at Northumbria University. He lectures on the Interaction Design programme and his research concerns the use of creative coding for development of novel data visualisations.

Simulating Photography: Images Made by the Scanning Electron Microscope

Dr Anastasia Tyurina
National Research University of Electronic Technology/Griffith University
Moscow, Russia/Brisbane, Australia
a.tyurina@griffith.edu.au

Abstract

This paper discusses the challenges of interpreting SEM images as pictures because the microscopic sample seems as if it is illuminated by the detector and observed in the eye aperture. The process of producing a picture by the SEM is camera-less; images formed by a focused beam of electrons, they are not photographs in the classic way that we perceive photography. The paper also raises concerns about mechanical objectivity in representation by the SEM. Having a closer look at both the imaging process and the examples of manipulations, such as adjusting the SEM and its in-built software settings, it is possible to illustrate that they can affect the resulting image and offer different interpretations of the same sample. Such "misinterpretation" is capable of providing a new meaning of that was previously unseen, that is, desirable for artistic context.

Keywords

Scanning Electron Microscope, signal processing, image processing, photomicrography, photography.

Introduction

The last decades' use of Scanning Electron Microscopes (SEMs) in creating scientific images formed a new, well-established visual culture within a variety of scientific disciplines [1]. Hentschel explains, it became "an image centered science in the sense of being even totally dependent on photographic images as basis of all further processes of inference" [2].

However, images made by the SEM are not photographs in the traditional sense; they go beyond what can be captured with light because the process of producing a picture is camera-less. Imagery produced by the SEM can confuse the viewer because the microscopic sample seems as if it is observed in the eye aperture when illuminated, and light seems to come from a particular illuminant. SEM photomicrographs are constructed out of pixels synchronised with a distribution map of the intensity of the signal being emitted from the scanned area of the specimen [3].

This paper outlines how SEM generates images rather than captures them. It also suggested that an "image in a digital form" is probably a more appropriate terminology than a "photograph" for an image made by the SEM. Thus, it is important to examine the process of image formation in relation to the imagery obtained by the SEM in modern microscopy, and then to apply the new definition to the images made by the SEM. It is also crucial to distinguish image generation by SEM considering that the process is not one that is based in code. The image generation process can be seen as a work of high-energy electrons that create a range of different signals when hit the specimen. Converted into pixels signals result in image formation appeared on the screen.

Image Generation with SEM

Technically, the SEM produces electron micrographs because the image is developed by either secondary electrons (electrons ejected from the material by the incoming electron beam) or backscattered electrons (electrons from the electron beam, which have "bounced" off the material into the detector). Dee Breger explains: "Scanning electron microscopes don't merely use electron beams to illuminate objects so small they can't be seen by light. Since they are electronic devices, SEMs can manipulate isolated groups of electrons from the sample-beam interaction to create separate pictures (such as secondary and backscatter images) that contain different kinds of information about a single object. This variety can lead to a "compound reality'" or, since no version tells the whole story, a kind of "ironic nonreality" [4].

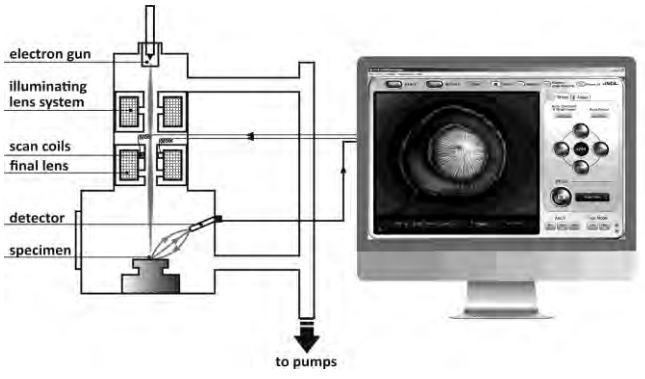


Figure 1. SEM's Principal Design. 2015

Images made by the SEM are beyond light because the process of producing a picture is camera-less; captured by a focused beam of electrons, they are not photographs. However, the most commonly used SEM electron detector, named Everhart-Thornley (E-T)[1], typically uses a material that produces light when an electron collides with it—a scintillator[2]. Therefore, the SEM does use photons, but they are converted back into electrons, which are accelerated onto the electrodes of the photomultiplier, producing an increasing stream of electrons until the final collector is reached [5].

The image formation in scanning electron microscopy consists of the scanning system, the signal detectors, the amplifiers, and the display [6]. A physical, material connection of the SEM apparatus with the studied object is gained by the interaction of these four elements. The SEM's principal design is illustrated in Figure 1.

During the imaging process, the energy exchange between the electron beam and the sample results in the reflection of high-energy electrons, the emission of secondary electrons and the emission of electromagnetic radiation, each of which can be measured by specialised detectors. The detectors interpret these signals by the algorithm and the resultant image appears constructed out of pixels. This algorithm is defined by each quantum of signal information but it is also implemented in the physical world in apparatus, computer, and screen [7]. In some sense, the SEM apparatus interprets (transforms) signals and visualis-es signals.

During the signal processing required for the final display, the operator can use different modes to manipulate the image contrast, because "good" contrast is required for the analysis, in particular.

The website of the SEM School at the Centre for Imag-ing and Analysis at the University of Cape Town provides an overview of the common modes of hard-wired signal processing needed to obtain "good" contrast. Importantly, they note: "In most cases, the unprocessed image contains enough "natural contrast" for the operator to be able to extract useful information from the image. "Natural contrast'" is thought of as the contrast contained in the signal which immediately leaves the speci-men/detector system' this is an important concept for there is another form of contrast called "image contrast" which is the contrast present in the image displayed on the visual and photographic CRTs. Signal processing techniques ma-nipulate the natural contrast so that the eye can perceive information through contrast in the image. You see, if the natural contrast is either too low or too high then slight signal changes corresponding to important detail may be otherwise lost." [10]

They also state that: "Despite the fact that the natural SEM image is entirely an artefact, it should be noted that signal processing can greatly change the appearance of an image relative to that which might usually be expected, and therefore the SEM operator is under an obligation to state whether processing has taken place." [11]

Authors providing some aspects of signal processing state that it is "a great inherent advantage in that the video signal can be manipulated and processed before being rec-orded" [12]. Considering such a position, it may be sug-gested that such images cannot be objective representations of reality.

Mechanical Objectivity in Representation by the SEM

Patrick Echlin discusses the challenges of interpreting SEM images as pictures. He explains that in viewing these images, the human brain is processing something that is not a photograph as a photograph and that there can be many pitfalls when a microscopist works without prepara-tion or caution. Echlin explains that: "Interpretation may be difficult to achieve, accurately, because mental proc-esses in our brain carry it out and our interpretations will, consciously or unconsciously, be subjected to various bi-ases. It is suggested that this interpretative process is quite different from the way we have learnt to view the natural environment we live in, and the way we decode pictures and drawings to translate any narrative they may contain. In addition, the images we obtain by the SEM are always a

2-D counterpart that complements the 3-D objects. …. They are immediately familiar to us because, like the natural world we live in, they generally appear illuminated from above. This feature, paradoxically, makes it either very easy or very difficult to interpret and the viewer must constantly remember that the image is 2-D and there really is no "up" and "down" or "in" and "out". [13]

A good example of the challenges when interpreting such imagery is a bubble on a surface. When we are looking at the bubble at a low kV (low electron penetration distance), we would see the outer surface of the bubble. At a higher kV, we see the empty space beneath the bubble because the high kV renders the thin film transparent.

Peter Galison discusses that the removal of "unnecessary" information in scientific images can undermine the objectivity of scientific findings [14]. In SEM images, information such as dust, scratches and other 'noise' that is recorded along with the specimen can be removed from the

[1] "The E-T detector operates in the following manner: when an energetic electron (≈ 10 kV energy) strikes the scintillator material (S), light is emitted. Light is conducted by total inter-nal reflection in a light guide (LG) (a solid plastic or glass rod) to the photocathode of a photomultiplier (PM). At the photo-cathode, the photons are converted back into electrons, which are accelerated onto the successive electrodes of the photo-multiplier, producing an ever-increasing cascade of electrons until the final collector is reached" [8].

[2] "A scintillator is a material that accepts incident high-energy electromagnetic or charged particle radiation and in turn uses that energy to fluoresce photons whose peak emission wave-length is longer than the wavelength of the incoming radiation. In the case of a SEM, the scintillator disc collects the second-ary electrons that are produced as the electron beam scans the surface of the sample. These electrons are converted into photons which travel through the light pipe to the photomulitiplier tube (PMT) so that the signal may be ampli-fied to the level required for viewing" [9].

image using basic methods of graphics software (e.g., Pho-toshop).

Other concerns about mechanical objectivity in the rep-resentation by the SEM can be illustrated by some manipu-lations which can be carried out through adjusting the SEM and its in-built software settings. The most illustrative ma-nipulation, in this case, is changing the electrical stress/tension, which allows one to see the image with dif-ferent stages of contrast and to make an accent at com-pletely different levels of detail, which in turn affects the interpretation from picture to picture (Figures 2-4).

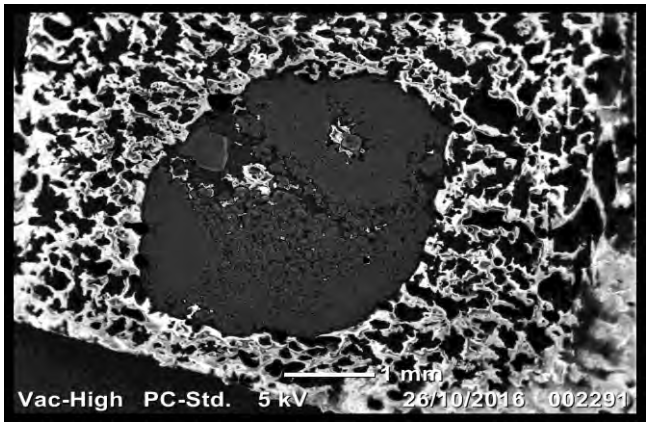


Figure 2. 5kV. 2016

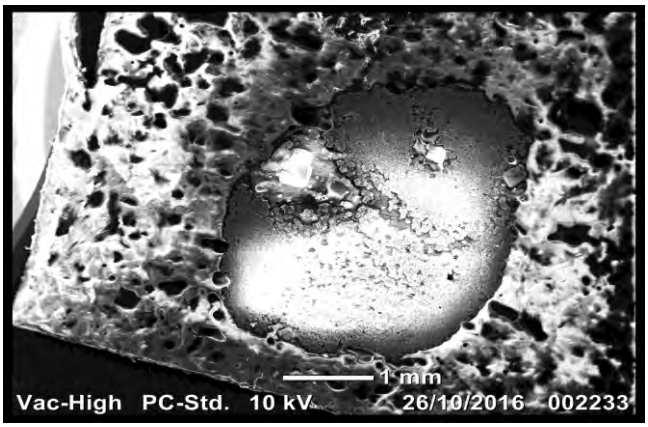


Figure 3. 10 kV. 2016

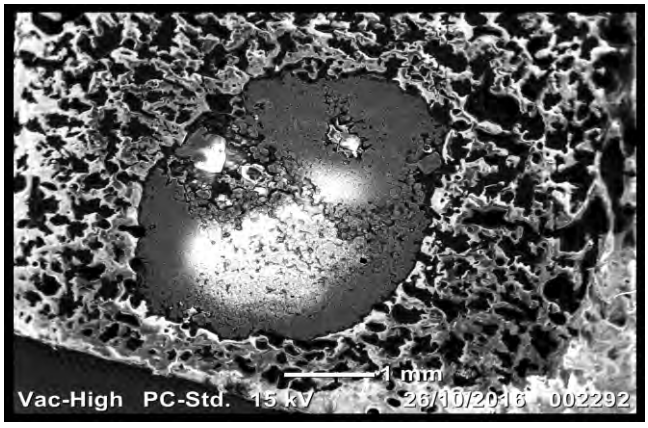


Figure 4. 15 kV. 2016

Additionally, the accumulation of a positive charge (a positive electric field on the sample surface) results in reduced overall image contrast. Accumulation of a negative charge leads to the opposite result, with the image becoming brighter.

Conclusion

It is beyond the scope of this investigation to discuss whether or not SEM-made images can be considered as trustworthy and objective scientific documentation as it is a question that requires a deeper study of the philosophy and history of science and its pictorial representation. Instead, this paper has attempted to emphasise that the new definition other than photographs (or photomicrographs) for SEM images should be sought considering the nature of the process of image generation by the SEM. This is particularly interesting due to the complex nature of the apparatus. Different ways in which images made by SEM can be interpreted create a premise for a new meaning in them arising from different perspectives, including artistic context.

References

[1] Klaus Hentschel, *Visual Cultures in Science and Technology. A Comparative History* (New York: Oxford University Press, 2014).

[2] Klaus Hentschel, *Visual Cultures in Science and Technology. A Comparative History*, 315.

[3,6,7] Joseph I Goldstein, Dale E. Newbury, Patrick Echlin, David C. Joy, Charles Fiori, and Eric Lifshin, *Electron Microscopy and X–Ray Microanalysis: A Text for Biologist, Materials Scientist, and Geologists* (New York: Springer Science+Business Media, 1981).

[4] Dee Breger, *Journeys in Microspace: The Art of the Scanning Electron Microscope* (New York: Columbia University Press, 1995), 11.

[5,8] "Electron Detectors (2017)", Universita Del Salento: Document Library, accessed 1 February, 2017. https://www.scienzemfn.unisalento.it/c/document_library/get_file?uuid=639f02da–34b4–43b5–b595–13978bae6164&groupId=10122.

[9] "Scintillators (2017)", SEMicro Division, accessed 12 March, 2017. https://semicro.org/collections/scintillators.

[10,11,12] "Some Aspects of Signal Processing on a SEM (2017)", University of Cape Town: Centre for imaging & analysis, accessed 1 February, 2017. http://emu.uct.ac.za/training/sem–school/some–aspects–of–signal–processing–on–a–sem/.

[13] Patrick Echlin, Patrick. "The Process of Interpreting Images Obtained by Scanning Electron Microscopy." *Microscopy and Microanalysis* 11, (S02), (2005): 1320–1321. doi: 10.1017/S1431927605500047.

[14] Peter Galison, "Judgment against Objectivity" in *Picturing Science Producing Art*, ed. Caroline A. Jones and Peter Galison, (New York: Routledge, 1998), 327–359.

Author Biography

Anastasia Tyurina is a new media artist, currently an Associate Professor at the National Research University of Electronic Technology, Moscow and a Lecturer at Queensland College of Art, Griffith University, Brisbane.

Biometric Visceral Interface: A Soft Robotic Immersive System for Extended Perception

Mengyu Chen[1], Jing Yan[2], Yin Yu[3]

[1, 3] Media Arts and Technology - University of California Santa Barbara, [2] D2 Nova Corporation
Santa Barbara, USA

[1] mengyuchen@ucsb.edu, [2] jyan@d2nova.com, [3] yin_yu@ucsb.edu

Abstract

The concept of a Biometric Visceral Interface originates from a search for an alternative to the visual presentation of biometric data. Departing from the habit brought by the spectacular society of seeing and understanding, Biometric Visceral Interfaces challenge the common practices of communication based upon visual memory and quantified abstraction of biological phenomena. The aim of such interfaces is to extend human perception of body information beyond visual paradigm and semiotic objects. A set of biomorphic designs of soft robotic prosthetics is introduced here to define a new human-machine interface that allows the users to have affective interpersonal communication. We describe how a multisensory immersive system can reconstruct a user's body schema in virtual space and visceralize biometric data into the user's body as a new way to perceive the presence of others.

Keywords

Data Visceralization, Soft Robotics, Haptics, Virtual Reality, Affective Computing, Biometrics.

Introduction

Existing biometric technology has enabled people to observe and understand the biological events and state changes in their bodies. It provides a reliable and objective way by which various body phenomena can be converted into quantified information that is shareable among people. Biometric information in the form of data can be segmented, analyzed, interpolated, machine learned, and fused in certain ways so that a meaningful and accurate description of a person's biological traits and conditions can be made interpretable [1]. We are particularly interested in mapping, mediating and transforming a user's biometric data to allow another user to gain some understanding of the body through cutaneous senses. We focus on how soft robotics and virtual social space can facilitate such experience, and how affect can be conveyed through these new methods.

Haptics plays a critical role in creating affective communication among the users. Certain amount of touch everyday can enhance affect and convey stronger sense of bond between people [2]. To perform affect transfer between individuals and elevate a user's perception of touch from mere feeling into recognition of others, several design factors need to be explored. Among all of them, the major questions are where the device is actuating on the body, how strong and how much sensation a user is experiencing, and what spatiotemporal pattern of touch sensation is actuated. We predict that these factors can influence how much affect and even how much information a user can decode from the actuation of a piece of biometric data.

Figure 1. (a) A user wearing a Biometric Visceral Interface and navigating in a computer-mediated virtual space. (b) A soft robot actuator on a user's neck. (c) A haptic link between the user and the device that incorporates pulse sensing on the user's ear.

Computer-mediated virtual space, on the other hand, serves as an environmental factor and can alter how a user is perceiving her own body. Recent technologies for Virtual Reality (VR), specifically Head Mounted Displays, (HMD), produce not only high levels of immersion, but also a strong sense of presence and embodiment [3]. An alternative body avatar in virtual space that is different from a user's actual body can potentially cause significant behavioral changes in the user [4]. The plasticity of the brain can cause a person to change and adapt her body schema to a virtual avatar that is not consistent with her normal body proportions, when she is given a certain amount of multisensory and sensorimotor body information [5][6]. This gives us inspiration that visceral perception of events external to a user's body can possibly be achieved when these events are "incorporated" into a new body schema that is reconstructed in our brain by multisensory stimulation [7].

Based upon these factors, we have built an immersive system that utilizes a soft robotic agent and an HMD with virtual avatars to facilitate multisensory visceral communication in a computer-mediated space. We name this new system as *Biometric Visceral Interface* (BVI) (Figure 1). In the following description of the BVI system, we discuss background, system, initial results and future directions of how soft robotics and VR technology can be used together to improve interpersonal communication and data visceralization.

Background

The practice of data visceralization draws upon previous concepts explored in the domains of tangible media and affective communication and is concerned with conveying information through sensations of touch [9], scent [10], vibration and warmth [11]. In this work, we are interested in how touch and vibration, those sense datum fundamental to our understanding of material properties (e.g., texture, mass, curvature, etc.), can work in conjunction with visual and auditory senses in order to give users a sensation of another presence inside her body as a way of visceral mediation.

In prior work, we discussed the development of a soft robotic prosthetic device, the *Biometric Perception Interface* (BPI), a wearable hardware interface that serves to extend perception for the purpose of affective computing [8]. The BPI system is divided into three parts: *Memorizer* (data center and controller), *Choker* (wearable actuator), and *Antenna* (linker and sensor). The system extends concepts that have been previously explored in soft robotic design, intimate communication, and remote haptic interaction [12][13]. We used soft materials to fabricate a pneumatic wearable actuator that can fit comfortably on a human body. It can physically link two people's bodies to give them haptic experiences of each other's pulses in real time without being in physical contact with one another. The BVI system we describe in this paper uses part of the BPI as its haptic infrastructure, and we implemented new designs that work along with VR technologies for multisensory immersion.

System

Our BVI system builds upon the design requirements for interpersonal haptic communication featured in the BPI, such as real-time biometric signal sensing, pulse simulation, on-body soft actuation, and push-pull connectivity for fast and portable linking between users. In order to integrate immersive visual experience to alter a user's self-body awareness, we identified new design requirements: extended range of movement that the user can walk with the device in physical space, quick placement on body and release, hands-free biometric signal sensing and haptic actuation, and networkability and software integration for social VR applications. These design constraints required us to formulate a new system by taking VR system as a critical factor into the design process. In a virtual environment, synchronization between the visual and the haptic elements must be prioritized in order to provide a coherent visuo-haptic experience. The physical mechanism of the BVI system need to communicate with the VR system at a latency as low as possible. Given the above constraints, we designed our BVI components with a focus on wearability, connectivity and visual synchronization (Figure 2).

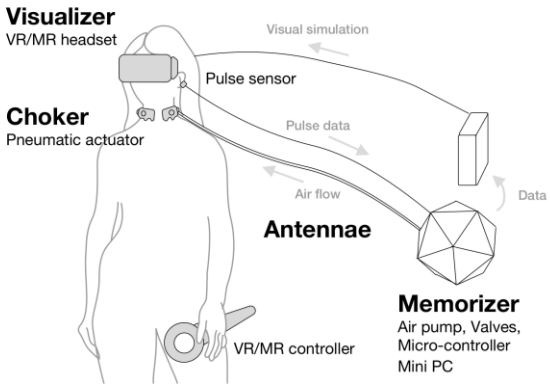


Figure 2. Installation diagram of a Biometric Visceral Interface.

Memorizer

The *Memorizer*, in this design iteration, serves as the data computation center and control mechanism. It handles jobs such as signal processing, pulse simulation, data communication, and virtual body rendering. The electronic peripherals embedded in a memorizer contains a mini air pump, a pair of valves, and an Arduino microcontroller. The visual computation is handled by a high-performance mini PC that has the processing power for VR graphics.

The haptic mechanism and visual data representation are separately handled on two different processing units, because we see the gap on computational workloads between the hardware and the software. The hardware control for the haptic interface requires very minimum amount computational power for signal processing and pulse simulation, as the pulse wave from a person can be easily converted to on/off signals for the valve system. We programmed a threshold-based switch that detects wave peaks to control the inflation pattern of the soft actuator. The ATmega328P microprocessor on the Arduino board is well capable of the amount of computational work on this part.

While the microcontroller is controlling the haptic component, the sensor signal is transmitted to the mini PC unit via serial communication after acquiring the data. The serial rate is set to be 115200 bits/second which ensures a fast data transmission in between the two units.

Choker

The *Choker* is a wearable soft haptic actuator that is to be worn on a user's neck. We use silicon based high performance rubbers to cast a soft and stretchable skin-safe pneumatic structure of varying degrees of elasticity (Figure 3).

When compressed air is pumped from the memorizer, an array of air channels on the choker's surface will inflate or deflate to morphologically simulate pulsing movements. In order to make it simple for wearing, we place a bendable metal wire inside the choker so that it can quickly fit onto a user's neck and stay there by itself with a proper neck shape. Push-pull connection ports for air tubing are designed on the back for fast release from the whole system.

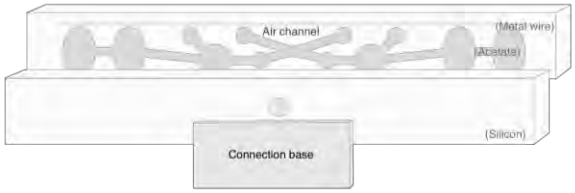


Figure 3. Structural design of the choker with air channels

Antenna

The *Antenna* is a cable-like multi-section connecting agent that links the memorizer, the choker, the visualizer and the users. An antenna provides air flow transmission and data communication via air tubing and electrical wires. It is designed to fit with the push-pull connection ports of other components for quick setup. A pulse sensor with a clip is placed on one section of the antenna to sense a user's heart rate on her ear.

Visualizer

In order to integrate the VR system into our visceralization research, we added a new *Visualizer* component to the system (Figure 4). The visualizer, connected to the memorizer and placed on the user's head, serves as an entry point to immerse into the computer-mediated space. It renders and maps a virtual body onto the user to give her a perception of an alternative body presence. A visualizer supports the most recent VR technologies on the market such as HTC Vive and Oculus Rift that precise tracking is integrated to give the user strong and responsive sense of immersion.

We use Unity game engine to generate real-time interactive 3D graphics in the visualizer, as Unity is well optimized for high-quality stereoscopic rendering and for GPU-based parallel computing. We designed voxel-based generative body avatar to induce the user to have an ownership illusion and to reconstruct the user's body schema. The pulse data is mapped onto the voxel particle flow that vibrates the virtual body to create an animated, dynamic and volatile sensation of visceral penetration beyond the body membrane (Figure 5). User orientation and positional tracking of the head and hands provides a visuo-motor congruence between the real and virtual when the user is walking, rotating the body and waving the hands. Placed inside an abstract and decontextualized space, the voxel-based virtual body is designed to enhance the user's level of immersion, so that the user can have a stronger sense of body ownership that takes her perception beyond the physical limits.

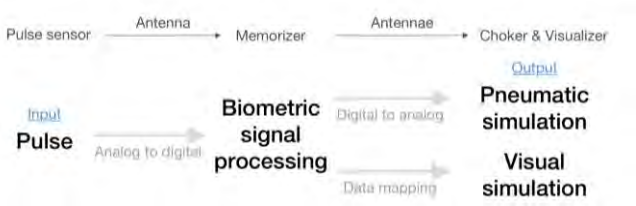


Figure 4. System diagram of a Biometric Visceral Interface

Interaction

Two different operation modes are designed in our system: local mode and network mode. In local mode, user can experience either pulse data stored in the memorizer or a real-time signal directly from the pulse sensor on the antenna as the source of visual simulation and physical actuation. A single BVI system can be used by two users sharing one memorizer, although the system can deliver visual simulation to only one visualizer. In such a case, a visualizer and two sets of chokers and antennae, are connected to a memorizer. The two users, being physically in the same space, can sense each other via soft robotic actuation on their necks. An extra projection screen can be connected to the memorizer to share the content from the HMD.

In network mode, a single BVI system is used by each user and each device serves as a node in the network. A connected user can wear a BVI system and remotely sense another user's biometric signal in real time. The memorizers telecommunicate with each other in the form of a remote visuo-haptic link. The computer-mediated space, in other words, becomes a social VR space where interactions are happening over the network. The users can encounter each other without being present in the same location.

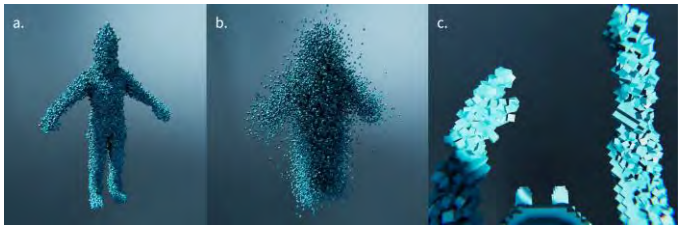


Figure 5. A voxel-based generative virtual body avatar can have different states: (a) deflated stable shape when pulse signal is low, (b) inflated and volatile expansion when there is a heartbeat. (c) dynamic movement with the user's tracked hand poses.

Network Protocol

In order to reduce the bandwidth usage, we only send pulse data between the nodes over the internet. We use ZeroMQ [14] messaging interface with TCP protocol to achieve low-latency and reliable data sharing. Specifically, we use asynchronous publisher/subscriber mode in ZeroMQ that starting the messaging nodes in the network are independent of each other and they can broadcast messages to others without making requests and responses. This allows the data to be transmitted with much lower latency.

Initial Results

Our design of a multisensory immersive system for extended perception using both soft robotic haptics and VR technology not only gives the user a visceral sensation of another presence in the body, but also provides a new way of affective interaction in a social cyberspace. The placement of our device onto a user's body, including an HMD, takes less than 15 seconds. The choker we designed for the BVI system is highly bendable but can still stay tightly on the user's neck. The user, while wearing the whole system, is also given complete freedom of turning, walking or using VR controllers with both hands. Inside the HMD, the user can see a tracked voxel-based virtual body on herself. The generative pulse animation on the virtual body is synchronized with the soft robotic pulse actuation on the user's neck. The network mode of our system also allows the same experiential link to be made over the internet.

Conclusions and Future Work

Our BVI system is capable of visceralizing biometric data to the user's body by visuo-haptic reconstruction of the body schema. Our system has many other potential application scenarios, such as multisensory immersive movie theaters, augmented telecommunication, and touch-based therapeutic art installations.

Future work will explore the idea of affective computing using the latest mixed reality technologies, such as the Magic Leap One and HoloLens 2 to further mediate and mix the user's sensation of the physical and the virtual, so that the visceralization of another person's biometric data can be more naturally achieved. We will also conduct user studies to evaluate the performance of our system based on the level of visceral and affective sensation, and overall user-friendliness of the hardware and software interface.

Acknowledgements

This work was supervised by Professor Yon Visell with space and equipment provided by the RE Touch Lab, and the Innovation Workshop at CNSI of UC Santa Barbara.

Reference

[1] A. Ross and A. Jain, "Information Fusion in Biometrics," Pattern Recognition Letters, pp. 2115–2125, Sep. 2003.

[2] A. Debrot, D. Schoebi, M. Perrez and A. Horn, "Touch as an Interpersonal Emotion Regulation Process in Couples' Daily Lives," Personality and Social Psychology Bulletin, 39(10), pp.1373-1385, 2013.

[3] D. A. Bowman and R. P. Mcmahan, "Virtual Reality: How Much Immersion Is Enough?," Computer, vol. 40, no. 7, pp. 36–43, 2007.

[4] N. Yee and J. Bailenson, "The Proteus Effect: The Effect of Transformed Self-Representation on Behavior," Human Communication Research, vol. 33, no. 3, pp. 271–290, 2007.

[5] M. Botvinick and J. Cohen, "Rubber hands 'feel' touch that eyes see," Nature, vol. 391, no. 6669, pp. 756, 1998.

[6] A. Maravita, and A. Iriki, "Tools for the body (schema)," Trends in Cognitive Sciences, vol. 8, no. 2, pp. 79-86. 2004.

[7] K. Kilteni, J.-M. Normand, M. V. Sanchez-Vives, and M. Slater, "Extending Body Space in Immersive Virtual Reality: A Very Long Arm Illusion," PLoS ONE, vol. 7, no. 7, 2012.

[8] M. Chen, J. Yan, and Y. Yu, "Biometric Perception Interface: A Multisensory Soft Robotic Agent for Affective Social Interaction," International Workshop on Haptic and Audio Interaction Design, 2019.

[9] J. Cha, M. Eid, L. Rahal, A. E. Saddik, "HugMe: An interpersonal haptic communication system", Proc. IEEE Int. Workshop Haptic Audio Visual Environ. Games, pp. 99-102, 2008.

[10] R. Strong, and W. Gaver, "Feather, Scent and Shaker: Supporting Simple Intimacy," Proc. CSCW'96, pp. 29-30, 1996.

[11] K. Dobson, D. Boyd, W. Ju, J. Donath, and H. Ishii, "Creating visceral personal and social interactions in mediated spaces," extended abstracts on Human factors in computer systems - CHI 01, 2001.

[12] J. Smith and K. Maclean, "Communicating emotion through a haptic link: Design space and methodology," Int. Journal of Human-Computer Studies, vol. 65, no. 4, pp. 376–387, 2007.

[13] C. Disalvo, F. Gemperle, J. Forlizzi, and E. Montgomery, "The Hug: an exploration of robotic form for intimate communication," Proc. IEEE Int. Workshop on Robot and Human Interactive Communication, 2003.

[14] P. Hintjens, ZeroMQ. OReilly Media, 2013.

Authors Biographies

Mengyu Chen is a new media artist and designer whose work examines how issues of network infrastructure, geopolitics, and virtual reality can affect our perception of self and society. He holds an MFA in Digital + Media at RISD and currently is a PhD student in Media Arts and Technology at UCSB.

Jing Yan is a media artist and interaction designer. Her work seeks, presents and argues for the essential qualities of materials, life beings, and hybrid entities in computational virtual and physical environments. She holds an MS in Media Arts and Technology at UCSB, and a BA in Advertising from Tongji University.

Yin Yu is a PhD student in Media Arts and Technology at UCSB. Her work explores the potential of multimedia interactive environments and the relationship between architecture and music by means of emerging technologies. She has a BS in EE, and two master's degrees in Information Technology and Interior Architecture.

You cannot step into the same museum twice – How Natural Light Pulsate a Space.

David Behar, Assistant Professor, Mundi_Lab, Faculty of Architecture and Town Planning, Technion, Israel

Abstract

You cannot step into the same river twice, said Heraclitus, sending forward a significant challenge to the world and language of interactive art and immersive environments. This paper presents a study case where interactive technology facilitated the manipulation of natural matter, light. The manipulation brought different time based light phenomena, such as penumbra and camera obscura. In this case technology became the tool rather then the object of appreciation, in order to reveal and present light phenomena.

The receptors of light were not only the visitors, but also a large modernist exhibition space, which was alternatively defined by multiple light appearances. The experience of the dynamic natural lighted space was felt through the senses with the complex perception of the various inputs composition. This suggests that such a framework can be used as a study case for the research of perception from various points of view: physiological, psychological, and philosophical.

Keywords

Natural light, responsive environment, space interaction, penumbra, camera obscura, phenomenology.

Introduction

The Mishkan Museum of Art Ein Harod, is a hidden gem in a little kibbutz in north of Israel. Artists and Architects visit the museum to experience the unique naturally lighted spaces. The building was designed by a talented architect, Shmuel Bickels in three phases during 10 years, which allowed a unique process of developing novel light – spaces. The big hall, the gallery for Israeli painting, is considered as the best venue to exhibit paintings in Israel, due to the supreme light quality (Manor 1990). Furthermore, this space has found a honorable place in the history of 20th century museum architecture, since it inspired the influential Italian architect, Renzo Piano with his De Menil Gallery design, one of the peak examples of 20th century museum architecture (Le Thierry 2001).

The big hall space characteristics are of a large expansive space (22mX11mX6.5m). Light and shade define the different players that compose the space: four upright columns, large terrazzo floor, white walls that expand and curve toward the light, and a hovering, cap-like ceiling. Light is poured in from both north and south sky directions, bringing different patterns and hues to the space. The curvy light funnels tame light, an architectural detail that strongly characterizes the space and define its light quality (Behar 2009, 2015).

The architectural space was intervened with different layers of technologies:

1. A motorized louver system was introduced to a selection of clearstory windows (total of 52 louvers with 52 motors). The rest of the windows were blocked out of light.
2. An array of PIR sensors (total of 28) that scanned the presence of visitors in the floor space.
3. A DMX light control system that was transformed to the function of motor control to open/close the louvers or any incremental angle between 0 to 90 degrees.
4. Integration software that control all inputs and outputs of the system.

This project came to celebrate and challenge the uniqueness of the big hall's daylight architecture, by creating a mediated responsive space, where the presence of the visitors trigger unique light-space performances. As the visitors enter the darken space, the dynamic daylight appearance stimulates an exploration of the large space (22x11x6 meters). Light and the natural sound of a water drip establish three overlapping spaces within the big hall, each with its unique dynamic quality. Two sculptural curved columns dialogue with both the existing columns and the curvature of the light funnels, a gesture that focus attention on the inspiring architectural language (Figure 1). Top light louvers control and pour in natural light in tamed and magical sequences, pulsating, orchestrating and stimulating a rich sensory experience (Figure 2,3). Occasionally light phenomena as camera obscura appears on the walls, bringing in the physical presence of the sky and the moving clouds. Sensors, motors and control units, facilitate the work that allows both random visitor interactions and artistically defined light-space choreographies.

Light played its major role, pouring in at an unexpected, time-based manner, giving presence to random patterns of textures, hues and colors. The space responded accordingly, expand in all dimensions

and squeeze back to its original well-known scale. These dynamic appearances of light and space brought the experience as if it was pulsating.

The work pose the following question: How can a space be felt and experienced as an autonomous entity? Space could be experienced and could be felt through the senses and the composition of their various inputs:
Sight, the dominant sense, brought visual compositions into play. Vision absorbs a large range of information, mostly overlapping with other senses intakes.

Sound: if vision is distancing oneself, then Sound brings an approach. The space is filled with sounds: interior sounds exterior sounds filtering in, merging together different worlds, and different realities. The body has the potential to evoke sounds when encountering the different elements of space, as a juxtaposition of the musician image and his instrument, the space.

Touch, Brings further a sense of intimacy, for example, touching the warm texture of wood on a guiding rail that invites to explore space while in movement. The contrast between wall and textiles, stone and glass, tile and doors are sensed with distance by the caressing eye. The tactile experience of mater communicates directly to one's intimate memories.

The smell of materials, the flow of fresh air introduces intricate time to the exploration. Smell can lead us to related memories linking present time with past events.

Movement: While wondering around the space, while exploring the expansive space, the invitation of light triggers bodily movement. Natural light triggered the visitors exploration in the space, thus the body could feel relations of scale, specifically towards the curved columns, and towards the presence of light, as appeared in the reflection areas, walls, columns and floor.

The multifaceted sensual experience reveals the unique time base event offered when natural light is introduced to the architectural spaces. A question arise, in times of prime consideration to well-being, when light is designed and light is engineered for everyday functional spaces, do we still find the opportunity to experience dynamic, time-based light-spaces?

Louis Kahn, one of the leading architects of the 20th century, has identified: "*No space, architecturally, is a space unless it has natural light...Artificial light does not light a space in architecture, because it must have the feeling in it of the time of day and season of the year – the nuance of this is incomparable with the single moment of the electric bulb...Nothing static, nothing static as an electric bulb, which can only give you one iota of the character of light*" (Latour 1991). Kahn's expression about the phenomenological necessity and presence of light reminds us that technology and its use has also an important role in exposing and bringing forward to our senses the intricate presence of natural phenomena.

You never enter a river twice said Heraclitus, can it be similar in museum spaces? By using and introducing natural light, which is changing by the hour, by the different time of year and season, Light-Space Pulsations offer a totally different experience of a white exhibition space. Furthermore, the experience of the space with its light, suggest a philosophical discussion about aesthetics, the perceptual expression of it and its phenomenology. To conclude, the use of technology facilitated a complete circular move towards a self-reflection of the museums core entity and identity.

Short Video documentation of the light space pulsations:
https://vimeo.com/207961071
https://vimeo.com/207704221

References

Behar, D. 2009. "The Light in the Museum of Art." PhD Thesis, Technion – Israel Institute of Technology, Haifa, Israel.

D. Behar, M. Levin and G. Capeluto, "*Light restoration proposal for Ein Harod Museum*", *Architectural Science Review*, Special Edition: Exploring Architectural Science in the Context of Cultural Sustainability, Volume 58, Issue 4, 2015.

Le Thierry d'Ennequin. 2001. "Machine a Lumiere Ein Harod." *Le Moniteur Archives* 10 (119): 106–115.

Mannor, M. 1990. *Portrait of a Museum*. Ein Harod: Ein Harod Museum.

latour A., *Louis Kahn, writings, Lectures, Interviews*, Rizzoli 1991.

Article figures:

Figure no. 1

Figure no. 2

Figure No. 3

Facing Death and Afterlife in Electronic Art

Stahl Stenslie
Affiliation: EE – Experimental Emerging Art Norway
Location, Country: Oslo, Norway
Contact Emails: stenslie@gmail.com

Abstract

The paper presents an overview of immersive, electronic art installations dealing either with the topic of death, or promoting somatic immersions into experiences associated to death and dying. Death and digital afterlife, often for all eternity, are frequently encountered topics in online media and literature, but less so in the physical form of experiential media art installations.

Keywords

Somatic art, immersive art, lethal interaction, interactive installations.

Introduction

If "*Death is the golden key that opens the palace of eternity"* (John Milton, Comus)*,* how can electronic art assist us on the way into the realm of the electronic Elysium? How can electronic art bring about the experience of death? And be the key to eternal life at the same time? Can we live forever by dying more often? In the context of media art, what are the ways to experience forms of Augmented Death? And what technologies of Death and Dying, whether real or simulated, are there in art?

Digital Elysium

The dream of a Digital Elysium, the digital paradise, is no new story. Eternity is inherently coupled with the idea behind the digital technologies. As a mathematical system, the digital is lossless. It is perfectly repeatable and the digital principle produces perfect copies of itself for all eternity. When the digital duplicates or replicates, then there are –in principle- no mistakes. And if, then reboot your system. Digital Nirvana guaranteed. This is rather different from the deadly reality of carbon based life forms; physical life is a one-time shot. You cannot reboot your physical self. Bridging the gap in this hybrid mortality, this discrepancy between the repeatable (digital) and non-repeatable (physical body) is an intriguing challenge, opening up for new aesthetic and possibly even somatic experiences.

The virtual connections between digital data, death and eternity have been treated by many. [1] [2] One example is Digital Immortality, how we can keep on living forever in social media, also after PD (Physical Death). [3]

Less thematized is how physical and somatic electronic art projects have given users a glimmer of death. The focus of this paper is therefore to present some of these works from the perspective of the somatic and immersive.

Immersive War: World Skin

One of the first immersive experiences of the dark and deadly world of war was in Maurice Benayoun's virtual reality project *WORLD SKIN* made in 1997. The project was a "photo safari in the land of war". Inside a VR cave users armed with 3D glasses and custom built VR cameras could navigate through a virtual warzone. With their cameras users could take snapshots of the various war sceneries, scarred by "war-demolished buildings, armed men, tanks and artillery, piles of rubble, the wounded and the maimed". [4] Thus users became complicit not just in documenting, but also somehow in a somatic experience of war given the bodily immersive aspects of these early Cave environments.

Twenty years onward similar experiences have found their way into mainstream media, such as the "Welcome to Aleppo" 360 video by Ryot (2015), named as the "First Ever War Zone in 360° Virtual Reality". [5]

Potentially Lethal: Spatial Sounds

The Dutch artist Marnix de Nijs have an acute sense of how to capture audiences inside an uneasy zone lingering between curiosity and deadly dangers. [6] His installations often carry an implicit promise of death, or at least harmful physical damage. In his interactive, kinetic and audio installation SPATIAL SOUNDS (100dB at 100km/h) done in 2000/2001 together with Edwin van der Heide, the audience is being drawn towards a humming speaker attached to a long, horizontal metal arm. [6] The system is acutely sensing who and where the audience is placed in the space. Once someone is lured towards the speaker's humming sound, the loudspeaker starts spinning, faster and faster, louder and louder up to 100dB at 100km/h. If the participant goes away the speaker slows down, thus underpinning the interactive connection and "game of attraction and repulsion" between the living audience and deadly tool (artwork).

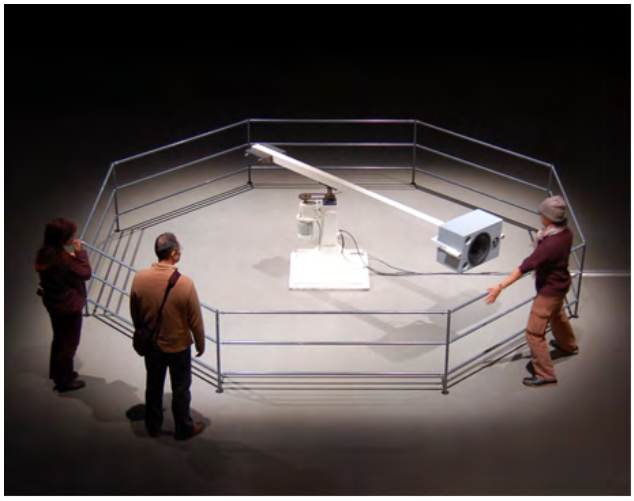


Figure 1.: Spatial Sounds installation. Photo Edwin van der Heide

Suicide Machine

Perhaps the most urgent and near-death experience of immersive art is the "Delusions of Self-immolation" (1993) installation by Erik Hobijn, shown by V2_ for the shown in the 1993 'The Body in Ruin' exhibition. Hobijn's installation was nicknamed the 'suicide machine' as it literally was made as a large human grilling machine that engulfed the participant in a lethal shower of flames. [7] The reason why no participants were physically hurt was due to i) short exposure time and ii) the immense preparation of each participant with a flame repellant protective layer put directly onto their skin. The preparation time took more than 90 minutes, but the exposure was only a few seconds long. Erik Hobijn's machine unleashed strong emotional responses as it put the participant into –to put it mildly- the existential conflict of simultaneously safeguarding their own health while experiencing (near) death. As such the installation represents a hard-core research into the somatic boundaries of life and living through a deadly encounter.

Figure 1. "Delusions of Self-immolation" (1993) installation by Erik Hobijn.

Biological Death

Experiencing death in media art is frequently encountered in Bio-Art. The practice of the Australian group Symbiotica is an example of how it is an art form dealing with not just making matter come alive, but also its maintenance and nurture so it stays alive and, ultimately, its death. [8] Bio-art is so intrinsically preparing for dying and death in its very life chambers.

A related art form is the to use biological matter to experience electronic art. The electronic sound installation "until I die" by the artist VTOL operates so to speak in the afterlife of the artist. [9] The work is based upon the artist blood turned into batteries that generate electricity. An elaborate technical set-up enables several batteries containing liters of his blood to power a small electronic and algorithmic synth module. The output of the sculptural installation is a generative sound composition.

Strange, Future Technologies

The movie *Strange Days* presents one of the more lethal and discursive concepts of how electronic technology and VR can go wrong. [10] Written by James Cameron and directed by Kathryn Bigelow, the story is built around the future and fictitious SQUID device (Superconducting Quantum Interference Device). It is a hair-net like device is put on the subject/user's head. Its minidisc-based system can both record the entire user's sensory experience as well as play it back, including onto the body of others. Through SQUID technology one gets a direct access to immediate corporal sensations as if one really is the other person. It is in many ways a similar model to Gibson's earlier cyberpunk concept of SimStim (simulated stimulation). [11] In the film this realtime experience is a part of the main plot as one of the main characters is killing people with a SQUID on both his and the victim's head. Simultaneously the killer enters the victim's body and can feel himself being killed by himself, an ultimate and repetitive suicidal process. Paradoxically this repeatable experience of death underscores how the killer enters 'the palace of eternity' by returning to life after his kill. Only to continue killing.

The concept of such a suicidal-existential encounter is also relevant to Lacan's concept of first and second death where knowing I am dead (second death) comes through the procedure of dying (first death). [12]

Figure 3. The SQUID system. Left image shows user, the right image the victim.

The experience of death contains the threat of possible annihilation of the self. The projects listed here all carry

elements of a catharsis, a mental and/or physical cleansing or levelling. In the context of electronic art, facing death as a cleansing experience references to the heroic, classical image of Prometheus; the mortal becoming immortal through technology. Although the human body is all too fragile for such an allegory, the mentioned artworks somehow attempt some form of existential reset and 'rebirth' into a new perception of existence. This pose the question of how to design our afterlives, so to speak from scratch. One such form of resurrection is thematized in the Erotogod installation, shown at the 2003 DEAF biennial in Rotterdam.

Erotogod

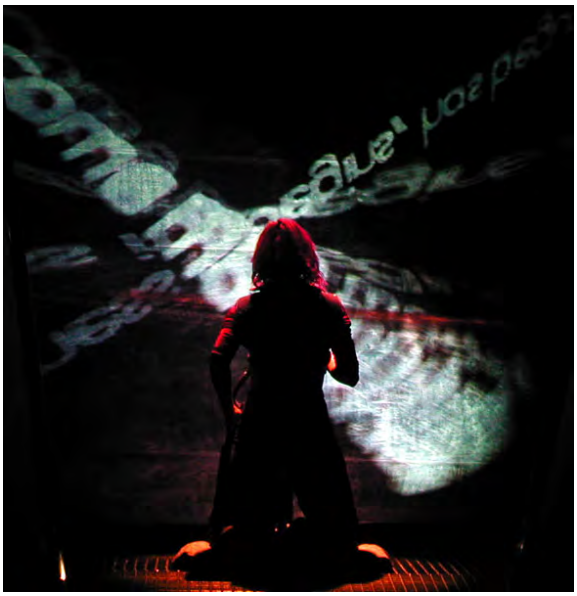


Figure 3. Erotogod. User kneeling in front of immersive screen display.

The Erotogod installation was built as a multisensory space of experience using sensors and effectors mounted into a body suit to let its users interactively write their own myths of creation. [13] The emergent myths appeared as three-dimensional sound, VR graphics and corporeal experiences inside the bodysuit. Together those expressions attempted to create a synaesthetic experience, that is, the combinations of multiple sensual modalities into a larger impression. Death was not the explicit topic, but implicit in how the installation promoted the creation of individual, ontological mythologies from scratch, as if asking how the visitor/user would like their electronic Elysium to be like. While performing the installation, the users simultaneously wrote their new stories of creation through auto-erotic touch of their body. This composed an elaborate 26 channel sound environment and visual immersion into a VR cave filled with recombinant texts. The installation elaborated on the somatic dimension of aesthetics by pitching advanced data- and interactive technologies against the human body as an emotional surface. In all their human fragility, the users were so enabled to physically write their individual and personal version for their own palace of eternity.

Death and Aesthetics

John Milton's introductory quote about "*Death is the golden key"* is from his text 'Comus', originally a performative play in honour of chastity. As such it represents an idealistic stance towards life, promoting conduct that should refrain from physical pleasures. In contrast, the electronic artworks mentioned here represent radical experiences putting the audience and the participants into existential and conflicting sensations such as danger (as in Spatial Sounds), fear (as in Delusions of Self-immolation) and corporal seduction (Erotogod). Such physically challenging and experiential works of art is a showcase of how the field of electronic art can provide somatic and immersive experiences as golden keys to expand our understanding of both life and aesthetics. They promote less eternal life, but all the more reflection on life and living itself.

References

[1] Moreman C. M., Lewis A. D. (2014) Digital Death: Mortality and Beyond in the Online Age: Mortality and Beyond in the Online Age. ABC-CLIO.

[2] Hoskins, Andrew (2017) Digital Memory Studies: Media Pasts in Transition. Routledge.

[3] Humphries, Courtney (2018) Digital Immortality. https://www.technologyreview.com/s/612257/digital-version-after-death/ downloaded on December 20th 2018

[4] Benayoun, Maurice (1997) World Skin. http://benayoun.com/moben/1997/02/12/world-skin-a-photo-safari-in-the-land-of-war/ downloaded on December 20th 2018

[5] RYOT (2015) www.ryot.org/VR, https://www.youtube.com/watch?v=Nxxb_7wzvJI downloaded on December 20th 2018

[6] Nijs, Marnix de (2001) http://www.marnixdenijs.nl/spatial-sounds.htm downloaded on December 20th 2018

[7] Pearson, Mike (2010) Site-Specific Performance. Macmillan Education UK.

[8] Zurr, I. & Catts, O. (2004) The ethical claims of Bio Art: killing the other or self-cannibalism? Australian and New Zealand Journal of Art, vol. 5, no. 1. Art and Ethics. http://www.tca.uwa.edu.au/publication/TheEthicalClaimsofBioart.pdf

[9] Morozov, Dmitry (2016) http://vtol.cc/until-I-die downloaded on December 20th 2018
[10] Chan, Melanie (2014) Virtual Reality: Representations in Contemporary Media. Bloomsbury Publishing USA.
[11] Gibson, William (1984) Neuromancer. Ace Books.
[12] Bard-Schwarz, David (2014) An Introduction to Electronic Art Through the Teaching of Jacques Lacan: Strangest Thing. Routledge. P. 163
[13] Stenslie, S. (2010) Virtual Touch. AHO Norway.

The projective and introjective experience of the landscape

Helena Ferreira
Universidade de Lisboa, Faculdade de Belas-Artes,
Centro de Investigação e Estudos em Belas-Artes
Lisbon, Portugal
helenaferreira@campus.ul.pt

Abstract

This paper is based on my on-going artistic and theoretical research on the concept of projection. This concept has always played a central role in the development of my own artistic work and in this paper I will address the notion of 'projection', using its most common definitions and personal interpretations, as it pertains to the psychological, optical and pictorial fields. I will do so by analysing its role as a transference medium for intrinsic motivations that occur through thinking, projecting and drawing pictures. Stemming from these assumptions the paper also provides a framework that considers a return to the materiality of the intangible images.

Keywords

Projection; Introjection; Light; Shadows; Materiality; Landscape.

Introduction

Let us consider a wider and more conceptual approach to the notion of projection, which is affiliated with the basis of the projective geometry principles that one can find across many fields such as geography, mathematics, chemistry, alchemy, psychology, psychoanalysis, cinema, photography. In each field to project is an operation that requires physical or mental activities for instance: to cast, to throw, to imagine, to transfer, to transform, to transport, to map, to depict, among many. It is no coincidence that 'projection' comes from the latin word *proiectionem* that means "transmutation by casting a powder on molten metal" [1], in the context of the alchemy of the XV century, in order to transform a base metal into gold. Also, to project (proicere; pro = forward; iacere/iactus = to throw) means *to strech out*, *to throw forth*, but also a *mental plan*, a *draft*, a *scheme*. [2]

In fact, in descriptive geometry it means a linear correspondence between two elements, which result in an intersection. In drawing, it entails a correspondence, a process, and a connection resulting in a representation or reproduction. In mathematics it implies several types of projection such as correlation, mapping, transformation. In chemistry, the term projection is used to coin depictions of molecules or monosaccharaides, for instance. In optics it means a trajectory, a transport that may be linear or diffracted. In psychology it is an unconscious process of transferring ones attributes to another.

For all purposes upon the use of projection, many of the applications cut across more than one field, but in the end they all share a common idea, which might be a more raw approach to the definition of projection, and that is, an extension of something beyond somewhere; projection is a process that describes a trajectory with a starting point and usually has a destination point, other than the first, and in that trajectory it may encounter several kind of disturbances, more than once at the same time (a paper or a canvas, a body or an object, a screen or a lens, the *other* or the *self*); projection is the process that occurs between the action and its result, being the action and the result determining factors for framing a meaning. With that in mind projection has its dwelling place in the space between things.

In the following study I seek to deepen this idea and I argue that projection is technically a process that requires a source that radiates a certain type of information, the space traversed by this information, and a surface on which it rests; but aesthetically projection imply a certain idea of *transit*, of a *transference* or a *transport* of experiences and emotions. I will do so by providing insights on the notion of projection and projected images, by focusing on the pictorial, optical and psychological fields, and by presenting my own artwork as a result of these interpretations.

The projective and introjective experience

Projection and *projected image* concepts often go hand in hand, but a further overview can reveal a clear distinction between them, being the first one related with the process and the latter with the result of that process.

The concept which derives from the *projected image* is far more complex, although an interesting starting point, than the one described by Pliny the Elder in *Naturalis Historia* in which a girl, the daughter of Butades of Sícion, outlines the shadow of her lover by the light of a candle. In fact, this story embodies the origin of several mediums in art (such as drawing, painting, sculpture) but also provides insights to the discussion of the motivations behind the creative process. One can state that the idea of projection involves not only geometric principles but also identifica-

tion principles, in this case with the represented image, since the projected shadow allows the identification with the original object. Pliny the Elder tell us that the first form of pictorial representation was not originated in direct observation of a particular body, but in fixing the shadow projection (of the body) onto the wall. [3] This argument, according to Stoichita, is based upon the idea that the pictorial world began as a need for *resemblance*, and as *souvenir* (or as *memory*) of something that is no longer with us, in order to make the absent present. [4]

Another interesting myth is of Narcissus, which plays an important role in the field of representation and projected images. In it, the character falls in love with its own image when he confronts his projected reflection on the water. But Victor Stoichita argues that *shadow* and *reflected image* were often seen as having the same meaning for a long period of time, but in fact they are very different in an optical and ontological point of view, and that is "the *shadow* represents the stadium of the *other*, and the *mirror* represents the stadium of the *self* ". [5]

This notion of the *self* and the *other*, as a result of projective operations, is central to my research when one speaks about the psychological field of the definition of projection. Dominique Païni has already touch upon a few aspects of the psychological aspect of projection when he stated that projection is not only a luminous transportation of images (optical field) but also it amplifies other senses, that is, projection is also the transport of emotions, the transport of the poetic and passionate nature of an oneiric, divine or hypnotic world. [6]

The exchange of characteristics, of emotions, of attributes, of states of mind, may occur either through projection or introjection if seen in the light of psychology. Projection occurs when an individual assigns to another individual specific psychological aspects that usually are not recognized as their own. As for introjection is understood as a mechanism where an external object, for instance personal characteristics from another individual, becomes internal and part of the personality, that is, an individual takes inward something external. I would say that, in a broader scope and within an artistic standpoint, projecting and introjecting provides a means by which an individual assigns their own motivations, characteristics, concerns, distress, desires to external objects and the other way around, all this through a creative process. It is a circular process in the aesthetic creation and experience. It is a combination between a *reflexive* practice that entails an impulse, an emotional thrust, a reflex outwards, and a *reflective* practice that has to do with an introspective attitude and a return inwards oneself.

The *(Pro)jection* (to throw forward) has an aesthetic meaning that assumes an extensible materiality and can unfold the space and convey a sense of creative suspension of time that allows the opposite perspective, that is, of *(intro)jection* (to throw inside). In fact, light projection has a spatial dimension, but also a temporal one associated with the wandering and moving tensions, since it implies a bodily relationship with space (throwing away) and an anticipation of time (prediction, in the sense of the desires and expectations of each individual).

> "The projection is thus something that displays a trajectory, a means of transport, (...) and implies a relation between the inside and the outside, between physical and mental perception. The screen intervenes in how the projection is to be seen, but equally, the circumstances in which the projective flow occurs, the interference it is subject to and its origin also influence the way the screen receives and reconfigures this information."[7]

In my artistic research and production I seek to approach the concept of projection in the light of the *pictorial field* - the drawing is always a projection in which we can identify the mind as the point of origin, the arm and hand as the visual rays, and drawing as the projected image; the *optical field* - the projection of light originates both luminous images and silhouettes or specular reflections, which allows for the possibility of the interaction and experience of spectator in the work/space; the *psychology field* - the projection of images has a double meaning, if on one hand it can represent the motivations of the artist, on the other hand it allows the viewer to experience the universe of images provided by the reflexive and reflective nature of both projection and introjection, engaging the viewer with himself and with space around.

Inner landscapes

"If we opened people up, we'd find landscapes" states Agnés Vardas in her documentary *The beaches of Agnés*. In fact, the vibrant changes of the projection and the variety of mental states that comes from that operation, can find a consonance in a surface, a place of dwelling when we look inwards:

> "It is a mobile place of dwelling, a transitional space that activates cultural transits. It is a plane that makes possible forms of connectivity, relatedness, and exchange. Such surface, far from being superficial, is a sizable entity: it is a space of real dimension and deep transformation. Conceived as such a space of relations, the surface can contain even our most intimate projections." [8]

Exploring the landscape aesthetically is part of my creative process because I can explore the surface and the depth by means of *projection* and *introjection*, simultaneously. When Bachelard speaks about the *metaphor of depth* related with the water and with the idea of diving in the poetic dimension to experience the depth of dreams, he speaks about the resonance in our inner selves by being confronted with the past and with our soul. To immerse oneself in the landscape implies to imagine and to transform the perceived and present images in order to lead us to other imagined and absent images. For Bachelard, it is

the possibility to release the imagery and poetic universe from the conceptual universe, since the imagination, far from the ability to form images from the perception, is mostly a process of transformation and freeing the perceived images, which he calls the 'primary images'. [9]

Furthermore, addressing the notion of 'projection' within a broader context allows me to explore the light as a substance and manipulate the transport of luminous images. The light beam can be a malleable element of space transformation and acts as a volatile and pulsing material, which thrust can be enhanced, subtracted, transformed, transfigured, according with the interferences it encounters in its trajectory. In the history of the projected images (a parallel history to the art history according to Dominique Païni), light is the material par excellence; light is not just to illuminate an image; light is the material that transports the image. "First, light traverses the image, then transports it, duplicates it by dematerialization, temporalize it and sometimes sublimes it". [10] The light-image has the ability to metamorphosing according to the scale, the angle of projection, the characteristics of the surface (material, dimensional and nature).

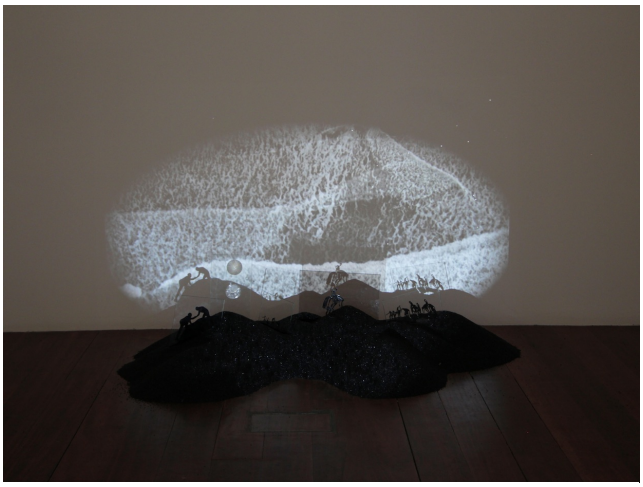


Figure 1. *Das sombras que permanecem* (en. tr. *From the shadows that remain*), 2017. View from the installation. © Helena Ferreira.

Das sombras que permanecem (Figure 1 and 2) is a mixed media installation that explores the struggle between the motionless time and the infinite movement that resonates in the cyclic phenomena of nature and in the human condition resilience. The projected video image is slowly unwinding a mobile and volatile element, the water foam, which flows upward the black sand while it configures in reliefs depicting the earth, composing a landscape of valleys and mountains in a kind of poetics of projection. This "alchemical" process gains strength through the texture of the projection surface (the sand), since the projection perpetuates the idea of being constantly transforming material states. The projected image appears as an impression or reminiscence, as an internal phenomenon of time experience that incorporates a given event in consciousness and memory.

> "Projection offers the possibility to sense this flow of time and to experience duration not only as an external but also as an internal phenomenon. This is a fundamental condition of projection if (...) we understand it as a landscape. The space of projection can sensitize us to the most basic passage of time, which is essentially a passage of light. In projective landscapes we sense light unfolding durationally, as a space." [11]

In the tense game of contrasts between mobility and immobility of the image, opacity and transparency of the materials, crystalline luminosity or shaded diffuse projection that characterize ***Das sombras que permanecem***, the spectator can observe the unfolding of a mobile landscape of uncertain contours inhabited by motionless characters that remain in a position of suspended effort. The cycle of nature, represented by the tides, the verticality of the incessant movement of the waves that spread out and transform into allusive earth features, the perpetual movement of the inert characters, contribute to reflect on the subtle changes in the repetition of events inherent to the experience of time and the human endeavour in dealing with that contingency.

Through the shadows that remain projected on the wall one can notice a clash between different paces, different rhythms, different times. There is no sound because silence is needed to apprehend this artwork. The silence of the steps of the shadowed characters is substituted by the sound of people passing by, the silence of the struggle of the climbers is override by the whispering of bystanders, the stillness of those wanderers is replaced by a child running through the space.

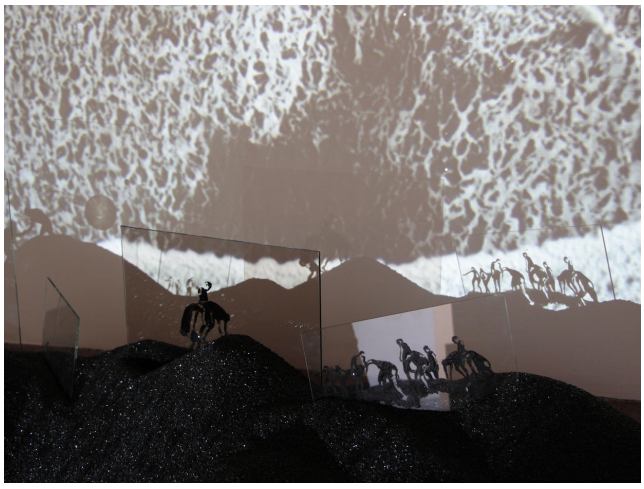


Figure 2. *Das sombras que permanecem (From the shadows that remain)*, 2017. Detail of the installation. © Helena Ferreira.

Final remarks

The projected image, since its emergence coming from the shadow plays, the magic lantern and also as part of the latest artistic events for entertainment in the urban space, always raised curiosity, fantasy and imagination by the simple fact that it calls for something that is not present, that is, it enables us to see intangible images, consequently unleashing "specific forms of spectatorship, engendering a psychic mobility paradoxically dependent on physical immobility" [12]. The projected image in the public space, for instance, produces wide broad types of spectatorship and attention, attitudes and experiences, to the extent that simultaneously acts upon times and places of transition and of contemplation. In this sense, the work of many artists who use the projection questions the role of the bystander (wanderer) not only as witnesses (viewer), but also as potential activators of the work (participant).

We already know that the artistic discourse about projection art is deeply engaged with site-specific practices, which calls into question the materiality in art but also the inescapable matter of the 'place' in art either as a theme subject as well as its relation with the social and institutional role of art. There are relevant insights on the notion of projection when we uncover the layers of this rich concept that put into question one-dimensional pre-conceived meanings. If on one hand, the specificity of the place was, and to some extent continues to be, a major factor in the way it is artistically explored on a certain space, on the other hand, it went on to acquire other levels of reflection and meaning, from which different speeches are mutually confronted and influenced.

Acknowledgements

The author wishes to acknowledge the Portuguese funding institution Science and Technology Foundation (Fundação para a Ciência e a Tecnologia) for supporting this research.

References

[1] Douglas Harper, "Projection (2001-2019)", Online Etymology Dictionary, Accessed Apr., 8, 2019. https://www.etymonline.com/word/projection

[2] Douglas Harper, "Project (2001-2019)", Online Etymology Dictionary, Accessed Apr., 8, 2019. https://www.etymonline.com/word/project

[3] Pliny, *Natural History. Volume IX: Book 35*, Translated by H. Rackham, (Cambridge, MA: Harvard University Press, 1961) 373.

[4] Victor Stoichita, *Breve História de la Sombra*, (Madrid: Editiones Siruela, 1999), 19.

[5] Victor Stoichita, *Breve História de la Sombra*, 40.

[6] Dominique Païni, *Projections, les transportes de l'image*. (Paris: Éditions Hazan/Le Fresnoy/AFAA, 1997), 11.

[7] Helena Ferreira, "Interrupted surfaces: Installing the projection", in *Post-screen: Intermittence + Interference*, (Lisbon: Edições Universitárias Lusófonas; Faculdade de Belas-Artes da Universidade de Lisboa, 2016), 59.

[8] Giuliana Bruno, *Surface. Matters of Aesthetics*. (Chicago, London: University of Chicago Press, 2014), 8.

[9] Gaston Bachelard. *L'air et les Songes. Essai sur l'imagination du mouvement* (Paris: Librairie Générale Française, 2007), 5.

[10] Dominique Païni, *Projections, les transportes de l'image*, 169.

[11] Giuliana Bruno, *Surface. Matters of Aesthetics*. 8.

[12] Liz Kotz, "Video Projection: The Space Between Screens", in *Art and the Moving Image: A critical Reader*, ed. Tanya Leighton (London: Tate Publishing/Afterall, 2008), 372.

Author Biography

Helena Ferreira (Lisbon, 1982) is an artist that develops mixed media installations in the scope of video, sculpture and drawing. She is graduated in Sculpture from Faculty of Fine Arts of Lisbon University, holds a master degree in Visual Art Teaching and is currently developing her PhD in Art Installation with a FCT Scholarship. Over the past decade Ferreira has shown her artwork in Portugal and abroad, has curated art exhibitions, has been invited to present conferences, seminars and workshops, and has taught Descriptive Geometry. She has co-edited essay books and catalogues, as well as published some findings of her research on screens and projection, public art, art research. Helena was also co-coordinator of the Post-Screen: International Festival of Art, New Media and Cybercultures.
http://helenaferreira.net.

SPATIAL INSTALLATIONS FROM INCIDENTS OF LIGHTS AND SHADOWS APPLIED IN ARCHITECTURE TEACHING

1st Paula Andrea Escandón, 2nd Andrés Felipe Roldán, 3rd Fernando Luna

[1]Universidad Nacional de Colombia, Manizales, Colombia, paescandon@unal.edu.co

[2]Universidad Nacional de Colombia, Manizales, Colombia, anroldang@unal.edu.co

[3]Universidad Nacional de Colombia, Manizales, Colombia, eflunan@unal.edu.co

Abstract

The use of light and shadow as natural compositional elements in art and architecture has been a tradition in the ancient and modern world, constituting part of the understanding of spatiality, the generation of environments and the relationship of the environment with the living space. In recent times, the emergence of technological resources has led to the use of artificial light, as a diversifying device that generates different possibilities of re-configuration of spaces. This has allowed spatial interventions to arise from the reflection of light altering the ways of how it is perceived, communicated and interacted with the architectural and artistic forms ordered by light. These manifestations allow that from the educative surroundings incentive spaces of experimentation that potentiate the spatial thought, from the handling and understanding of compositional criteria and the understanding of the representation of the light and the shade in the architectural space.

Keywords

Architecture, space, composition, light and shadow, perception, installation.

Introduction

Light, far from being a physical phenomenon that alters our relationship with materiality, has become an essential component of designed space, while the natural or artificial combination transforms the perception of shapes, volumes, spaces and environments, a fascinating man from different times and cultures. The spaces designed to meet the needs of human habitation, comfort and leisure take advantage of the variables and characteristics of light as a resource to stimulate the senses and the aesthetic enjoyment from their contemplation, interaction, and mediation.

In architecture, light has become a language that, together with shadow, geometry, and color, constitute compositional pillars in the art of transforming and adapting space to human needs. This influence is reflected from the first religious and ceremonial constructions; for example, the average age was given in the light qualities of beauty and purity, whose perceptions are maintained until our days.[1]In modern times, the use of light manifests itself in a permanent way in architecture, this is how its reinterpretation is seen in the works of architects like Le Corbusier, who expresses in his work the use of light freely, being for he a fundamental basis of architecture[2]. Another example in the use of light as a source of inspiration is presented by Tadao Ando, who found in the light a way of understanding and living architecture[3], or Peter Zumthor with his work Therme Vals[4] where light is combined with the darkness of the materials such as stone, water reflections, and steam. These, among other examples, constitute references of the historical importance of the use of the light and the shade in the architecture.

Hand in hand with technological advances gave way to artificial light, which is present in most buildings and urban and rural spaces. A situation that besides the study of the physical characteristics of light, has allowed configuring the architectural space, understanding the characteristics of the technical and aesthetic elements that intervene between light, space and the observer [5].

It is precisely this understanding of the use of artificial light that has allowed proposals such as the architects Jean Nouvel with the technological façade at the Arab World Institute in Paris[6] or the labia with the Dexia towers that in addition to using the led light, generates visual information about the city's climate[7]. In addition to these works, there are different examples especially in

[1] Díaz, *The knowledge of architecture and the arts*.
[2] Pauly, *Le Corbusier*.
[3] Baek, *Nothingness*.
[4]Hauser, Zumthor, and Binet, *Peter Zumthor Therme Vals*.
[5]Caveda and Alcojor, *Artificial lighting is architecture*.
[6]Farrelly, *Basics Architecture 02*.
[7]«Dexia Towers Rainbow LEDs / Lab-Au».

technological lighting facades that take advantage of the use of artificial light, to generate possibilities from interactive experiences or transmit information.

Architects, designers, and artists around the world have taken up the task of using artificial light at smaller scales, making permanent or temporary artistic interventions. This is the case of Selgas Cano [8] architects who with their lighting installations play with color, transparencies, and structures to produce different sensations in their viewers.

Understanding the principles of light, both natural and artificial, becomes an indispensable and fundamental knowledge of every architect in training, constituting themselves as conscious subjects of the possibilities that the forms have constructed when interacting with light, allowing them to represent the space more beyond the traditional forms, reconciling in some way the built space with the human scale.

In articulation the previous reflections the teachers of the area of representation of the School of Architecture and Urbanism of the city of Manizales- Colombia, have developed a training strategy based on the execution of a compositional exercise through spatial interventions using light and shadow, which is based on highlighting the articulation potential of some geometric compositional principles developed in the semesters of foundation. This is how the students of the first levels of the architecture career have been sensitized, in the use of light as an instrument that shapes the space, an enhancer of the delimiting materiality and a resource for the enrichment of the interaction with the spaces.

This practice was carried out through the development of a short-term workshop, which allowed the material construction of lighting installations applying the basic concepts of design such as geometry, shape, composition, symmetry, among others and intervening the campus space. The Cable of the University National of Colombia at the Manizales headquarters.

The teaching exercise is described below from the planning, the execution process and the results obtained in this experience.

Antecedents

In the School of Architecture and Urbanism the practice of carrying out spatial interventions as artistic installations, has been carried out since 2016 in a recurrent manner, by linking teachers and students in proposing so-called vertical workshops in the area of representation, in which students apply creative responses collectively for the exploration of compositional concepts and project representation.

Likewise, competencies such as teamwork, planning, and development of projects, the anticipation of problems, creative resolution of situations, coordination of activities and the materialization of ideas are evident. This serves the objective that students of the first levels of architecture training can improve their knowledge in two-dimensional and three-dimensional representation techniques.

The frequency of these transversal training exercises is annual, a situation that has led to the generation of working groups of students of different levels of training, where those who are newly admitted to the program have the opportunity to share and learn from more experienced colleagues; likewise, those with more experience will be able to socialize the knowledge acquired, in a relationship of reciprocity that promotes the exchange of knowledge and knowledge management.

The workshop not only attended the development of a spatial intervention, in addition, but the students who participated also had to register the creative process that they developed jointly through representations such as sketches, perspectives, isometrics, and diagrams.

Method

The vertical representation workshop held in 2018 was proposed under the name *In the Just Measure,* to motivate the development of three-dimensional compositional explorations in which concepts related to space are applied, integrated with basic compositional elements of harmony with light, shade, and proportion.

The premise of the workshop was the use of generative growth patterns based on the principle of the Fibonacci sequence, the coherent and adequate handling of colors, textures, and shapes, as well as the projection of light and shadows on one or several surfaces.

The three-dimensional composition should include a directed light source, continuous, intermittent or multi-directional light; contained in the composition and of autonomous character, which will work without relying on electrical installations or power connections. Students were asked to use recycled materials at a minimum ratio of 90%.

For the execution, it was based on a design process

[8] «Life after Serpentine».

consisting of three main phases: *Think, project and materialize*, which allowed to unify the processes and guarantee the obtaining of the results. The stages proposed in the exercise were: create, compose, intervene, and had to be recorded in a work log in which they showed the communication of their ideas and where through sketches, elevations, plants, and perspectives, they addressed the themes developed in class and recognized the drawing the value it has within the design process[9].

Finally, the students constructed three-dimensional objects with self-supporting characteristics, with which they intervened and modified the free spaces of the building. The socialization of the process was carried out by means of an exhibition by groups, which consisted of detailed socialization of the phases, processes, and participation that took place in the development of the project and as a strategy to demonstrate the light qualities of the material exploration. The final exhibition was held in the evening hours with the participation of the academic community of the School of Architecture and Urbanism of the National University of Colombia Sede Manizales.

Results

The lighting installations carried out by the students and which resulted from this workshop focused on highlighting the properties of light and shadow as constituent elements of the presented compositions. The materiality of the constructions included a large part of recycled materials, such as paper, cardboard, and wood. The use of color and modularity, based on the Fibonacci frequency, allowed students to play with basic geometric shapes that, when intervened by light, reflected in the shadow the distortion game that allowed directed artificial light, see figure 1.

Figure 1. Group 10: Andrés F Puerta, Daniel S Morales, Sara G Monsegny, Brayan E Perez, Germán A Roa, Daniel A Morales, Juan F Neira. Own photography.

As part of the creative process, some work groups proposed the use of transparencies and volumes that would allow internal displacement, that is, the realization of a journey, which when installed facilitated the re-signification of the daily spaces of a university building in a sensory experience through the play of lights and colors, see figure 2 and 3

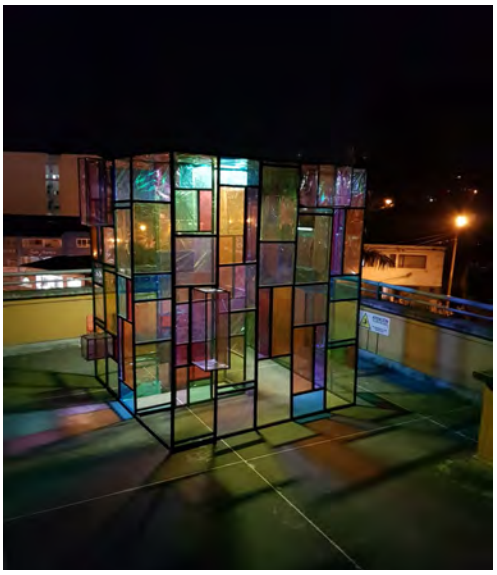


Figure 2. Group 17: Leidy V Jurado, Jhon J Jaramillo, Mauricio C Marín, Andrea C Ortiz, Valeria G Vásquez, Daniel Escobar, Harold Franco. Own photography

[9]xxxxxxxxxxx, «Drawing Teaching Strategies: Representation Medium and Spatial Analysis Applied to the Project Process».

.
Figure 3. Group 11: María I Parra, Laura C Sierra, Javier A Camayo, Johan M Betancourt, Silvia P Cardona, Mariana Roa. Own photography

The results of the lighting installations were diverse in relation to their application of the properties of light and shadows in different paths with geometries and unconventional explorations. The possibilities of transformation and intangibility of light, sought reflection on the emotional experience of the observers to interact with each of the works, seeking a renewal of living in everyday spaces in an artistic experience.

This exercise as a creative workshop presented 25 lighting installations made by students of the first levels of architecture, constituting an attractive, applicable and demonstrable training experience, which is replicable in other architectural training scenarios. The experience allowed the academic community in general to appropriate the concepts of light and shadow that are basic in the foundation of the architect's creative process.

Conclusions

The teaching and learning process in architecture requires collective participation exercises that are proposed, structured, developed and evaluated, evidencing the transversal application of the concepts. The approach of a project process generates an awareness of how to approach the creative process and the importance of different forms of representation to develop a project proposal.

Light and shadows are fundamental elements for the understanding of space in students, as they facilitate the understanding of material subtractions, the projections of bodies and virtual materialities. This resource has been little explored in a formal way and in which interventions tend to be carried out intuitively, as a result of the unconscious experience with light.

The vertical workshops allow the exchange between different participants, a situation that enhances teamwork as a strategy for knowledge management. These are represented as short learning laboratories, where constant collaborative interaction allows us to explore the different possibilities of representing space both in an analogous and virtual way and in a real way through the materiality of facilities that intervene in a space.

The approach of artificial light, as a requirement and the use of the resource of the penumbra, as configurator of the installations, allowed to understand the artificial light as an intangible material that can be manipulated and transformed according to the intentionality of the one who creates or intervenes a space, resources that the architect must welcome as important inputs in the understanding of space as a place for human beings to develop their potential. In this sense, the architect must have the ability to achieve that the spaces created interact with the needs, interests, and capabilities of those who inhabit it, by configuring architecture communication codes, among which light stands out.

References

[1] Marta Llorente Díaz. *The knowledge of architecture and the arts: the formation of a field of knowledge from antiquity to the century (XVII* Univ. Politèc de Catalunya, 2000), 116.
[2] Danièle Pauly. *Le Corbusier: the Chapel at Ronchamp* (Springer Science & Business Media, 1997), 44.
[3] Jin Baek. *Nothingness: Tadao Ando's Christian Sacred Space* (Routledge, 2009), 159.
[4] Sigrid Hauser, Peter Zumthor, and Hélène Binet. *Peter Zumthor Therme Vals* (University of Chicago Press, 2007), 26.
[5] Eduard Folguera Caveda and Adrià Muros Alcojor. *Artificial lighting is architecture* (Universitat Politècnica de Catalunya, Digital Politècnica Initiative, 2013), 49.
[6] Lorraine Farrelly. *Basics Architecture 02: Construction & Materiality* (AVA Publishing, 2009), 105.
[7] "Dexia Towers Rainbow LEDs / Lab-Au". *ArchDaily*, July 26, 2010.http://www.archdaily.com/70264/dexia-towers-rainbow
[8] "Life after Serpentine: Second Lives of Architecture's Famed Pavilions". *ArchDaily*, October 18, 2018. https://www.archdaily.com/903223/life-after-serpentine-second-lives-of-some-of-architectures-famed-pavilions.
[9] Paula Escandón, Fernando Luna. "Drawing Teaching Strategies: Representation Medium and Spatial Analysis Applied to the Project Process". (paper based on a talk presented at the fourth Latin American meeting of architectural education Manizales, November 2018)

MICROBIOME ANTHROPOPHAGY

Clarissa Ribeiro, Ph.D.
CrossLAB, University of Fortaleza
Fortaleza, Brazil
cr@clarissaribeiro.com / www.clarissaribeiro.com

Abstract

"Transplanting the Self: Microbiome Anthropophagy" (2018) was designed as a bioart installation that involves the audience as active participants in an experiment that invites for a reflection about the limits of microbiome manipulation, evoking and exploring ancient practices such as the use of young virgins' saliva in the production of ritualistic alcoholic drinks, such as the 'cauim'. The drink is produced from chewed and fermented manioc and the collective consumption of cauim integrates ancient rituals of hunting and cannibalism of native Brazilian tribes. Relating to ISEA 2019 subtheme Aeternitas: Eternity of the Mortal the work discusses and explores future possibilities in engineering personalities addressing critically issues such as the very nature of consciousness and the self. 'Transplanting the Self' can be understood as both an installation and a performance were the artist and the audience contributes for its actualization and activation as an artwork.

Keywords

Molmedia (neologism), personality transplants, microbiome anthropophagy, neuroregenerative nutrition. microbial resource management, cannibalist manifesto, psychobiotics, art and science, relational food, probiotics

Introduction

This short paper presents in a very concise way the artwork 'Transplanting the Self: Microbiome Anthropophagy' (2018) – an explorative exercise of the possibilities in science related to gut–brain communication and the use of neuro-regenerative nutrition in treatments for neurologic conditions. We live the years in which humans are mastering engineering behaviour on a molecular level. A growing number of researches investigating the relationship between microbiota, human brain and behavior examine the impacts of manipulating specific microbial colonies in human hosts.

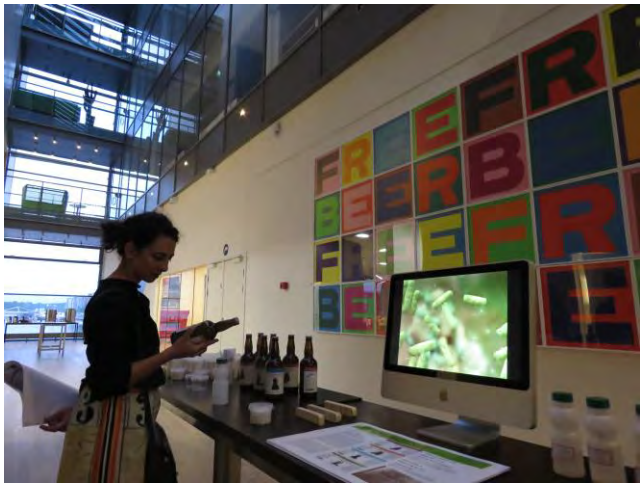


Figure 1. Transplanting the Self: Microbiome Anthropophagy at EVAC POM exhibition (2018) curator Sebastian Frese Bülow. (Photo by the author).

To enable discussing and understanding communicational phenomena that occur in a molecular level and in scales that can reach the subatomic realm, we propose the term *molmedia* – a metaphorical reference to the concept of mole, denoting here not exclusively the quantitative amount of substance but the information exchange processes (taking the substances as messages) that are going on at elementary entities level such as atomic, subatomic and molecular within a given system. In a living organism, interacting emitters and receivers are the organism native cells and hosted microbiota. Within this self-organizing structure, the structuring informational processes produce, as an emergence, the self in its multiple expressions and its behavioral patterns that can be appreciated, manipulated, cannibalized. The installation can be seen as an exploration of the very idea of elementary entities level communication as a key to understand consciousness and the self as emergent phenomena.

I intentionally refer to the project as a "relational installation" as a reference to Lygia Clark's late 1960s and 1970s series 'relational objects' in which the artist created art installation as experiences conceived as healing processes to treat patients with psychological problems. The therapeutic aspect of the artist work was aimed to recover a notion of

the body's plenitude [1]. Clark's series restore the link between art and medicine far beyond the fetishized contemporary laboratory based 'art and science', connecting the participants to their deepest emotions, thoughts and memories. As observed by Rachel Price,

> "Clark's last works – relational objects – would characterize a new era beyond marked distinction between self and other, subject and object. They borrowed from British psychiatrist D. W. Winnicott's concept of 'transactional objects'. Clark's relational objects were designed to be destroyed but to negate the destruction." [2]

Ferreira Gullar, Brazilian poet and art critic, who in 1959 wrote the "Neo Concrete Manifesto", in his 'livro-poema' (poem-book) invited the manipulation of the audience at the poem's reading – a key and influential step in the broad concept embraced by Neo-Concrete art. Gullar explored these ideas in series of works such as 'poemas espaciais' (spatial poems), the 'poema-objeto' (object-poem), and the 'poema enterrado' (buried poem) – an installation consisting of a poem-room built underground with wooden block-cubes manipulated by the reader to reveal the words. Introducing in his explorations physical experience and considering the reader penetrating a poem, Gullar and his seminal 'Teoria do não-objeto' influenced Lygia Clark and Oiticica's 'relational objects'. The relational objects were not ready-mades but, rather, mediators. 'Transplanting the Self' extrapolates the idea of a relational-object by abolishing, diluting the object – and so the audience is invited to drink the artwork and/or to transplant themselves into an artwork to be transplanted, activating and welcoming an internal conversation that is invisible, molecular.

Chemical Messengers

Scientific evidences support the understanding that the microbiome can influence behaviour since it affects brain chemistry across the bidirectional gut–brain communication. Strategies including probiotic and antibiotic treatments, faecal transplantation, among others, integrate psychobiotic-based therapeutic strategies for psychiatric disorders. Experiments [3] show that salivary microbiota – microbial colonies in general – have the potential to spread within the digestive tract. There are evidences highlighting the similarities between the oral and gut microbiome and reciprocal exchange of bacterial pathogens has been observed. Chemical disturbances in both environments impact the colonies as shown in a study in which the oral microbiome in cirrhosis was evaluated and compared with stool microbiome [4] It is via endocrine, immune and neural networks that the gut–brain axis enables bidirectional communication between the gastrointestinal tract and the brain. The neurotransmitters, the molecules, are the packages of information. The complex mechanisms of these molecular-scale conversations impact directly the emergence of macro behaviors.

Psychobiotonic

Imagine a fictional scenario in which you can choose one personality to 'embody' a time buying a pro-biotic drink taking into consideration the specificity of the encapsulated microbiome samples (mixed cultures, i.e. microbial associations or communities) of selected donors. You can also consider being diagnosed with schizophrenia and starting a treatment in which you must drink a beer a day as an alternative treatment. Inviting for a reflection on the limits of microbiome manipulation, 'Transplanting the Self' (2018) evokes ancient practices such as the use of saliva in the production of ritualistic alcoholic drinks, such as the 'cauim', present in rituals of hunting or cannibalism in native Brazilian tribes such as The Great Tupinambá Nation. According to Eduardo Viveiros de Castro [5], the ceremonial hunting that precedes nowadays the production of cauim by the Araweté people replaces the Tupinambá warriors' expedition – the contemporary Araweté have the same word (ka'i nãhi) for both 'enemy' and 'cauim seasoning'. The researcher analyses that the ingestion of cauim rescues the anthropophagic practice. The journalist and anthropologist Renato Sztutman, who has described a caium recipe in his article [6], suggests that, as a ritualistic drink, the caium, far from affirming a well-defined identity, represents the ideal of a continuous transformation of the self from the other.

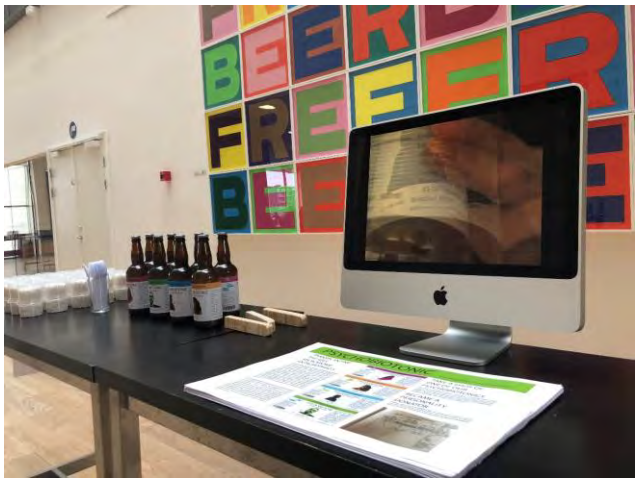


Figure 2. Transplanting the Self: Microbiome Anthropophagy at EVAC POM exhibition (2018) curator Sebastian Frese Bülow. (photo by the author)

'Transplanting the Self: Microbiome Anthropophagy' (2018) was first installed in Copenhagen in May 2018 for EVAC POM [7] juried exhibition and was additionally presented as a performance where the public could participate both as donors and/or receivers of the Psychobiotonic. The exhibition curator Sebastian Frese Bülow chose to place the installation in a hallway that leads from the main auditorium to the main exhibition area, directly under the Superflex artwork "Free Beer" (2004) mounted on the wall, considering the direct dialogue between the two artworks. According to

the artists, the Superflex work name is based on a well-known quote by free software activist Richard Stallman underlining that [8] to understand the concept one should think of 'free' as in 'free speech,' not as in 'free beer'. The work was originally named Vores Øl (Our Beer) in its first version from 2004 and was conceived by Superflex and students from the Copenhagen IT University.

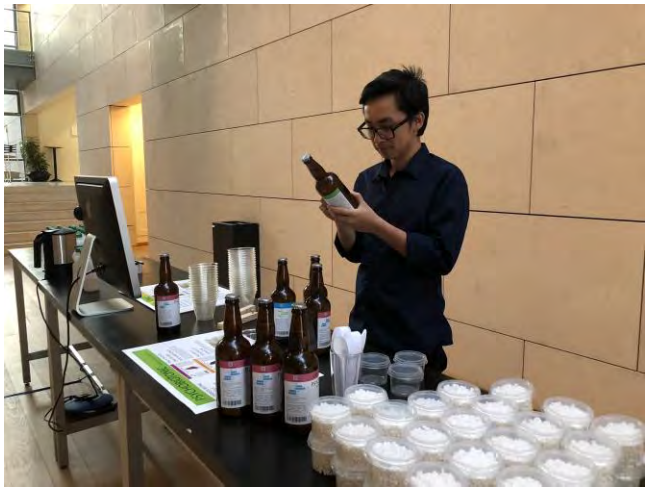


Figure 3. Transplanting the Self: Microbiome Anthropophagy at EVAC POM exhibition (2018) curator Sebastian Frese Bülow. (photo by the author)

For the Psychobiotonic tasting, the curator considered having the work presented as a performance, being part of the evening event on 16 June 2018, where there were other performances (a number of events/concerts) in the main canteen area of the Copenhagen Aalborg University, right next to the main exhibition space where the work was installed, giving people a chance to sample the Psychobiotonic. The audience joined and became involved in the experience.

Having 4 (four) microbiome donors, the Psychobiotonic was produced in Brazil following adapting the original native's receipt to follow artisanal brewing guidelines for filtering, sterilization and proper conservation. After production the resultant pro-biotic was bottled, capped and labeled. A poster with the following instructions or options was distributed to the audience:

TAKE A SHOT OF ONE OF OUR PSYCHOBIOTONICS:
Choosing pre-produced drinks containing a 'microbial blend' from cultured microbiome samples of real individuals that have a specific expression of it – 'personality donors' that have emergent behavioral patterns derived from the chemical interactions and integrations between their body cells and their gut microbiome.

BECOME A PERSONALITY DONOR:
Produce your own Psychobiotonic by mixing your salivary microbiome with manioc flour and fermenting it having as a result a pro-biotic before it turns into a drink that is too alcoholic, similar to a homebrew.

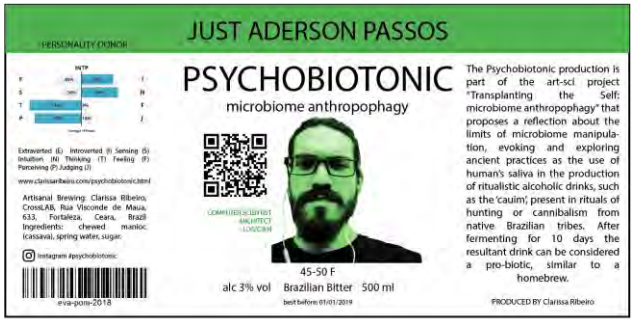


Figure 4. Psychobiotonic bottle lable. Transplanting the Self: Microbiome Anthropophagy at EVAC POM exhibition (2018) curator Sebastian Frese Bülow. (Design by the author).

The label provides information about the donor's personality traces (Figure 4) according to Myers-Briggs Type Indicator. The work was adapted as a workshop for the 2018 Sciart Nanolab of the Art|Sci Center and Lab in Los Angeles at UCLA CNSI (California Nano Systems Institute) in August 2018, this time with the help of the Art|Sci Collective for the cooperative production of fermented drink with all five groups of students (alpha, beta, gamma, delta and epsilon) and all the instructors producing a Psychobiotonic by mixing their salivary microbiome – chewing manioc flour, spiting back in a bottle, waiting for the mixture to ferment for five days, filtering, transferring to sterilized glass bottles and labelling.

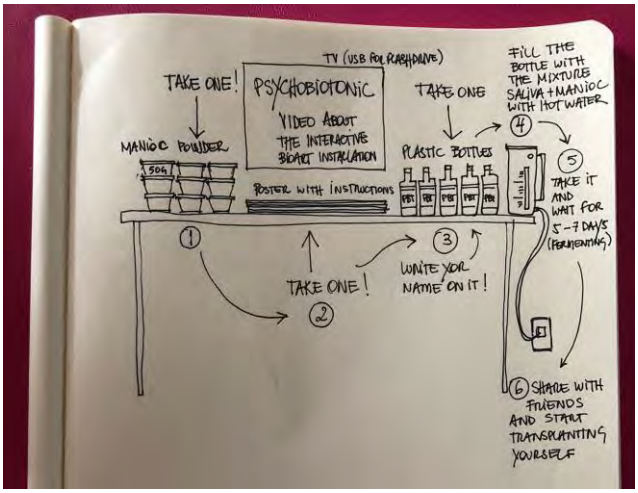


Figure 5. Transplanting the Self: Microbiome Anthropophagy at EVAC POM exhibition (2018) curator Sebastian Frese Bülow. (sketch by the author)

Final Considerations

The complex mechanisms of these molecular-scale conversations impact the self. Beyond the classification of the mes-sages as molecules, here we are talking about organized en-ergy circulating in space and changing shape by subtle pro-cesses of recombination in morphogenetic ways. A growing number of studies using culture-independent molecular bio-chemical analyses such as genomics, transcriptomics, prote-omics and metabolomics [9] show that the collective com-position of the microbiota – the microbiome – is host-spe-cific and relatively stable over time. We can assume from these findings that each one of us has an exclusive identity related to our microbiome. Nevertheless, despite the relative stability of the microbiome composition, different condi-tions such as ingestion of microbiota from the most diverse sources can lead to dramatic and permanent reconfigura-tions, possible imbalance or rebalance. The project 'Transplanting the self' is emblematic in the sense it represents the recent efforts in science that can help rescuing strategies through which we used to navigate nature and the self by manipulating elementary entities' scales communication processes.

Future unfolding of the project can include choosing potential donors by analyzing their microbiome composition and creating a classification (maps) related to the 'potential efficacy' for treating psychological disorders or simply changing mood and behavior. Laboratorial tests and research will depend on applying for funding and research partnerships. A more consistent discussion about the work concept and its poetics was recently publish in the journal Technoetic Arts: A Journal of Speculative Research (. 16, p. 151, 2019) under the tittle – 'Molmedia: Communication at elementary enti-ties level'.

Acknowledgements

The artist would like to thank the microbiome donors Clara Reial, Aderson Passos and Andressa Hadig Haidar.

References

[1] Guy Brett, 'Lygia Clark: In search of the body', Art in America, July, 1994, p.62.
[2] Price, R. (2007), 'Object, Non-Object, Transobject, Relational Object: From "Poesia Concreta" to "A Nova Objetividade"'. Revista De Letras, 47(1), 31-50. Retrieved from http://www.jstor.org/stable/27666821
[3] D. Bourgeois, et al, 'Oral microbiota, intestinal microbiota and inflammatory bowel diseases', Research & Reviews in Biosciences, 12:3, pp. 136–38, 2017.
[4] J.Bajaj, et al, 'Salivary microbiota reflects changes in gut microbiota in cirrhosis with hepatic encephalopathy', Hepatology, 62:4, pp. 1260–71, 2015.
[5] E. V. de Castro, (1986), 'Araweté: os deuses canibais', Rio de Janeiro: Jorge Zahar Editor.
[6] Sztutman, R. (2003), 'Cauinagem, uma comunicação embriagada – apontamentos sobre uma festa tipicamente ameríndia', Sexta Feira, Revista da Comunidade Virtual de Antropologia, n.2.
[7] EVAC POM (2018), 'Clarissa Ribeiro: Transplanting the Self: Microbiome Anthropophagy (Fiction or Intervention)', EVAC POM Art Track: Exhibition, Concerts, Performances Abstracts & Bios. Politics of the Machines – Art and After, Eva-Copenhagen Aalborg University Copenhagen, 15–17 May, http://www.eva-copenhagen.dk/wp-content/uploads/2018/05/Art-Track_2.pdf. Accessed 31 May 2018.
[8] Superflex, 'Free Beer, 2004', accessed: Octobery 27, 2018, https://www.superflex.net/tools/free_beer.
[9] H. Blum, 'The human microbiome', Advances in Medical Sciences, 62:2, pp. 414–20, 2017

Author Biography

Clarissa Ribeiro, Ph.D. in Arts, Former Fulbright Scholar in Arts, M.Arch, B.Arch, chair of the first Leonardo ISAST LASER talks to be organized in Brazil, directs the CrossLab research group and art collective and the LIP - Lab for Innovation and Prototyping at the University of Fortaleza. She was an Associate Professor for Roy Ascott Studio B.A. in Technoetic Arts in Shanghai in 2015, after one year (2013-2014) collaborating with the Art|Sci Center and Lab at UCLA in Los Angeles as a Fulbright Post-Doctoral Research Scholar in Arts. From 2009/2010 she was a Ph.D. researcher at the CAiiA node of the Planetary Collegium, University of Plymouth, UK, by the time she was a Ph.D. candidate at the University of Sao Paulo, and a member of Gilbertto Prado's art collective Poéticas Digitais. Her artistic and research interests converges in the exploration of consciousness and the self as emergences from local and nonlocal communication phenomena in macro, micro, molecular and subatomic scales.

ISEA2019

Windward | Windword : Elemental Metaphors for Data Art

Joel Ong
York University
Toronto, Canada
joelong@yorku.ca, joel@arkfrequencies.com

Abstract

The advent of the much-publicized crisis of 2015 cast human migration as one of the biggest issues yet facing western society. Many artists directed their attention to the ethical and emotional undertow of the crisis, in particular, merging visual art and critical design through exploring shifting forms of data representation. This poignant example of affective rationalism urges a renewed look at the way informational ecologies may move from an *immeasurable source* to *measurable* data, and then to *immeasurable* artistic/aesthetic outputs. In this way, quotidian data sources like weather data may play a vital role in providing metaphors for driving deeply affective digital narratives and immersive experiences. This paper presents one example of this through a series of artistic experimentations done as part of the research-creation project Windward | Windword. In this series, artworks combine the author's personal experiences in advocacy for undocumented migrants in Seattle, Washington, and broader aesthetics derived from access to readily available human migration data.

Keywords

Wind, data visualization, elemental media, migration

Introduction

"To live is to leave, that is all." Frederick Beuchner [1]

A pilgrim... a migrant.... a wanderer.... a nomad... all descriptions of a process of constant removal. As Frederick Buechner's emphatic conclusion reveals, such is the inevitability of our modern, globalized societies where we are but travellers acting on a universal desire to progress or return to one space or the next. This inevitability of a journey undertaken not only metaphorically, but also geo- graphically in the sense of a perpetual desire for physical migration can be seen as symptomatic of 21st Century globalization.

The advent of the much-publicized crisis of 2015 cast human migration as one of the biggest issues yet facing western society. As many artists directed their attention to the ethical and emotional undertow of the crisis, in particular- merging visual art and critical design through exploring shifting forms of data representation. Albeit, the use of data, its technological constraints and politics of access and surveillance could be seen as counterproductive in the perpetuation of forms of information transmission that privilege few and neglect the marginalized. In responding to a philosophical need, this paper explores some writing in the philosophical roots of human movement as a social and biological inevitability. Like most phenomena on a global scale, quotidian access to human migration is typically computational i.e. downloaded data and/or secondary visualizations of information, maps, documentations etc. Its varied representation in the media urges a renewed look at the way informational ecologies may provide an affective but rationalistic discourse regarding the humanity of the crisis.

The paper questions how our visualization and aestheticization of data, human migration data for instance, move from an *immeasurable* source to *measurable* data, and then to *immeasurable* artistic/aesthetic outputs. I propose that deeply affective data sources like weather, wind and breath may play a vital role in providing metaphors and templates for driving digital narratives and immersive experiences. This paper presents a research-creation trajectory entitled *Windward|Windword* that combines the author's personal experiences in advocacy for undocumented migrants in Seattle, Washington, and broader aesthetics derived from access to readily available human migration data.

Tracing Freedom

"We . . . have worked out the laws regulating our movements but not those relating to the sweep of wandering – just as we have worked out the laws regulating a falling stone but not the vagaries of the wind." Vilem Flusser [2]

In his book 'the Freedom of the Migrant', Vilem Flusser describes nomadism as a "collapse of settledness"[3] as being a condition that holds not to the possessions and values of settledness at any particular location - not even the assumption of a "heimat" or homeland that one can say she belongs to. Being "free from geographic attachment" is how he defines the quintessential character of the migrant in our society today:

> Although the migrant, this human representative of a beckoning future without heimat, carries in his unconscious bits and pieces of the mysteries of all the heimats through which he has wandered, he is not anchored in any of them. . . The loss of the original, dimly sensed mystery of the heimat has opened him up to a different sort of mystery: the mystery of living together with others.[4]

Flusser's proposal of a sort of conviviality in a community is paradoxically created in the absence of a traditional social/nationalistic unit - instead writing in favor of transient and liberal sociality, something he personally experienced in his geographical dislocation from his land of birth to his adopted home in the way he realizes he is free to choose his neighbors.

A parallel thread of transience pervades the writing of the Transcendentalist movement of the later half of 19th Century, perhaps most poignant in Thoreau's espousing of the process of 'walking' – one he relates to "sauntering", a word carried forward from the Middle Ages that referred to the way idle people would move seemingly aimlessly through the county in search of the Holy Land. [5]
In today's broad reach of the environmental humanities, it is not uncommon to find walking positioned as a focused activity that goes hand in hand with environmental science, green romanticism, references to the wild and wilderness, as well as broader cultural forms of sound-walking and locative media practices. At the intersection of such embodied presences in the field and computational modes of environmental sensing lie nascent discourses on connectivity and ubiquitous computing. Visible and invisible forms of technology we carry around with us continuously track and monitor our activates, constituting a hybrid relationship of digital and analog transfers between us and the earth.

At its core, perennial connectivity obfuscates the site-specific geography of my current space and time, leading to a condition Flusser describes as the collapse of settled- ness with no inherent locality:

> The settled person, the farmer, and the citizen can be localized in space; they have defining addresses. That disintegrates as soon as we compute. Within the network everyone is an omnipresent potential. [6]

The *flaneur* now not only embodies the experiences and sensations of the world, she also receives and transmits traces of herself and her movement into the space around. If we lose the defining character of our settled-ness through the vagaries of the virtual, how can we experience presence and absence in our computational worlds? What traces do we leave in the real world that are also recorded (and re-cording) in the computational ones?

Most crucially, what affordances do modern technologies allow to gain access to our inherent identities as migrants and nomads and how can we articulate these poetics of transience, loss and movement?

Windward | Windword

The project Windward|Windword was part of a exhibition at the Jacob Lawrence Gallery at the University of Washington. It consisted of a series of 3 experiments that explored the metaphors of freedom and transcience brought about through mediated experiences of the wind. Metaphors and models of transcience and movement abound in the natural world, as seen in vernacular articulations like a *wandering* stream or a *drifting* haze and I was interested in seeing how these metaphors could address some of the issues in human migration. Initial attempts to understand the way border restrictions were affecting the lives of individuals and families around the area involved conducting interviews with members of Casa Latina [7], a not for profit organization in the International District in Seattle working to provide migrant (documented and/or otherwise) workers from South America with economic and educational opportunities, to understand more about their lives moving and living across the border.

In a bid to understand the plight of *undocumented* migrants, interviews were also conducted with members of the NWDC (Northwest Detention Center) Resistance movement, as well as undergoing training with World Relief Seattle to become a volunteer visitor to the inmates at the Northwest Detention Center.

In the gallery, 3 *etudes* were designed to explore the way directionality of the wind could trace imaginary pathways from which origin and destinations could be recorded, establishing an emotionally affective connection to our past, present and future.

In the first exploration *Windward*, a site specific installation is set up outside the NorthWest Detention Center (NWDC) in Tacoma where over 1500 undocumented migrants are held and are faced with the threat of deportation – each of the arrows in the sand represent the directions of 102 countries from which they have come from. A wind vane in the center of these arrows moves freely and shows the direction to which the wind is headed. In the gallery space, a simulation of this installation is presented with a mechanized wind vane and anemometer connected to real-time wind data recorded at the site of the NWDC. On top of the mechanized components moving in tandem with the data received, the installation also had a Raspberry Pi powered screen that showed information

on the direction and speed of the wind, as well as provided a list of countries of origin of NWDC inmates that the wind was blowing towards.

Figure 1. Installation View of *Windward* at the Jacob Lawrence Gallery at the University of Washington.

Figure 2. Installation View of *Between Us a Breath*

The second study *Between us a Breath* was an interative installation inspired by my personal experience with as a volunteer at the NWDC particular in the conversations and friendships that were developed across a visitation booth. I realized very early on that it was impossible to achieve a deep connection with an inmate because of a fundamental inability to "share the air" with him. Apart from the obvious political barrier, the visitation booth window forms an impervious envelopment of the climate/air, creating what Bruno Latour describes as an immunity towards to what is deemed to be *outside*[8]. I decided that this installation would focus on the visulization and collaborative 'commonwealth' of air that could arise from the simple act of breathing during conversation. In it, two vistation booths are set up in the gallery, each with a telephone that was connected to the other booth. As people began to converse with each other, the phone picked up the breaths of conversationalists and used it to drive ventilators at each end of the reflecting pool. As the conversation developed, so did the patterns on the pool created through sensing the breaths of the conversationalists.

In the third study, the project *Windword* was a 6 channel spatial sound installation that explores computational methods of mapping a digital dataset – human migration to sensory phenomenon of wind by generate breezes in the gallery space. In the gallery, a small confined room was chosen for the installation. Whispers created from filtering oral narratives were spatialized according to human migration data, moving across the listening space in trajectories that matched the predominant human migration movements provided in the UN Migration Stock of 2015 [9] that presents estimates of international migrant by age, sex and origin for all countries and areas of the world.

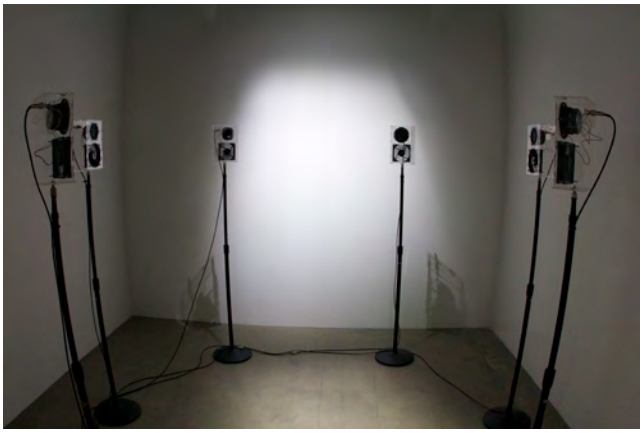


Figure 3. Installation View of *Windword*

Aeolian Traces

The following work that was created directly from this series of works was entitled Aeolian Traces. This was a multi modal installation that incorporated both the sensory premise (wind) of the installation *Windword*, and also a data visualization segment. Fundamentally, the work involved the imagination of human migration as a series of freely movement, wind driven particles. The overall experience of the installation proposed a connection between the wind and human migration, providing an aesthetic and sensorial catalyst for the imagining for the migrant as a part of larger planetary aeolian currents. The aim was to envision, perhaps even to propose a future where such movements were not viewed as politicized and hence constrained but instead a naturalized process of tracing.

Figure 4. Installation View of *Aeolian Traces* at the Currents New Media Festival 2018 showing ventilator setup

In this work, a data visualization component consisted of progressive experimentation with the display, moving from static 2D "flat" surface infographics (Figure 5) to more 3-dimension imaging (Figure 6) and finally to dynamically rotating 3D surfaces. The final series of visualizations (Figure 7) focused on the creation of abstract geometrical shapes by connecting the particles floating in mid-air. Organized in time, these experiments explored different options of stretching and connected lines representing each data point's movement from origin to destination. Connective threads connect and spread over areas of the globe.

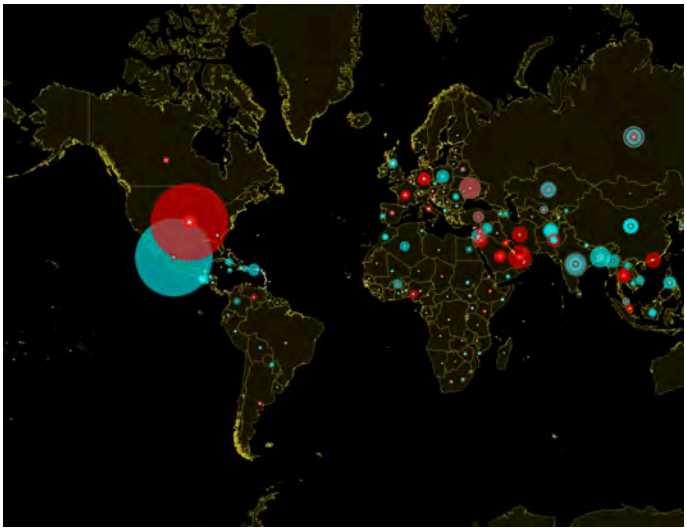


Figure 5: Data visualization of countries with the most inward migration (red) and outward (blue) migration.

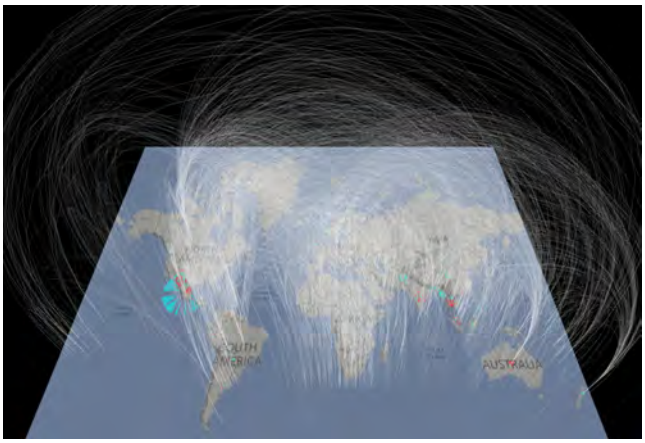


Figure 6: Initial Data visualization experiments

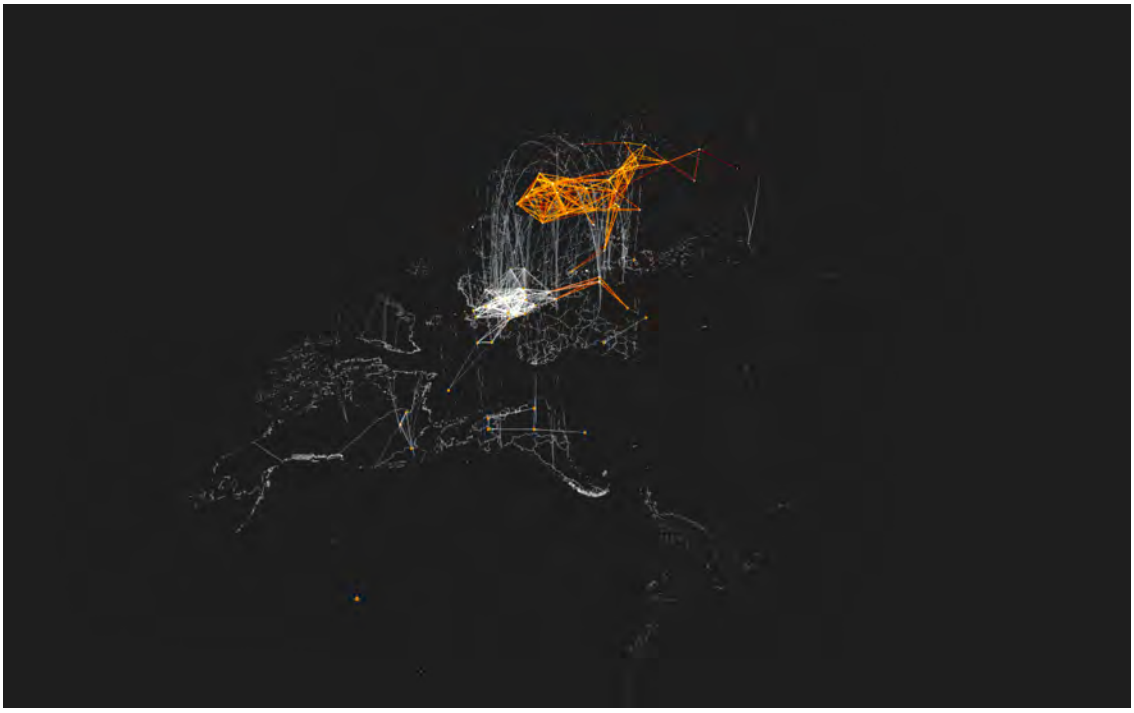


Figure 8. Final visualization of Aeolian Traces.

Measuring the Immeasurable

Elsewhere I have commented on the use of architect Luis Kahn's mandate of measuring the *immeasurable* in order to create immeasurable experiences to direct the data visualization process [10]. Beyond justifying creative license, this process allows the artist an expansive platform to reintroduce immeasurable aesthetic or poetic metaphors from the environment that may have been compromised through the sampling process of data harvesting. This process also grants the artist with a non-linear interpretation and abstraction of information beyond a direct correlation of source material and final product.

In the series *Windward|Windword*, the progressive study of multi sensory explorations of wind data aimed to present elemental media as rich databases for aesthetic production but also to relate this data to existing metaphors for creating data artworks that have both informative and affective potential. The project *Windward* looked at the wind as a bridge of distance and directionality as a way to communicate or create connections. The project *Between a Breath* was an aesthetic exploration of the commonwealth of air, a collaborative breathing project that created patterns on the surface of a reflecting pool. The project *Windword* was a spatial sound project that linked spatial sound and wind gusts in a confined space matching the sensation of wind across the listener with the passage of human migration around the globe according to census data. The follow up project *Aeolian Traces* developed the metaphor of freedom and caprice of the wind, by merging ventilators, spatial sound and visualization of human migration as particles moving freely on a screen.

Conclusion

As far back as cave drawings, art through the ages has always been invested in the aesthetization of information. Whatever developments we see daily in the computational and technological fronts are an extension of what has been amalgamations of the processes of impression, abstraction and inscription. The move from *immeasurable to measurable* and then to *immeasurable* experience is emphasized here in the way the artistic processes aim to recover the immeasurable content lost through visualization and sonification processes. In the projects' immersive content, it is poignant to note the current epoch of XR technologies – its resurgence in the virtual and the widespread use of these tools across the arts, science and entertainment. Perhaps these tools might constitute a more direct and experiential processing of information. As it stands, they tools have already started to long journey of enriching the environmental humanities and sociopolitical discourse with imaginative narratives and poetics.

References

[1] Buechner, Frederick. *The Magnificent Defeat* Harper San Francisco. 1985
[2] Flusser, Vilém. The Freedom of the Migrant: Objec- tions to Nationalism. Translated by Kenneth Kronenberg. Ed, Anke K. Finger. University of Illinois Press. 2003. P43 [3] Ibid. p4
[4] Ibid. p14
[5] Thoreau, Henry David. "Walking" in *The Natural History Essays*. Gibbs Smith. 1980. pp93-13
[6] Flusser, Vilém. *The Freedom of the Migrant: Objec- tions to Nationalism*. Translated by Kenneth Kronenberg. Ed, Anke K. Finger. University of Illinois Press. 2003.
[7] "Casa Latina": http://casa-latina.org/ . Accessed 10 May 2017
[8] Latour, Bruno. "Some Experiments in Art and Politics". E-Flux Journal, 23, March 2011. Online at https://www.e-flux.com/journal/23/67790/some-experiments-in-art-and-politics/ accessed 14 Nov 2016.
[9] "United Nations International Migrant Stock 2015" Online at http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates15.shtml. Accesssed 14 Nov 2016
[10] Ong, Joel. (2018). "Elemental Monitoring: the Afterlife of a Breath". In Proceedings of the Ammerman Center for Art and Technology 16th Biennial Symposium

Affective Atmospheres | Ambient Feedback Ecology

1st* Nima Navab
Topological Media Lab
Montreal, Canada
nima.navab@gmail.com

2nd* Desiree Foerster
Institute for Arts & Media
Potsdam, Germany
foerster.desiree@gmail.com

Abstract

Encompassing a series of experiments with atmospheric scenography the following paper maps out the relationships between different materials and energetic flows as part of a spatial design. These investigations emanate from the assumption that poetic relationships between material and immaterial processes can induce new meaning to the ways we inhabit our environment. In diffusing the boundaries between elemental dependencies connected to water use or airflow and the perceiver, unfolding atmospheric processes on scales that usually remain unnoticed are made sensually perceptible. The focus shifts from the concrete to the in-between. The visualization and enaction of flows that make up our surroundings suggest a greater involvement of oneself with the environment. Through these experiments we demonstrate 1) how spatial continuity can be achieved in relating attributes of dynamic behavior of water, vapor, air, sound, and light to significances in space; 2) that the indifferent role of the human perceiver is challenged in making their impact and responsiveness to the environment part of the spatial composition itself; and 3) how the expressive qualities of atmospheric variables could be used to experience layers of meaning in spaces, that are usually not comprehensible (such as ecological dimensions of water use).

Keywords

Process Philosophy, Embodied Cognition, Enactivism, Rhythmanalysis, Responsive Media Ecologies, Ambient Environmental Feedback, Material Computation, Fluid Dynamics, Caustics, Dissipative Structures.

Introduction

Discussions about climate change, scarcity of resources and the lack of distributive justice, often point towards a phenomenological problem. People in western industrial nations, who mainly live in urban areas, generally have little direct reliance on natural processes, lacking a sense for the direct significance of local consumption of resources and global consequences. Instead, digital networks regulate the climatic well-being of residents and consumers, car drivers or passengers. This lack of awareness comes at a cost. As global climate change is outpacing all attempted solutions, the feeling of powerlessness predominates and needed changes in life style—especially in industrialized nations—fail to materialize. The point of departure of our interdisciplinary work therefore lies in the demand to find new ways of expressing climatic processes on scales that are outside of our every-day awareness, to increase the attentiveness towards our environmental condition, and to allow for a more ecological perspective to develop. We do not though turn towards the planetary scale—instead, we focus on micro-climatic processes in our immediate surrounding, trying to develop design solutions that heighten the sensitivity of citizens in every-day environments. Concretely in the projects presented here we explored the phenomenology of energy cycles and dynamic material flows in atmospheric surroundings beyond scientific-technical approaches. In the outline of this paper we present two projects in which we investigated the use of ambient feedback to mediate water and energy consumption as well as elemental co-dependencies in atmospheric environments, in order to relate them to the felt experience of space. What follows then is a discussion of questions of experience and agency that come with the inquiry of forms of engagement with our environments that shift away from a human-centered point of view towards a more ecologically informed perspective. By experimentally exploring these questions, the discussion is enriched and raised to a higher level than a purely theoretical treatise could do. The paper concludes with a discussion of the potential of atmospheric media for architectural design.

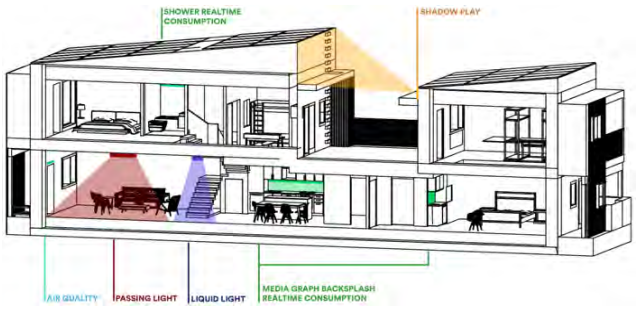


Figure 1: Axonometric of integrated media installations into Solar Decathlon, Deep Performance Dwelling (2018). Illustration by Tatev Yesayan and Julie King. ©Respect Copyright.

In this paper, we investigate the use of ambient feedback to amplify qualities of usually unperceivable processes and relate them to the felt experience of space. The term ambiance goes back to the Latin *ambiens* as in "going around." The English notion is adapted from the French *ambiance*

* Both authors contributed equally to this paper.

which means “atmosphere,” “mood,” “character,” “quality,” or “tone”. Taking ambiance or atmosphere not metaphorically as the character of a place but instead as the sum of the phenomena that form rather the background of conscious experience in a space than objects with clear affordance, shifts the perspective towards the meaning of being embodied in space. Shifting our attention towards the particles in the air we breathe, the temperature regulation of our indoor spaces, the water distribution networks, makes it crucial to ask how our physical presence and actions relate to these processes. The projects in this paper explore the use of ambient feedback to mediate these relations in a meaningful way.

Solar Decathlon’s ‘Performative Dwelling’

The first part in this paper explores *Performative Dwelling*, a contribution to the 2018 Solar Decathlon competition in Dezhou, China. The paper focusses on two responsive lighting installations that were integrated into a model-house (figure 1) and courtyard in order to create a visually stimulating and experiential environment while raising awareness of consumption, performance, and behavior relative to use of water and energy resources.

The first installation was a lighting fixture embedded into the kitchen cabinets of the house (figures 2,3,4). On top of the sink, water droplets were released inside the fixtures' fluid chamber. The pace of the droplets falling was according to the current water use, evaluated in accordance with overall consumption trends. The falling drops were animated by light from the top of the chamber, which lead to the formation of different patterns reflected onto the wall behind the sink. In by being installed in place where it visually connected the performed action of the residents in real time with the overall consumption of water, an experiential dimension of scales usually not accessible was added to everyday action. Central to the ecological approach of the project was that this relation was not represented with numerical data, but expressed by a processual, ambient animation. The animation could be ongoing on the periphery of perception or catch our full attention. This communication of the relation of the amount of water used for washing the dishes or drinking water to resource consumption was purposefully mediated in an aesthetically pleasant way: The eco-feedback display gained an ambient quality that merged with the every-day activities. This way the medium involved the user in the interdependencies of individual water use and overall consumption in a bodily way, conveying a form of tacit knowledge. Because ambient feedback displays are capable of producing intuitive, bodily knowledge about the relationships between situational actions and overall consumption, they can be a good addition to other forms of data visualization, which are mostly abstract or oriented towards the deficits of the actions.

While the light fixture that was embedded into the kitchen cabinets communicated through manipulation of liquid textures overall trends in consumption of water over time, the second installation in the courtyard of the house used different light structures that animated shadows of plants as expressive qualities for energy consumption in the house

Figure 2: Liquid Light (installation version), Hexagram Blackbox Theatre, Montreal, 2018. Photo by Nima Navab. ©Respect Copyright.

Figure 4 Liquid Light integrated into model house. Dezhou, 2019. Photo by Nima Navab. ©Respect Copyright.

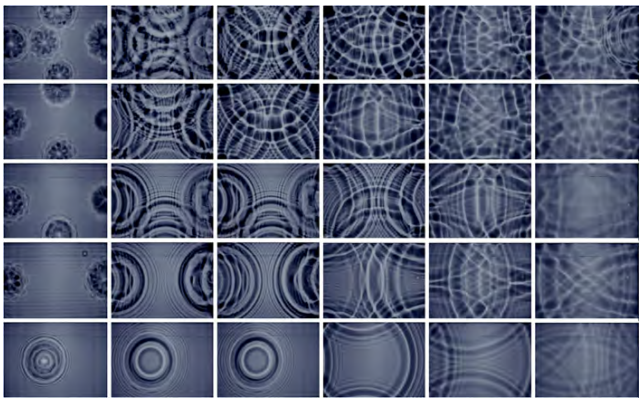


Figure 3: Liquid Light. Stills of visualization patterns. Dezhou, 2018. Photo by Nima Navab. ©Respect Copyright.

(figures 5, 6). The shadows dispersed and overlapped, becoming more diffused as the energy consumption started to outweigh solar energy gained during the day. Thereby the invisible interrelationship of occupants and their home expressed in the continuous flow of energy, water, and other resources, became present and could be experienced in its processual nature throughout time. Both installations used water and light as active resources to convey meaning of resource consumption in real time. The impact of resource consumption on our environment that is intrinsically part of our everyday life, could therefor come to our attention, and might potentially lead to a new perspective on our being-in-space.

Caustic Scenography: Responsive Cloud Formation

While the first project in this paper engaged primarily with the mediation of resource consumption in a way that a tacit knowledge can be used for design purposes to enable a more intimate way of inhabitation, the second project presented here shifts more towards the material qualities of atmospheres as media. The project *Responsive Cloud Formations* was developed during a residency at the Synthesis Center, located at the School of Arts, Media and Engineering at the Herberger Institute for Design and the Arts and Fulton Schools of Engineering, Arizona State University. The experimental work ran parallel to philosophical investigations, with practice and theory constantly stimulating each other. The questions that guided the project encompassed philosophical as well as design-strategic inquires. The philosophical questions were primarily related to phenomenology and subjectivity and how it emerges as a certain perspective in encountering atmospheric processes.

The starting point of this investigation was an installation that explored ephemeral fields of light, water, air, sound, and temperature as a trigger of pre-reflective, embodied ways of relating to environments by shifting boundaries between human agents and their surroundings. The installation *Responsive Cloud Formations* was composed of a pool of water in which atomizers were submersed that created mist and clouds, by converting variable ultrasonic power to high frequencies driving piezoelectric transducers. The apparatus was placed in the middle of a room and visitors could approach it from different angles. The digitally programmed atomizers could provoke different states of the water: wave adulations, droplets, up to clouds in different textures and size. In thus conditioning the phase-shifts of water to clouds and their movement above and across the pool, we simultaneously intensified and augmented the movement and transformations of matter and their response to the exterior conditions (figures 7-11).

At the intersection of philosophy and design we wanted to find out if novel engagements with atmospheric surroundings could push the relationship of observing or mapping environments towards *being in* environments, to suggest bodily rich and meaningful ways of dwelling.

Figure 5: Courtyard space of the model house with the Shadow Play awning. Dezhou, 2019. Photo by Nima Navab. ©Respect Copyright.

Figure 6: Shadow Play visualizing energy consumption at night. Dezhou, 2019. Photo by Nima Navab. ©Respect Copyright.

To approach these questions, we took into account the semantically rich meanings of atmospheres when constructing the installation. Atmospheres can mediate moods, they can affect the perceiving subject in the way s/he feels (Boehme, 2017). This emotional-affective quality of atmospheres is expressed in the installation by way of dramatic structured lighting, which suggests natural phenomena that are already charged with a certain mood, such as sunsets or sunrises, the reflection of sunlight on a water surface at the horizon. In re-creating these phenomena at arm's length from the perceiver, s/he becomes corporeally affected. Memories of familiar phenomena merge with the felt significance of testimony. Being in space thereby is loaded with meaning and emotionally intensified. As such, we had laid the foundation for an affective environment that toned the experience of conditioned events in a certain sense.

More than creating an affective environment as such, we wanted to explore if we can use different material states of water to introduce new relations into space that are characterized by spatial continuity, instead of distinctions. These relations were on the one hand conditioned by the apparatus: Through distributed continuous modulation of frequencies,

the atomizers vibrated particles at rapid pace, in effect, allowing for the creation of low to high density cloud structures, while spreading water droplets around its periphery. What usually would be considered a nuisance was instrumentalized in the installation, orchestrating subtle to dramatic undulations within the bounds of this reflective pool. A multi-directional embedded light design projected these wave patterns through reflection and refraction; creating a caustic scenography around the installation. The material computation made physically felt the co-dependencies of immediate to remote actors in play within its spatial setting. In effect, performative qualities of transformative states of matter were amplified through caustic experimentations. Besides this amplification of performative qualities through the apparatus, the bodily engagement of visitors with the materiality of the clouds played a crucial role. In observing encounters of visitors with the installation, the authors wanted to understand what modes of perception it takes to recognize an event within diffusive processes, to recognize a meaningful referentiality between the elements at play.

What kind of perceiver-subject emerges when the center of engagement is not a solid object but ambient conditions that can be experienced and embodied through their effects on multiple scales? Atmospheres envelop the perceiver in space (McCormack, 2018). If this envelopment moves from the background of our attention to the foreground, can it lead to novel engagement with the clouds that becomes meaningful over time? What is idiosyncratic about atmospheric media such as clouds is that they change shape, take on form and dissolve on layers barely visible. This is because clouds are no solid objects, they are processual in nature. The leading question therefore was, how the perception of intermediate states instead of fixed objects can be extended in time and allow for meaningful bodily engagement. To approach this question, we investigated how the patterns of cloud-formation and transformation could be re-patterned through movement and gestures. Over the course of two weeks, visitors developed various ways of bodily engagement with the clouds. In applying pressure on them through blowing, using flat materials or their hands, they explored ways to move the cloud structures through the space. Using hand gestures they tried to create new structures within the clouds, such as tiny swivels. They also developed collective strategies to create a larger impact on the ephemeral medium by blowing together into the mist or trying to create a vortex in coordinating movements at the corners of the pool.

Besides the emotional charge of atmospheres that was part of our subset in the installation, we wanted to use them as media to relate to processes on scales incomprehensible to us in everyday life. Atmospheres in the climatic sense of the word mediate weather phenomena, in being the sum of the parameters that constitute weather: air temperature, atmospheric pressure, humidity, precipitation, solar radiation and wind. We cannot experience climate in its complexity, but we do know weather-phenomena and we experience their impacts. In our installation, these familiar phenomena were made tangible: the multiple phases that constitute the

Figure 7- 11: Cloud Chamber. Atmospheres Workshop, Synthesis Center, Tempe, Arizona (2018). Photo by Elsa Alonso and Thomas Domingue. ©Respect Copyright.

formation of dense clouds, their dissipation and transformation into water droplets, the impact of wind and pressure on the movement of clouds and mist, was laid out in a sensually accessible and bodily experienceable way. These effects were both applied within the installation as well as in the space that surrounds it: through the digitally controllable

matrix of the platform, the dynamics of processual phenomena could be empathized. In blowing into the cloud formations, using the hands or objects to touch or move the clouds, one's own body could become part of the internal dynamics of the system. In a second version of this installation at the Topological Media Lab based at Concordia University, Montreal, we additionally used fans of different sizes and angles as well as heat plates, to use the impact of temperature change and airflow to extend the clouds towards space (figure 12). The heat plates were installed above the water level and moved the mist upwards. Fans installed on the edges could form a vortex in the middle of the platform, fans connected to a pipe sucked the mist upwards and released a thick stream of vapor into the air. Each of these different movements and ways to create, transform and dissipate clouds allowed for bodily engagement on different layers. One could blow into the mist, touch it, move it, increase the impact of the airflow or heat or try to weaken it. This way, atmospheres create a context in which one's own body becomes the medium for experience. The way sensory experience is structured, is brought in relation to the ever-changing surroundings.

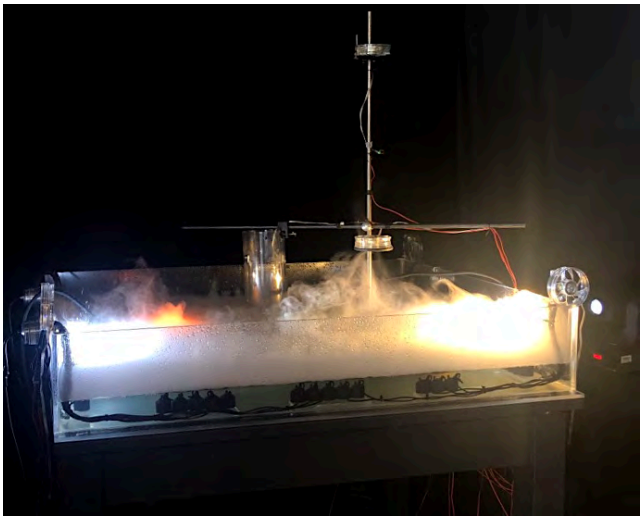


Figure 12: Cloud Chamber. Atmospheres Workshop 2, Topological Media Lab, Montreal (2018). Photo by Nima Navab ©Respect Copyright.

There is an increasing number of works in Architecture that involve different sense modalities to sensitize or give a different perspective on the relation between our atmospheric environments and the human being a part of it—either as a user of resources or even just a breathing body. Installations such as "Yellow Dust" by Nerea Calvillo and Emma Garnett mediate "pollution through the inclusion of different 'categories' of knowledge, such as touch and feeling", creating thereby "an opportunity to consider data in ways beyond enumeration, and to test the effect of this shift." (Calvillo, Garnett, 2019:342) Using atmospheric or ambient media to rather sensitize for the contexts of our everyday actions than to manage behavior, considers the necessity to allow citizens to engage with the built world they inhabit in different ways. We believe that starting with individual experiences within a shared context, can lead to a development of more positive and heterogeneous relations with our surroundings. As such, the installation *Responsive Cloud Formations* lead to numerous subjective experiences—experiences that as diverse as they might have been, related to the same concept: the concept of an atmospheric surrounding that offered sensual ways of relating to phase-shifts in the material. The sum of these subjective experiences allowed for sharing feelings and impressions with others, collaborative engagement and play, and possibly might lead to a heightened awareness for elemental interdependencies in our atmospheric surroundings.

Turning towards atmospheres in this way, means to enrich the experience of the in-between: the multi-relational zone between bodies in space, between objects, between the perceiving subject and its environment. Thereby, we argue, atmospheric media can induce new meaning to the ways we inhabit our environments. By seeing and feeling how our bodies and the surrounding atmosphere interrelate, we begin to focus our attention in a new way and become aware of the processes and relationships that normally only form the background of our perception.

Conclusion

The aim of the project *Ambient Feedback Ecology* was to investigate if eco-feedback technology can sensitize for the impact of individual and collective behaviors on the environment. It was found that material interfaces of *sense* and *fluid* are helpful in highlighting which activities residents can target to reduce water and energy demands while the media installations evoke a sense of care by poetically engaging the residents with the matter to raise curiosity about consumer behavior in the first place. Atmospheric media such as light and water have been found rich materials to serve in such a design context: they allow to express the subtle and gradual ambient shifts of the environment. These observations, perceptible in atmospheric relations, such as sunlight's illumination of interior spaces or the sound of rain hitting the glass of window panes, became a way for us to map the dynamic and complex energy flows of our environment and their subsequent impact on the built world. Through the exploration of material agencies translated through temporal and textural properties of water and light, occupants attune to the rhythm of cumulative patterns of consumption. The quality of light, to signify changes gradually detailed and aesthetically rich, allows to relate abstract data to one's own experience of space by making them perceptible and tangible through the slow and gradual composition. In sum, this project used interactive and immersive technologies to enable design solutions for fluid lighting automation and communication of environmental data while paying close attention to everyday behavior in domestic space. Thereby, media installations that revolve around the concept of a performative dwelling and make use of architecture as an interface, directly relate and engage with

internal and external flow dynamics of material and immaterial processes.

The project *Responsive Cloud Formation* started from the idea to explore the interrelations of humans and their environments through using atmospheres as an affective infrastructure. In exploring how the processual change of water, light and air can be brought into a perceptible relation to processes that are not directly perceptible, we built a space that included a distributed agency of atmospheric processes, digital technology and human behavior. While in *Ambient Feedback Ecology* there was on the one side the possibility to mediate the feedback-loop between residents, their actions, and energy flows in the house—the conditions of a site—in the second project, we wanted to include the flows of materials and energy themselves, in which our bodies participate. Both projects together can serve as a contribution to the exploration of atmospheric media to develop new perspectives on and embodied knowledge of processes that are usually hard to grasp, such as climate change and resource consumption.

In both projects, the unfolding of material and energetic processes that enact both space and its inhabitants, were moved from the background of experience to the foreground. The visualization and enaction of these flows not only offered a greater understanding of a place and its microclimatic conditions—it also offered new affordances to act in this space and thereby suggests a greater involvement with the environment. This involvement impacts the sense of agency: When solid boundaries are replaced with processes of transition, exchange, and transformation of matter, one's own impact and responsiveness to the environment must be mediated in a new way in order to gain meaning for the experiencing subject. The projects show how the implementation of atmospheric phenomena into space discloses layers of interaction and relation, thereby creating a space that affords multiple layers of engagement. The layers that compose a space can encompass multiple dimensions of experience such as social and ethical—as the water use of a household,—or physical—in the ways our bodies participate in metabolic processes that our surroundings are made of, in sharing the air we breathe, the energy we take in and the wastes we release back into our environment. If these layers become meaningful for an experiencing subject, its own actions as well as the actions of others can be experienced as relevant in novel ways. We have shown that the expression of different, formerly invisible layers of a site can enable a new perspective and subsequently, new ways of engaging with a space as well as with others might follow. A further investigation would have to show if this experience and a more continuous engagement with different layers of spaces can impact a lasting change of habits as well.

References

Books

[1] Böhme, Gernot. *Aesthetics of Atmospheres* (London; New York: Routledge, Taylor & Francis Group, 2017).

[2] Charles, John M. *The Sense of Space* (Albany, New York: State University of New York, 2004).

[3] Debaise, Didier. *Nature as Event: The Lure of the Possible* (Durham: Duke University Press, 2017).

[4] Frost, Samantha. *Biocultural Creatures: Toward a New Theory of the Human* (Durham: Duke University Press, 2016).

[5] McCormack, Derek P. *Atmospheric Things: On the Allure of Elemental Envelopment*. Elements. (Durham: Duke University Press, 2018).

[6] Merleau-Ponty, Maurice. *Phenomenology of Perception* (London: Routledge, 2005).

[7] Sha, Xin Wei. *Poesis and Enchantment in Topological Matter* (Cambridge: MIT Press, 2013).

[8] Whitehead, Alfred North, David Ray Griffin, and Donald W. Sherburne. *Process and Reality; an Essay in Cosmology* (New York: Free Press, 1985).

Journal article (print)

[9] Nerea Calvillo and Emma Garnett, "Data Intimacies: Building Infrastructures for Intensified Embodied Encounters with Air Pollution." *The Sociological Review* 67, no 2 (2019): 340–56.

[10] Kirsh, David, "Distributed Cognition: A Methodological Note," *Pragmatics & Cognition* 14, no. 2, (2016): 249.

[11] Peter Rudiak-Gould, "We have seen it with our own eyes. Why we disagree on climate change visibility," *Weather Climate Society*, 5, (2013): 120-132.

Storydiving: techniques for engaging 360 narratives

Nadja Lipsyc
Center for Excellence in Film and Interactive Media Arts (CEFIMA), The Norwegian Film School
Lillehammer, Norway
Nadja.lipsyc@inn.no

Abstract

With the flourishing of XR (VR, AR and MR) 360 narratives receive undivided attention. From hybrid experiences to multiplayer games, designers multiply attempts to reach out the maximum degree of "immersion". Through the study of the experience *Lone Wolves Stick Together*, we will explore how combining tools from video games. theatre, live action roleplaying (larp) and installation art, allows artists to create uniquely engaging experiences, and how world building and horizontal co-creation allow richer fictional environments.

Keywords

Game Design, Immersion, VR, Roleplaying, Environmental design, Art-Research, 360 storytelling, Larp, world building, agile methods, character

Introduction

The experience *Lone Wolves Stick Together* by Nadja Lipsyc is developped in the context of an art-research fellowship on storytelling for Virtual Reality. Part of this research is to develop a methodology for using physical 360 roleplaying as a model for dense interactive VR narratives.

Lone Wolves Stick Together is a constructivist project: it develops knowledge based on experience, a knowledge that does not aim to be any absolute truth but to bring a solution that works within a context, as very early stated by Vico : verum ipsum factum , "what is true is what is done" (Nicolini, 1953 ; Le Moigne, 1995 ; Mucchielli, 2004).

In this sense. organizing physical versions of this roleplaying experience allows us to playtest the concepts that we will develop in VR, and adjust them, as the project grows.

In Autumn 2018, the Centre for Excellence in Film and Interactive Media Arts (CEFIMA) started the production of a 360 environment for *Lone Wolves Stick Together*, in the two film studios of the Norwegian Film School.

From December 2018 to February 2019, the studios have welcomed visitors and players, to participate into three different modules of experience, going from one hour of narrative visit to six hours of live action roleplaying.

The storyline as a *mise en abyme* of VR

Inspired by the movie *Stalker* (1979) by Tarkovsky, *Lone Wolves Stick Together* is an expedition through a mysterious zone, towards the "Chamber"; the one place in which one's most intimate desire will come true.

During this journey, the participants mark five stops: Doubts, Nostalgia, Disillusion, Despair, Truth. Truth, the final act, is the moment where they have to decide on the fate of their character: will they enter the Chamber, or will they go back to their life?

In this story, the Chamber is a metaphor for VR – which is very similar to an "experience machine" as described by Robert Nozick, capable of replacing our harsh reality with a virtual paradise, cut in our most secret desires.

That way, we aim not only to create a discussion on VR consequences and opportunities, but to *feel into* them. Such process is similar to what Robert Vischer calls "Einfühlung" (1873); a non-objective process of understanding by "feeling into".

A multilayered engagement

Most 360 narrative experiences are limited in their potential of engagement: narrative games (adventure, story based, RPG) largely use branching storylines, which limits players' agency and ability to embody their character, 360 video forces the audience into the skin of a character they can hardly appropriate, and immersive theatre, generally puts the audience in a different reality than the actor's one, where they do not directly belong to the fiction or interact with their settings.

This fracture between how involved in the narrative the participant possibly wants to be, and their available options depletes their engagement in the experience.

Lone Wolves Stick Together borrows techniques coming from larp, such as character creation and narrative game mechanics, and applies them to a highly artistic 360 environment.

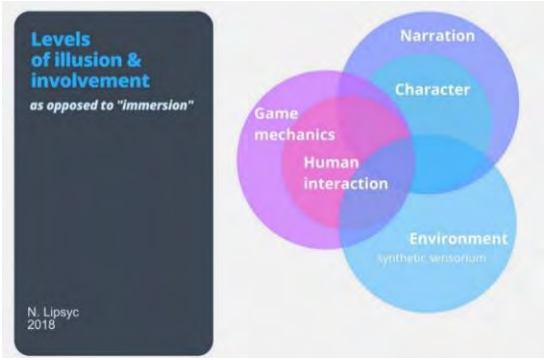


Figure 1. *Storydiving "dispositif"*"(as defined by Foucault) of engagement

Our research thus aims to bring such multilayered engagement to VR.

This article will further elaborate on two main levels of involvement: environment and character.

Environmental design and worldbuilding

Lone Wolves Stick Together is meant to be experienced physically, in a heterotopic space called "the Woods". This space is meant to answer different physical laws and interacts – very much like a character would – with the participants.

The journey has been built over the two cinema studios of the Norwegian Film School, as a series of independent sub-environments.

These sub-sets stage each of the narrative stops: Doubts, Nostalgia, Disillusion, Despair, Truth, as well as the Chamber.

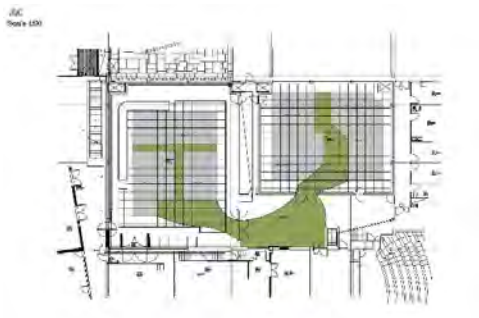


Figure 2. The two film studios, separated in 6 sets, connected by "the Woods"

Each of these sub-environments was designed by a team of one production designer, one sound designer and one photographer, as a multisensorial space, in collaboration with the creator, Nadja Lipsyc.

To ensure that our fictional environment wouldn't be dominated by the visual construction, we worked with agile co-design methods, starting the collaboration from the ideation phase.

This dynamic allowed us to create through dialogue and adaptation. Soundscapes, scenography, and game design thus fed and constrained one another, without any of these facets taking the definite lead.

The example of Nostalgia

This creative dialectic can be illustrated by our work around the set "Nostalgia".

This set – or "act" – is the most sentimental part of the experience. The participants are invited to remember what stories brought their characters to these Woods; the very roots of their desires.

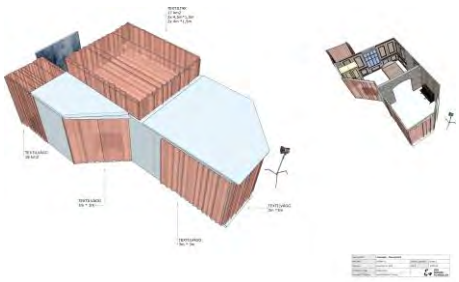


Figure 3. Early design for the set "Nostalgia"

From this standpoint, the team thought in terms of evocation and decided to work around ethereal and musical feelings; in the vein of Derrida's concept of *hauntology*.

An old piano became part of the room, as to create a layer of diegetic music over a deconstructed musical and spatialized background. Similarly, we also positioned a water pump behind the window, as to follow the rainy mood of that soundscape.

As the team installed a high roof made of floating cloth, the narration was changed to include a flashback involving the memory of a night under the textile roof of a tent. This flashback then led the production design to add a bed to the scenery.

Such tight collaboration goes beyond environmental design as used in video games, to flirt with the concept of *worldbuilding*.

Figure 4. Nostalgia, finished set

Despite not being the most spectacular construction from *Lone Wolves Stick Together's* sets, participants have been remarkably enthusiastic in their feedback on Nostalgia; instead of articulating the reasons for their interest, they would refer to the set as deeply emotional and troubling. A true success for our methods, and for our artistic vision, that aims to create an emotion through what is commonly referred to as *immersion*.

Figure 5. The set "Disillusion" built above subwoofers gave striking haptic feedbacks to the participants.

Our main creative difficulty arose when we had to break those sub-environment teams in order to work collectively on the transition spaces. As a result, those appear much less inspired, and poorer than the rest of the sets. This realization fed our constructivist research: it proved us the importance of our early co design methods, which we will implement for the VR experience.

Bridging to the fictional world

The second layer of engagement that we will discuss in this paper is character engagement.

Character

Like many narrative games, and like larp, *Lone Wolves Stick Together* develops a character-based narration, based here on six pre-written characters.

Regardless of how guided the narration is, playing a character grants the actor with an artistic power and some flexibility to offer a subjective interpretation to the fiction they're being part of.

In larp, although most players aren't professional performers or artists, the excitation of creating collaboratively is part of the appeal. This project defends that it is a widely spread feeling that can reach a greater audience, especially through VR.

In *Lone Wolves Stick Together*, the character creation is in the hands of three main forces:

- the character's background, which takes different forms according to the preferred module of experience (see *Adapting the experience to the audience*, below),
- the "tapes", which represent the mind flow of each character, and which are designed by sound designers, using the author's narration,
- the participant's own creative impulse.

Figure 6. As to ease the roleplaying, and as to get closer to our future VR avatars, the players wore 3D printed wolf masks.

The "ferryman"

While the character takes the player to the fictional world, we also worked with modules of experience that did not involve such heavy roleplaying.

We thus created the function of a "ferryman" to seamlessly take the players to the fantasy shores.

Our ferryman was an actor pretending to be a participant, initiating interactions with the environment as to encourage the visitors to get more playful, leading them to suspend their disbelief and join the *Lone Wolves Stick Together* universe.

Adapting the experience to the audience

Because we want to reach participants that are interested in maximum involvement, as well as participants who would rather have a more passive, or intimate experience, we worked on three levels of engagement.

Those levels aren't meant to be amputated versions of the longest experience, but complete journeys following different modalities; an exclusive experiment in the context of narrative games.

Dive

This module is the longest, the one with the most game mechanics, that juggles with all the levels of involvement presented above.

In this module, the 6 participants fully embody a character. By improvising, they shape the story of *Lone Wolves Stick Together*.

Diving involves reading about a character beforehand, participating in theatrical workshops, wearing elements of costume and using props.

Swim
This module is an opt-in/opt-out interactive experience.
It allows the 5 participants to get progressively involved in the story, or to remain entirely passive.
The character of the "Guide" - assisted by the clandestine ferryman - will lead the expedition through the Woods, recreating, but more fragmentary so, the story of *Lone Wolves Stick Together*.

Float
This module takes the form of a guided tour of the environment, alternating between solitary moments of exploration and listening, and commented visit of the sets.

Figure 7. The participants of a "Float", during the act "Despair".

It is after organizing two "Float" journeys, that we realized this guided tour had much more potential than we were hoping for. The experience turned out to be an artistic narrative exploration on its own, even a moving one for some of our participants.

Comparing physical and virtual journey

Lastly, this research also investigates the cognitive, interpretational and emotional differences between a physical narrative journey and a virtual narrative journey.

In January 2019, the sets in the cinema studios were scanned, using a LiDAR scan. This 3D space will be modelized and we will recreate the journey through the game engine Unity. We will then oppose the physical environment to its virtual replica.

Figure 8. Preview of the 3D scanning of the sets.

This study could bring us enlightenments on the possibilities for hybrid experiences; are there specific aspects of *Lone Wolves Stick Together* – and, perhaps, narrative journeys in general - that are more relevant to be experienced in real life? Inversely, are there spaces, moments, mechanics, that work best virtually?

Acknowledgements

This experience was produced by the CEFIMA with the production design, sound design and cinematography students of the Norwegian Film School, under the supervision of Fredrik Gråver, Siri Langdalen and Carl Svensson.
I also thank Maureen Thomas for her feedback and support, as well as Christy Dena for her insights and, finally, the larp community for sharing their knowledge.

Bibliography

Books
Derrida, Jacques. *Specters of Marx* (Routledge, 1994).
Eddington, Sir Arthur. *Space, Time & Gravitation* (CAM Press, 1999)
Foucault, Michel. *The Confession of the Flesh* (Colin Gordon, 1980)
Grau, Olivier. *Virtual Art* (MIT Press, 2003)
Robinson, Sarah, Juhani Pallasmaa et al. *Mind in Architecture* (MIT Press, 2015)
Tarkovsky, Andrei. *Sculpting in time* (UT Press, 1989).
Virilio, Paul. *La Machine de vision* (Galilée, 1988).
Journal article (print)
Foucault, Michel. « Des espaces autres. » *in Architecture, Mouvement, Continuité, no 5*, 1984.
Websites
Bowman, Sara Lynne. Immersion into larp", in *First Person Scholar*, 2017, http://www.firstpersonscholar.com/immersion-into-larp.
Lipsyc, Nadja. « On Immersion", *in Synpeira*, 2018, http://synpeira.com

More Than a Render: Digital Humans and the Politics of Representation

Assistant Professor Meredith Drum
Arizona State University
Tempe, Arizona, United States
mdrum@asu.edu

Abstract

This paper addresses the politics of virtual representation of human bodies by focusing on two realms of on-line media: educational tutorials for modeling female avatars and market-places that sell virtual humans. As a professor who teaches 3D digital modeling and animation, I set out to empower my students with the critical language to unpack these problematic objects. Through reading and discussing D. Fox Harrell's writing about phantasms, my students and I together dissect the ideology at work within these constructs, and we think through the mechanisms that allow these phantasms to appear socially real even though they are "rooted in processes of imaginative cognition."[1] As part of this pedagogical and creative project, I have begun an ethnographic study comprised of an on-going dialogue with the makers of web-based tutorials and the creators of digital humans for purchase. Through this research I am developing a stronger understanding of how virtual humans are produced and how they function in the marketplace. In turn, I am enabled, and my students are empowered, to build new phantasms to participate in less-violent, more inclusive worlds.

Keywords

Animation, avatars, cultural studies, digital bodies, feminism, game studies, gender, media representation, scopic regime, virtual humans.

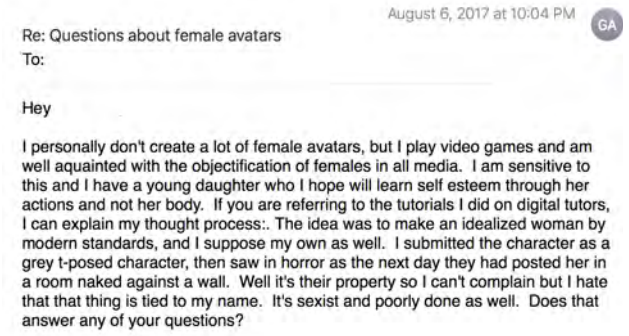
Introduction

I am frustrated by the persistence of sexist and racist representations in virtual worlds. It is as if these worlds, particularly video games and related interactive media, are forty years behind in terms of the politics of representation and the evolution of visual culture.

As a professor who teaches 3D digital modeling and animation, I work with my students to explore how and why this might be happening. During our in-class discussions, the majority of my students are adept at recognizing and unpacking the problems presented by disturbing images such as those in figures 1, 2, and 6. Yet about 10% of my students remain silent during these discussions. It is these students who concern me most. Will they leave my class and go on to create work that perpetuates these negative phantasms?

Figure 1. Screen shot of a tutorial, "Modeling a Female Character for Animation in Maya," from the Pluralsight on-line learning website, accessed December 18, 2018.

Figure 2. Screen shot of a virtual woman for sale on TurboSquid (which was accompanied by a text that noted that her private parts can be animated), accessed December 18, 2018.


August 6, 2017 at 10:04 PM

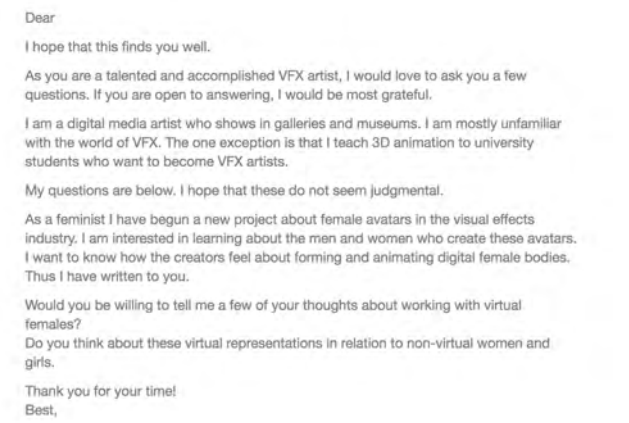
Re: Questions about female avatars

To:

Hey

I personally don't create a lot of female avatars, but I play video games and am well aquainted with the objectification of females in all media. I am sensitive to this and I have a young daughter who I hope will learn self esteem through her actions and not her body. If you are referring to the tutorials I did on digital tutors, I can explain my thought process:. The idea was to make an idealized woman by modern standards, and I suppose my own as well. I submitted the character as a grey t-posed character, then saw in horror as the next day they had posted her in a room naked against a wall. Well it's their property so I can't complain but I hate that that thing is tied to my name. It's sexist and poorly done as well. Does that answer any of your questions?

Figure 3. Email response from the producer of the tutorial "Modeling a Female Character for Animation in Maya" shown in figure 1


Dear

I hope that this finds you well.

As you are a talented and accomplished VFX artist, I would love to ask you a few questions. If you are open to answering, I would be most grateful.

I am a digital media artist who shows in galleries and museums. I am mostly unfamiliar with the world of VFX. The one exception is that I teach 3D animation to university students who want to become VFX artists.

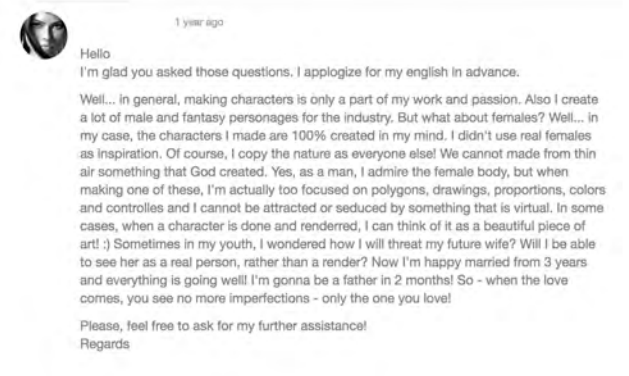
My questions are below. I hope that these do not seem judgmental.

As a feminist I have begun a new project about female avatars in the visual effects industry. I am interested in learning about the men and women who create these avatars. I want to know how the creators feel about forming and animating digital female bodies. Thus I have written to you.

Would you be willing to tell me a few of your thoughts about working with virtual females?
Do you think about these virtual representations in relation to non-virtual women and girls.

Thank you for your time!
Best,

Figure 4. Email correspondence with a creator of digital humans; response below.


1 year ago

Hello
I'm glad you asked those questions. I applogize for my english in advance.

Well... in general, making characters is only a part of my work and passion. Also I create a lot of male and fantasy personages for the industry. But what about females? Well... in my case, the characters I made are 100% created in my mind. I didn't use real females as inspiration. Of course, I copy the nature as everyone else! We cannot made from thin air something that God created. Yes, as a man, I admire the female body, but when making one of these, I'm actually too focused on polygons, drawings, proportions, colors and controlles and I cannot be attracted or seduced by something that is virtual. In some cases, when a character is done and renderred, I can think of it as a beautiful piece of art! :) Sometimes in my youth, I wondered how I will threat my future wife? Will I be able to see her as a real person, rather than a render? Now I'm happy married from 3 years and everything is going well! I'm gonna be a father in 2 months! So - when the love comes, you see no more imperfections - only the one you love!

Please, feel free to ask for my further assistance!
Regards

Figure 5. Email correspondence with a creator of digital humans in response to my inquiry in figure 4

As a part of this pedagogical and creative project, I have begun ethnographic research centered around email correspondence with producers of hyper-sexualized avatars. While the emails reveal that most of these producers are aware of the cultural discourse about gender stereotypes, they avoid discussing how their work may cause real-world harm. Most express that they produce avatars that will sell, pointing to the marketplace as the dictator of their choices. While certainly market demands are hard to ignore if one's income depends on sales, these producers seem slow to recognize their participation in the supply cycle, eschewing the idea that every decision they make has the potential to reinforce or shift the demand for these products.

Yet I have been pleasantly surprised at times. For instance, the producer of the tutorial "Modeling a Female Character for Animation in Maya" told me that he did not intend for his model to be shown as depicted - naked with her hands against a wall looking suggestively over her shoulder at the camera (figure 1). He wrote that he was shocked by this, and had given the avatar to the company in a simple t-pose (figure 3). While this was a refreshing discovery, more often my correspondents evince a less developed perspective regarding the representational politics afoot in their creations (figure 5)

During my presentation at ISEA 2019, I will share my continuing ethnographic research and my evaluation of the phantasms apparent in the production and marketing of digital humans. Further, I will continue to share this work with my students as part of my aim to help them develop a reflexive criticality when making 3D virtual worlds. And I will continue to work, both independently in my own creative research as well as with my students, to manifest liberatory phantasms that can counter the dominate commercial imaginary of human simulation.

References

[1] D. Fox Harrell, *Phantasmal Media: An Approach to Imagination, Computation, and Expression* (Cambridge: MIT Press, 2013) 343.

Bibliography

Bogost, Ian. *Persuasive Games* (Cambridge: MIT Press, 2010).

Goldberg, Daniel and Larsson, Linus, editors. *The State of Play: Creators and Critics on Video Game Culture.* (New York: Seven Stories Press, 2015).

Flanagan, Mary. *Critical Play* (Cambridge: MIT Press, 2009).

Flanagan, Mary. *re;skin* (Cambridge: MIT Press, 2007).

Flanagan, Mary. *Values at Play in Digital Games* (Cambridge: MIT Press, 2014).

Malkowski, J., & Russworm, T., editors. *Gaming Representation Race, Gender, and Sexuality in Video Games* (Bloomington: Indiana University Press, 2017).

Murray, Soraya. *On Video Games : the Visual Politics of Race, Gender and Space* (New York: I.B. Tauris, 2018).

Nakamura, Lisa. *Digitizing Race : Visual Cultures of the Internet* (Minneapolis: University of Minnesota Press, 2008).

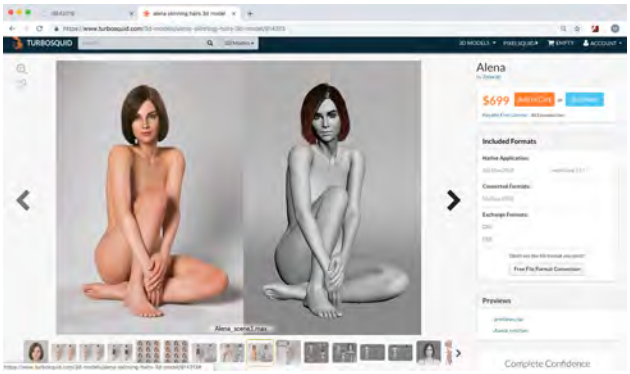


Figure 6. Screen shot of a virtual woman for sale on TurboSquid, accessed January 9, 2019.

Nakamura, Lisa, & Chow-White, Peter. *Race after the Internet* (New York: Routledge, 2012).

Sarkeesian, Anita. *Tropes Vs. Women in Video Games*. Web-series https://feministfrequency.com/video-series/

Shaw, Adrienne. "What is Video Game Culture? Cultural Studies and Game Studies." (*Games and Culture*, Vol 5, 2010).

Author Biography

Meredith Drum is a research-based artist and professor. She produces videos and animations as single-screen shorts and multi-screen installations; in addition to her solo work she often collaborates with other visual artists as well as dancers, writers, urban planners, computer programmers, and scientists on book projects, public art, movement research, and augmented reality initiatives. Her work is influenced by feminist art history, cinema studies, environmental justice, feminist science studies, game studies, science fiction, multispecies anthropology, and contemporary visual culture.

Without Stones there is no Arch. Subjectivity and Identity Production in Virtual World Aesthetics

Dr. Francisco Gerardo Toledo Ramírez
The University of Western Ontario, Canada | Universidad Autónoma Metropolitana Azcapotzalco (Mexico City) Canada | Mexico
get611interceltic@gmail.com | ftoledor@alumni.uwo.ca | trfg@azc.uam.mx

Abstract

This paper presents paths of identity and subjectivity production that have stemmed from experiencing virtual aesthetics in networked interaction. It is through the intensive communication with computers and social networks that one currently delineates life, work and leisure time, representing our self to others in a permanent and often curated way within a narrative. A voluminous body of contemporary research demonstrates that both the production of sociality and subjectivity (via the 'invasion' of intimacy by sophisticated systems of communication, sociability and surveillance) belong to the broader domain of Bio Politics and the Economy of Attention/Affectivity. One ominous future view on this, points to the standardization, normalization and complete control of our behaviour through newer/stronger affective technologies like Artificial Intelligence, Augmented Reality, 3D virtual interaction, ubiquitous and wearable computing, etc. Emerging from the analysis of virtual aesthetics, dual subjectivity and *myth-making*—all at the centre of my doctoral research—I present an alternate view that stems from SL-Based Art and the examination of the topics above mentioned. My goal is to widen the dialogue on the subject so the human, affective, psychological and aesthetic components emerging from virtual aesthetic interaction, in social and non-social networks, do not become excluded or neglected.

Keywords

Liminality, Autoempathy, Machinic-subjectivity, Dual-subjectivity, Myth-making, Identity-flow, Avatar interaction.

Introduction

Marco Polo describes a bridge, stone by stone. "But which is the stone that supports the bridge?" Kublai Khan asks. "The bridge is not supported by one stone or another," Marco answers, "but by the line of the arch that they form." Kublai Khan remains silent, reflecting. Then he adds: "Why do you speak to me of the stones? It is only the arch that matters to me." Polo answers: "Without stones there is no arch."
(Italo Calvino) [1]

My research over the past ten years has centred on Virtual World's Aesthetics, Autoempathy and Subjectivity [2], defined four *vectors* [3] or trajectories describing the shifting patterns of identity, subjectivity and sociality produced in 'users' and Second Life (SL) residents by artwork and aesthetic experiences created by artists working in the online environment between 2007 and 2012; specifically artists that decidedly used the *metaverse* as raw material for creation in and outside virtual worlds.

These artworks trigger responses at the level of human perception, affection and interaction, via *virtuality*, *avatar interaction and identity projection*. In recent years I have been researching and writing about these aspects and modalities for the reshaping of a user's sensorial and cognitive paths, social sharing, subjectivity production, and the always fascinating (and polemic) creation of unstable, multiplied identities. I claim that, today, art and creativity experienced through virtual and *metaversic* interaction greatly affects how we 'construct' our identity and subjectivity. Additionally, we implant them in *liminal* ways for the purpose of merging our *personae* (our different identities) with the fluid stream of data and aesthetic distribution of information that characterizes current ordinary life, work and social interaction within techno culture.

In this condition, the 'obsession' for shaping and curating our identities, profiles and *personae,* occurs almost permanently, in such a way, and to the extent that, *liminality* becomes a perceptual/psychological naturalised state: a 24/7 network connection; a *way of being* in the reality of the informational world that has become the norm. In other collaborations [4] I have written that this mode of being connected to the world is proof of an ongoing normalization process, through intense interaction, 'throwing' ourself represented images and identities into the social networked (eco)systems. This dynamic precipitating the mutability and projection of images of our-self, lived and presented to others *as another one-self*, is what I identify as the *liminal,* augmented and multiplied identity, stemmed from networked interactions (part digital/virtual, part actual—real).

The way in which it unfolds is key to the proliferation of *plots to a narrative* or *myth-making* production around the idea of a synthetic *one-self* who is *an acting extension of ourselves*. The obsessive time everybody spends curating and editing his/her social profiles and identities on the net (that is a number of differentiated personalities and subjectivities) is the clearest example of the 'naturalisation' of a

technologically-shaped behaviour. In these conditions our identity becomes amplified, fragmented and modified to adopt an *Identity-flowing state* aiming at the production of such forms of subjectivity. I am convinced that aesthetic experience in the networked system is a powerful way to activate responses at both the conscious and the unconscious levels, or the rational and the sensorial. Interacting socially through informational digital technology helps us to create (and obtain during that interaction) an enhanced, hybridised sense of our-self 'living' vicariously through its representation as 'another' oneself, 'who' is virtually presented to others in the social. Logically we uphold, foremost and above all, an affective and rational bond with it; an intimate 'sensation' emanates in terms of *empathy* and agreement, first and foremost, with our represented *synthetic selves*.

This is what author Adriano D'Aloia calls *autoempathy* [5]. Despite the fact that one does not use an avatar in the conventional way while working and interacting daily in digital networks, it is true that, in fact, we do adopt an *avatarian mode* while performing with it; our identity extends and distributes itself within our synthetic assorted *personae*. Hence, a symbolic layer is in operation, helping us to access and synchronise our identities with the flow of distributing-data displaying a bigger narrative (besides connectivity): that of *us expressing ourselves and connecting to the (whole) world*. This is, by far, the most common way in which everybody negotiates their *personae*, their position and subjectivity, playing socially as a valid metaverse *actant* [6]. This procedure pulls us, metaphorically, from the penumbra of social isolation to the *eclairage* (coming to light) of the socially accepted, positively ranked, successful identities.

Information aesthetics is part of "The Baroque"

My research is grounded on the observation of mixed media art landscapes, Design Praxis and Pedagogy for Design, Techno Culture and Aesthetics. My methodology combined virtual field work conducted by my avatar in SL (*Lacan Galicia*), qualitative research and *netnocultural* analyses, which allowed me to deploy findings in accordance with Anna Munster's hypothesis that **the digital is part of a "baroque" event**—a *time-based event* rather than fixed or static one in a determined historical stage.

Munster affirms that "the digital conceived as part of a baroque flow, now unfolds genealogically out of the baroque articulation of the *differential* relations between embodiment and technics." [7] This suggests that the *differential* relocates the conventionally excluded binaries between body and mind, man and machine, interface and direct communication with the computer (*the machine*), on a very distinct light: nature, artifice, body, machine, sensation and concepts integrate a flow of "relations of discordance and accordance with each other." [8]

In this condition, a throbbing field of aesthetic forces comes to the front, metaphorically speaking, emerging from penumbral stages and coming to light as an *assemblage*. Munster also claims that, in this case, binaries that conventionally "have populated our understanding of digital culture and new media technologies—physicality and virtuality, analog and discrete states, real and hyperreal—can be seen **to impinge upon each other rather than be mutually exclusive.** The effect of these areas' convergence and divergence is to produce ever-new and consistently mutating outcomes." [9] (my emphasis). I have intentionally articulated this position with that of the notion of "the fold", borrowed from Giles Deleuze [10] for the purpose of using this latter as an aesthetic method capable of resonating with information aesthetics and, at the same time, with the aesthetic continuum of baroque-essence, penetrating (via techno culture) into the Contemporary Virtual Art and Social Networked environments. The theoretical foundation is that such techno-aesthetic perspective, provides evidence of a contemporary notion of technologically mediated creativity as a result of the dialogue between **mind and body moderating each other**.

This analytical frame, along with the field-work conducted by my avatar in the virtual realm of SL-Based Art, allowed me to approach an interesting feature stemming from virtual worlds and HCI (Human -Computer Interaction) of our current time: the crisis of the *introspective*; that is, *the blurring between private and public* expressed in our quotidian world interaction with time through digital devices and social networks. Indeed, with the advantages of powerful and almost immediate technologies of information, we can learn, work, produce, create, share, distribute and multiply wealth in seconds. At the same time the invasion, spectacularization, commodification, and even trafficking of our privacy, leisure time, and identity, are—disturbingly—real and immediate possibilities today.

This is coupled with the exhausting reshaping and drowning of our political/ideological identities, as moulded by the excesses of Bio Politics, surveillance and the lack of counterbalances as a consequence of the same techno cultural dynamics. This is what cultural critic and professor Juan Martín Prada has termed the *Network-system*. Prada stresses a particular point that fittingly encompasses what I discuss in the final part of this text, that the new forms of economic power (particularly those in the Internet) have extended their control beyond social institutions, acting, in fact, within everyday life, reshaping it, to such extent, that life itself has become the true "*objeto de poder*" (object of power). "Because **bio-politic production is, essentially, subjectivity production**; we see that the goal of corporate multinational entertainment and communication has long ago exceeded the commodities and/or technological production. Instead and above all, it produces forms of subjectivities ... and specific patterns of interpersonal and social networking" [11] (my translation, my emphasis).

Subjectivity production in Second Life-based Art

Art practices in the virtual environment of Second Life contribute to us allowing the adoption of newer forms of identity, subjectivity and social production. These have the potential to trigger current and future patterns around creativity, social networked behaviour, sensorial and cognition

paths, education and art, and aesthetic exchange: all of them are based on the oscillation, amplification and mutability of *our selves projected and represented as another selves in the interaction*.

This kind of research needs to be conducted in an inclusive, combined, multi-perspective manner, one that does not neglect or oversimplify the dialogue between technology, digital culture, humanities, information, communication, psychology and aesthetics. This is the best method to fully grasp an effective and profound understanding of today's digital, virtual and networked techno cultural landscapes. Accordingly, my perspective is centred on aesthetic exchange in virtual and networked conditions. I focus on the enhancement and amplification of our subjectivity paths, through examining the shifting configurations of learning, perceptive and aesthetic interaction patterns. All of these are currently mediated by digital technology, virtual world, and virtual games experiences and social networks use.

I use the term *vector* (borrowed from Patrick Lichty, see reference 3) as a way to broaden and deepen the comprehension of effective ways to cope with future changes in human visual learning, creativity, and interaction with digital and virtual art. The cognitive paths—rational and emotional intelligence that stems from the exchange—show us how interlaced and mutually influencing (and regulating) those patterns might turn out. Hence, in future social interaction, the mediation of Virtual Reality, Augmented Reality, Social and Networked Systems, Artificial Intelligence protocols and devices, and other enhanced environments via techno-sensorial hybridisation layers, will conduct our cognition, perception and subjectivity to identify, interrogate and—finally—adopt *new forms of embodiment: time-based forms of behaving socially*. This might be to learn, share or exchange distributed forms of subjectivity and identity in the virtual, telematics, and artificial realms of information.

The artwork and interactive experiences analysed in my research, demonstrate that new behavioural configurations coalesce and emerge from avatar interaction as production of sociality, helping us to recode and configure our own private-to-social-to-intrapersonal interaction in the *metaverse*. That is to say: the experience of our full-time connected way of being. Thus, the *vector*, as previously described, is a resource to articulate and map different *myth-making*, subjectivity, and identity production modalities. In the *metaverse* there is not just one formulaic way of expressing and embodying agency, subjectivity and identity. Rather the opposite is true: the artwork, aesthetic statements, subjectivity and identity propositions of artists, become *differentials* that are *assembled* (in the *Deleuzian* sense) as innovative strategies for visualising, first and foremost, the *metaverse* itself, and from then, the space of interaction as a *social sphere*. That also constitutes a way of enacting and performing both *dual subjectivity* and *dual immersion.* I have borrowed these notions from the Italian Philosopher of Media Mario Costa's theory of "The Technological Hyper Subject" (as quoted by Vito Campanelli in his book *Web Aesthetics*) [12]. Campanelli explains *dual subjectivity and dual immersion as the conditions in which our subjectivity becomes interdependent and symbiotic, during the interaction with informational, electronic, social systems and networks*.

In other words, when they work in tandem, fully embedded in the logics of learned-habits while interacting with hardware and software machines, networks, and other digital devices in our daily labour, and or leisure time in 'front' of the VR multimedia terminal or the screen. In sake of the brevity required for this communication I will only resume two *vectors*, those corresponding to avatar artists Gazira Babeli and Bryn Oh.

Gazira Babeli's vector:

I can walk barefoot but my avatar needs Prada shoes
Gazira Babeli (2009)

Gazira's performances and interventions using code and *machinima* narratives are, to me, the paradigm of *a vector* of *illusion and representation transformed in the true bearers of continuity between the real and the virtual worlds.* Gazira's art in SL explores the connection between humans and virtual and real worlds. This achievement emphasizes the role of *illusion* and *representation* as the essential components on the *continuum* between worlds, the actual and the virtual, rather than marking their split. I examined her artwork, particularly focusing in *Acting as Aliens*. This code performance (2009) comprises the personal yet powerful proliferation of narratives budding from their own *liminal* identity: an avatar capable of controlling 'real' (actual people) in the Kapellica Gallery (the penumbral factor) for which I show a short video on my presentation, and the exceptional condition of behaving like one self (one mind) that performs through two bodies, one in the actual, one in the virtual (the *eclairage* factor). Indeed, in *Acting as Aliens* the artist advances a position **against** the more or less profuse belief in VW theory relying—even today—on the principles of disembodiment, by *reversing the conventional logics, turning real people into avatars, controlled by her virtual hidden avatar* (Gazira Babeli). This is how she incorporates an unusual degree of intellectual and challenging criticism of both mainstream digital techno-culture and the more conventional consumerist ethos prevailing in virtual worlds, particularly the art scene in SL.

Bryn Oh's vector:

I'm an artist only existing on the Internet. When someone falls in love in SL, they fall in love with another mind, not with a cartoon character
Bryn Oh (2010)

Bryn Oh's machinima, installation, and paintings illustrate an *unfolding narrative vector*. As quoted by my avatar in her in-world interview: when one enters Bryn's Simulators (SIMs) one becomes integrated in the dynamics of a poetic discourse unfolding from the series of objects, characters and situations that open semiotic potential in accordance

with one's focus, curiosity and patience. Bryn's artwork illustrates the conflation of form, space, mutable semantics and narrative order of fictional myth-making flows. More than looking to anchor our interpretation of her stories, Bryn pursues for the multiplication and rearrangement of articulations to which visitors can connect her own affective-receptivity and intellectual interpretation of the performing objects and spaces. In her bucolic and morbid atmospheres (so common in her expressive repertoire) we find ourselves surrounded by talking and narrative devices, ready to lead us—at the request of a curious and patient visitor—to new levels of interaction and narrative, around a number of phantasmagorical and personal subjects: ill robots, rusted machines, abandoned toys, and other infantile items of memory, *all melancholic spirits wandering in the dusk, or at night on the borders of the real, the virtual and the oneiric*.

Conclusions: Four corners that make a Pentagon

The four corners (*vectors*) on my Case Studies conform not a square but a pentagon: a *fifth* corner arises from the intermediated, aesthetic and liminal substance amalgamated by *dual* and *machinic* subjectivity. This also includes the paradoxical and omnipresent self-reflexive practices alongside the aesthetic 'lives' of virtual selves. These selves are artists and avatars whom, above all, cannot help but be the first and most qualified interlocutors of their performances.

In this particular way, the examination of certain features like identity amplification, intimate and social blurred-boundaries and autoempathy, all combined, coalesce into the paradoxical condition of the *individually social*. This is a personal metaphor I have crafted to outline the current and future quotidian condition of most users, visitors and dwellers of virtual worlds and social environments.

References

[1] Calvino Italo, *Le città invisibili*. (Torino, Italia: Einaudi, 1972. Translator WilliamWeaver as *Invisible Cities*. New York: Harcourt Brace Jovanovich, 1974), 82.

[2] Francisco Gerardo Toledo Ramírez, "Because I am Not Here, Selected Second Life-Based Art Case Studies. Subjectivity, Autoempathy and Virtual World Aesthetics" (Ph.D diss., Faculty of Information and Media Studies, The University of Western Ontario, London Canada, 2012).
Available at: http://works.bepress.com/fco_gerardo_toledo/2/

[3] Lichty Patrick, "Art in the Age of DataFlow." *Networked. A (Networked_Book) About (Networked_Art),* (2008) (last accessed December 8, 2018). http://lichty.networkedbook.org/ "I look at the emergence of nonlinear narrative (1940-2006), using the mathematical terms scalar, vector and flow as conceptual or visual metaphors that describe structure, transmission, and social patterns. Scalar examines the set, non-linear narratives of hypermedia and the indeterminate narratives of Wikis; vector, the dialogic narratives of listserves and blogs; and artistic visualizations that seek to reveal patterns as flows of information in networked cultures increase. These modes of representation, and the artists who exemplify them in this chapter, illustrate the transition from linear to non-linear narrative, the emergence of indeterminate notions of authorship and readership, and the problematic nature of communication and representation in open networks"

[4] Francisco Gerardo Toledo Ramírez. *Individually Social: From Distribute Aesthetics to New Media Literacy Approaching the Merging of Virtual Worlds, Semantic Web and Social Networks.* Chapter in "The Immersive Internet. Reflections on The Entangling of The Virtual with Society, Politics and the Economy". ed. Robin Teigland and Dominic Power, ISBN 978-1-137-28301-6 (UK: Palgrave Macmilan, 2013), 58-59.
Francisco Gerardo Toledo Ramírez. *Consensual hallucination: Bryn Oh's2 Second Life-based work*. Chapter in "Virtual Creativity" Vol. 4, Issue 1. (2014) 35 - 53 (formerly published as Metaverse Creativity), ISSN 2040-3550 (Print); ISSN 2040-3569 (Online)

[5] D'Aloia Adriano, "Adamant Bodies: The Avatar-Body and the Problem of Autoempathy" *AISS-Associazione Italiana di Studi Semiotici. EIC Serie Speciale,* (2009) Year III, Number 5: 51-56 http://www.ecaiss.it/monografici/5_computer_games.php

[6] Ricoeur Paul, *Oneself as Another*. (Chicago: University of Chicago Press, 1992), 16. In Oneself as Another Paul Ricoeur uses the term actants to refer to these characters or players capable of affirming themselves through action and narrative. He states that "narratives express (represent) worlds inhabited by agents capable of responding to questions such as 'Who is speaking? Who is acting? Who is recounting about himself or herself? Who is the moral subject of imputation?'"

[7] Munster Anna, *Materializing New Media. Embodiment in Information Aesthetics*. (Hanover, New Hampshire: Dartmouth College Press, University Press of New England, 2006), 5

[8] Munster Anna, *Materializing New Media. Embodiment in Information Aesthetics,* 5.

[9] Munster, Anna. *Materializing New Media. Embodiment in Information Aesthetics,* 7.

[10] Deleuze Gilles, *The Fold: Leibniz and the Baroque*. (Minneapolis: University of Minnesota Press. 1993)

[11] Prada Juan Martín, *Prácticas artísticas e internet en la época de las redes sociales*. (Ed. AKAL, Arte Contemporáneo. Madrid, 2012), 51-52.

[12] Campanelli Vito, *Web Aesthetics: How Digital Media Affect Culture and Society*. (Amsterdam: NAi Publishers Rotterdam and Institute of Network Cultures, 2010), 226. "the belief that contemporary subjectivity is connected to and depends on digital networks: the contemporary hyper-subject is made up of human and machinical/technological components, including the … protocols, processes and the hardware and software platforms regulating the functioning of digital networks. Networking, as a cultural practice based on making networks, is a multiplication of identities, roles and methods no longer built exclusively on human beings but also on non-living beings and relevant topologies and physiologies." (Mario Costa, quoted in Campanelli Vito, 2010)

The ‘Gaze’ of the Artwork: Seeing Machines and Interactive Art

Raivo Kelomees
Estonian Academy of Arts
Tallinn, Estonia
offline@online.ee

Abstract

The goal of this presentation is to discuss and analyse viewer-sensing artworks and the reversed situation in the exhibition space where artworks ‘look’ at the viewer. To answer these questions I firstly looked at the topics of machine vision, computer vision, biovision and the evolution of vision.

Dividing interactive artworks into four categories (distant, contact, chance-based and bio-based/symbiotic interaction) enabled me to illustrate developments in feedback systems which became evident in recent decades.

Keywords

Interactive art, digital art, spectator paradigm, gaze of the artwork, symbiotic interaction, biofeedback art, machine vision, surveillance art, viewer-sensing artworks.

‘Seeing Machines’ and Interactive Art

The meeting of the viewer and the artwork is a meeting between the living and non-living. Traditionally, one is looking and the other is looked at; one is moving and the other is static. However, exhibitions of contemporary media art offer encounters with artworks which are themselves ‘looking’ at the viewer. The visitor remains (willingly or not) in the zone of the artwork's sensors and his image—or other activity-based information—becomes the raw material for manipulation of the artwork. We can describe this as a situation where the relationship of the viewer and the viewed is reversed: the artwork's ‘gaze’ is turned toward the viewer, such that the owner of the ‘gaze’ is the artwork, not the viewer.

I would like to elaborate different categories of interactive and biofeedback art from the point of view of ‘seeing machines’. This helps answer the following questions: do we have here a new spectator paradigm in which the artwork is active and no longer simply an object under observation? Are there parallels to be found in art history or do we see here something which belongs to the digital era? Is this phenomenon only common to technical and interactive art?

In this discussion I use the term *paradigm* in the relatively unused combination of ‘spectator paradigm’. 'Paradigm' means ‘an outstandingly clear or typical example or archetype’ (Merriam-Webster’s Collegiate Dictionary), [1] hence, the ‘spectator paradigm’ refers to the situation in an exhibition where the spectator is the subject and the artwork is the object—one is looking and the other is watched, one is active and the other passive.

This describes the classical and canonical exhibition setting but it is challenged by interactive artworks which can bring about the ‘reversal’ of the canon. More than 20 years ago Simon Penny [2] wrote that: ‘Interactive art represents a radical phase-shift in western esthetics.’ Penny subsequently identified the new territory that artists were confronting to be that of: ‘…the esthetics of machine mediated interactivity.’ In this article we are dealing with this ‘phase-shift’ in the sense that the technical artwork is not passive and not one which is only to be looked at—it is sensing back.

The Term ‘Gaze’ and the History of Research of Visual Perception

Research into visual perception, scopic regimes, and the conventions of visual representation has a long history. Ancient philosophers dealt with questions of vision and their opinions were divided between two theories of visual perception: extramission theory (emissions from the eyes to the object) and intramission theory (emissions from the object to the eyes).

As I am using the term ‘the gaze’ which is familiar in the context of visual studies, and I am exploring artworks as mutually ‘gazing’ objects, then several authors can usefully be referenced. The terms ‘gaze’ and ‘spectator’ have everyday meanings but they have a rich connotative background which could be compiled from writings by theorists of psychoanalysis, visual studies and art history: Jacques Lacan, [3] W.J.T. Mitchell, [4] Jonathan Crary, [5] Martin Jay, [6] Norman Bryson, [7] Christian Metz, [8] James Elkins [9] and Michel Foucault [10].

A quite independent field of research concerning vision and the gaze is that of *vision research* and the associated phenomenon of *visual attention*. Marisa Carrasco provides an overview of this research field in *Visual attention: The past 25 years*, [11] writing that since 1976 there have been hundreds of articles published that focus principally on behavioural research and neurophysiology. Initially, mechanisms of vision were categorised as pre-attentive or attentive: attention being a selective process. ‘Attention can be allocated by moving one’s eyes toward a location (overt attention) or by attending to an area in the periphery without actually directing one’s gaze toward it (covert attention).’ Carrasco concludes her overview by explaining that as the cost of cortical computation is high, attention is crucial in order to optimise the system’s limited resources.

The discussion of vision research illustrates the vastness and multidisciplinarity of philosophical, historical, cultural, psychological and other approaches to vision. My task is to link these issues with some unsolved questions relating to new media art research and the notion of viewer-sensing artworks. To that end it would be much more suitable to propose the term 'interacting subject' instead of Crary's 'observing subject' and to consider the term 'participation regime' (instead of 'scopic regime') as being more appropriate for the contemporary digital art context where input from the viewer is required.

The term 'spectator' used in this article is a replacement for various terms of which the most suitable would be 'interactor'—and where possible I use this latter term. Taking into account that encountering an interactive artwork means participation, not simply observation, I present below a variety of terms, some quite general, some specific to certain authors, that show that the roles of spectator and participant in the art context has been under discussion for some time. These terms include: viewer, consumer, user, spectator, observer (Jonathan Crary), active participant (Roger F. Malina), [12] vuser (viewer/user) (coined by Bill Seaman in 1998, published 1999), immersant (Char Davies 1995), spect-actor (Augosto Boal), [13] interactor (David Rokeby), [14] executor, (co)creator, viewer-interactor, receiver-participant, viewer-performer (Ryszard W. Kluszczynski) [15]. Certainly this list is not complete, but it shows how various researchers have attempted to define those fundamental changes that we have been witnessing in exhibition spaces.

The Relationship of Artwork and Viewer in Interactive Art

It is not possible here to provide a comprehensive historical overview of interactive art practices and discussions based around the term 'interactivity.' The year 1990 could be considered an historical watershed because this was when Ars Electronica introduced its *Interactive Art* category in a desire to create a simple classification of ongoing trends of experimentation and debates in the field. Before that one can consider pre-forms of interactive art originating at the beginning of the 1960s (and even earlier in kinetic art) including Roy Ascott's works (*Change Painting*, 1968), closed-circuit video installations (as researched by S. Kacunko) [17] and the earliest forms of interactive environments as programmed by Myron Krueger and others.

We can therefore say that pre-forms of interactive art and the idea of the potentiality of such art existed decades before the 'boom' of the 1990s. By the year 1997 interactive art had become a 'firmly established' arts genre according to the Ars Electronica's jury statement in 2004. [18] Thorough overviews of the tendencies that preceded and influenced interactive art, and discussions about the term itself, can be found in the writings of Söke Dinkla, [19] C. E. Beryl Graham, [20] Katja Kwastek, [21] Dieter Daniels, [22] Christiane Paul, [23] Peter Weibel, [24] Edward A. Shanken, [25] Ryszard W. Kluszczynski, [15] and many others.

It is important to point out here that a significant break in practice and discourse occurred in the 2000s, which is reflected clearly in Erkki Huhtamo's article *Trouble at the Interface 2.0. On the Identity Crisis of Interactive Art* (2004) [26]. In 2003 the Ars Electronica jury had already mentioned 'an apparent redundancy of approaches' and in 2004 agreed about the need for a 'broader definition of interactivity.' Since 2014 the Ars Electronica interactive art competition has been held biannually and the category has been renamed *Interactive Art +*. However, at the same time the interest of researchers and art historians became somewhat stronger, due to the fact that the accumulation of information and practice in the field had become very substantial.

I would like to bring an example from the interactive art field, which illustrates the changed situation and art trends. Golan Levin's and Greg Baltus' *Opto-Isolator* (2007) reverses the audience position: a sculptural eye on the wall follows the eyes of the viewer. [16] The viewer encounters a framed mechanical blinking sculpture on the wall—a mechatronical eye—which follows the movement of the spectator's eyes and responds with psychosocial behaviour: looking at the viewer, turning eyes away as if shy when looked at too long etc. Rather similar is *Double-Taker (Snout)*(2008) and also *Eyecode* (2007). All the above offer clear examples of ironic artworks based around looking at the viewer(s).

The topic of the seeing machine in art could be introduced through video feedback artworks in which the spectator was placed into the context of the artwork and is seen on the screens of the installation (the works of Frank Gillette and Ira Schneider, Bruce Nauman, Dan Graham, Peter Campus, Bill Viola, Peter Weibel, Jeffrey Shaw and others): this type of work could be understood as a pre-phase of participative and interactive art.

In the early 1970s we already encounter viewer-sensitive computer environments designed by Myron Krueger: here the viewer was embedded in a computer-based projection where he could play with his own silhouette and with a graphical actor added by a computer programme. A perfect example of an installation that follows the viewer's gaze from a distance is Dirk L sebrink's and Joachim Sauter's *Zerseher* [27], which uses Giovanni Francesco Caroto's painting (c. 1515) as source material.

Many other early interactive artworks could be mentioned where the viewer is situated within the field of vision of the artwork and switches on or off its auditive and visual elements: Peter Weibel's (1973), [28] David Rokeby's (1990) *and* Simon Penny's (1993) works.

Additional works may be mentioned in which the artwork's 'gaze' is turned at the viewer: Carl-Johan

Rosén's (2006) *Predator*, Togo Kida's (2005) *Move*, Random International's (2012) *Rain Room*, Rafael Lozano-Hemmer and Krzysztof Wodiczko's *(2015) Zoom Pavilion* An emblematic work is Marie Sester's (2003) (Figure 1) surveillance installation *Access*, [29] where people passing by are tracked by a robotic spotlight and a directional acoustic beam system. Samuel Bianchini's (2007) *niform* has similar aspects in that the viewer's physical proximity reveals images of policemen in the projection.

Figure1. Marie Sester, Access, 2003.© http://www.sester.net/access

Four Categories

I would like to classify 'viewer-sensing artworks' into four categories according to their methods of engagement with the spectator's consciousness.

The four categories are: distant interaction, contact interaction, chance-based distant and contact interaction, symbiotic interaction.

The viewer-sensing artworks in the following classification are defined by the degree of closeness between the machine and human parts of the situation. The contact between the pre-artwork and the viewer changes from distant (non-contact) to tangible, tactile and physiological. These categories reveal how sensors get closer to the viewer's body until they reach information sources beneath the skin (blood, brainwaves etc.).

These categories exemplify the artwork's 'gaze' approaching the body of the viewer until it penetrates its surface, reaching 'under the skin' areas. Cheaper and more widespread technology has made this possible—various sensors are used in such works, which show a tendency from sensing the viewer as a distant subject to detecting physiological reactions using sensors that literally enter the viewer's body. In all these artworks and categories the viewer is in the position of being surveyed.

Conclusion

The goal of this article was to discuss and analyse viewer-sensing artworks and the reversed situation occurring in the exhibition space when artworks 'look' at the viewers or sense them in some other way.

Interactive art reflects clearly the activity of an artwork—these are not passive objects. The functioning of the artwork influences the viewer and vice versa. It is a reciprocal relationship which is born because the artwork has the capability to 'sense': it perceives the viewer and exerts its influence on the aesthetic experience.

Finally, can we answer the three questions posed in the beginning: does a new spectator paradigm arise; do these 'sensitive' artworks belong to specific areas of technical art or are there precedents in art history to this situation of 'sensing' artworks; and can we talk about the 'gaze' of the artwork? In connection with interactive art and other forms of technologically responsive artworks we are certainly encountering a new paradigm in the tradition of experiencing art: there is a bi-directional interaction between the viewer/interactor and the artworks (which are mostly technological objects). The exhibition setting is not unidirectional: the viewer is active—he/she senses and acts to influence the artwork which also 'senses back' by responding/acting/working in relation to the viewer's activity. This "new paradigm" already has a history, and is not solely connected with interactive art.

Understandably, the interpretation of the 'gaze' of the artwork has been rather metaphoric here and it refers not only to visual, but any other input produced by the human body that technical devices can detect and therefore 'sense'.

To answer the question as to whether these 'sensitive' artworks belong specifically to the area of technical art and if there are precedents in art history to this situation of 'sensing' artworks, then my answer would be: responsive and sensitive artworks are a rather recent art historical phenomenon. Certainly these artworks—as technological objects and machines—are not unique, because similar 'responsive' machines or mechanisms can be found everywhere in our contemporary environment, in metro station gates, supermarket doors, cars (car proximity sensors), mobile phones, etc.

Dividing interactive artworks into four categories (distant, contact, chance-based and bio-based/symbiotic interaction) enabled me to illustrate the developments in feedback systems which became evident in recent decades. These categories exemplify the artwork's 'gaze' approaching the body of the viewer until it penetrates its surface, reaching 'under the skin' areas. Cheaper and more widespread technology has made this possible—various sensors are used in such works, which show a tendency ranging from sensing the viewer as a distant subject to detecting physiological reactions using sensors that literally enter the viewer's body. In all these artworks and categories the viewer is in the position of being surveyed.

If finally we ask whether all manner of medical and physiology measuring technology can be used in artworks as an artistic technology, then the answer would be

affirmative. But the question becomes one of context, about how and where this technology is used.

References

[1] Penny, Simon. "From A to D and back again: The emerging aesthetics of Interactive Art." *Leonardo Electronic Almanac*. Volume 4, No. 4. April 1996. Accessed March 30, 2019. http://simonpenny.net/1990Writings/atod.htm

[2] Mirriam-Webster's Collegiate Dictionary. Eleventh Edition. Springfield, Mass.: USA, 2006, 898.

[3] Jacques Lacan, *The four fundamental concepts of psycho-analysis*. Edited by Jacques-Alain Miller; introduction by David Macey. Vintage, London, 1998.

[4] W.J.T. Mitchell, "Showing seeing: a critique of visual culture." *Journal of Visual Culture*, Vol 1(2): 166, 2002.

[5] Jonathan Crary, *Techiques of the Observer*. Cambridge: MIT Press, 1999.

[6] Martin Jay, *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought*. Berkeley: University of California Press, 1993.

[7] Norman Bryson, "The Gaze in the Expanded Field. " In *Vision and Visuality*. Ed. By Hal Foster, Dia Art Foundation,1988.

[8] Christian Metz,.*Psychoanalysis and Cinema. The imaginary signifier*. MacMillan Press, London, 1975

[9] James Elkins, *The Object Stares Back*. San Diego: Harcourt, 1997.

[10] Michel Foucault, *Discipline and Punish: The Birth of the Prison*. Vintage Books, New York, 1995.

[11] Marisa Carrasco "Visual attention: The past 25 years." *Vision Research*; 51(13): 2011, 1484–1525. Accessed March 30, 2019. doi: 10.1016/j.visres.2011.04.012.

[12] Roger F. Malina, "The Beginning of a New Art Form." In *Der Prix Ars Electronica*, Hannes Leopoldseder (ed.), Linz, Veritas-Verlag, 1990.

[13] Augusto Boal, *Games for Actors and Non-Actors*. Routledge, London, 2002.

[14] David Rokeby, "Transforming Mirrors: Subjectivity and Control in Interactive Media." In *Critical Issues in Electronic Media*. Ed. By Simon Penny. State University of New York, 1995.

[15] Ryszard W. Kluszczynski, "Strategies of interactive art." *Journal of Aesthetics & Culture*, 2010. Vol. 2, DOI: 10.3402/jac.v2i0.5525

[16] Golan Levin, and Greg Baltus, Opto-Isolator, 2007. Accessed July 4, 2018, http://www.flong.com/projects/optoisolator/.

[17] Slavko Kacunko, Closed Circuit Videoinstallationen: Ein Leitfaden zur Geschichte und Theorie der Medienkunst mit Bausteinen eines Künstlerlexikons. Berlin: Logos, 2004.

[18] Scott deLahunta / Peter Higgins / Hiroshi Ishii / Tomoe Moriyama / Elaine Ng, "Interactive art. Rearview Mirror: 1990-2004." *Ars Electronica archive*, 2004.

[19] Söke Dinkla, *Pioniere interaktiver Kunst von 1970 bis heute: Myron Krueger, Jeffrey Shaw, David Rokeby, Lynn Hershman, Grahame Weinbren, Ken Feingold*. Edition ZKM Karlsruhe, Ostfildern-Ruit: Hatje Cantz, 1997.

[20] Beryl Graham, *A Study of Audience Relationships with Interactive Computer-Based Visual Artworks in Gallery Settings, through Observation, Art Practice, and curation*. PhD thesis, The University of Sunderland, 1997.

[21] Katja Kwastek, *Aesthetics of Interaction in Digital Art*. Cambridge: The MIT Press, 2013.

[22] Dieter Daniels, "Streategies of Interactivity." In *The Art and Science of Interface and Interaction Design*. Ed. by Christa Sommerer, Lakhmi C. Jain, Laurent Mignonneau: Springer Verlag, Berlin Heidelberg (Studies in Computational Intelligence, Volume 141). 2008, p. 27–62.

[23] Christiane Paul, *Digital Art.* Thames and Hudson, London, 2003.

[24] Peter Weibel, "It Is Forbidden Not to Touch: Some Remarks on the (Forgotten Parts of the) History of Interactivity and Virtuality." In *MediaArtHistories*. Ed. by O. Grau. Cambridge: MIT Press, 2007, pp. 21–42.

[25] Edward A. Shanken, "Historicizing Art and Technology: Forging a Method and Firing the Canon." In *MediaArtHistories*. Ed. by. O. Grau. Cambridge: MIT Press, 2007, pp. 43–71.

[26] Erkki Huhtamo, "Trouble at the Interface 2.0. On the Identity Crisis of Interactive Art." First published in Framework, The Finnish Art Review, 2/2004 (Helsinki: FRAME Finnish Fund for Art Exchange). Accessed March 30, 2019. http://www.neme.org/texts/trouble-at-the-interface-2.

[27] L sebrink, and Joachim Sauter, Zerseher, 1992. Accessed July 4, 2018, https://artcom.de/en/project/de-viewer/.

[28] Peter Weibel, Crucifixion of the Identity, 1973. Accessed July 4, 2018, http://www.medienkunstnetz.de/works/krucifikation/.

[29] Marie Sester, Access, 2003. Accessed July 4, 2018. http://www.sester.net/access/.

Biography

Raivo Kelomees, PhD (art history), artist, critic and new media researcher. Presently working as senior researcher at the Estonian Academy of Arts, Tallinn. He studied psychology, art history, and design at Tartu University and the Academy of Arts in Tallinn. He has published articles in the main Estonian cultural and art magazines and newspapers since 1985. His works include the book "Surrealism" (Kunst Publishers, 1993) and an article collection "Screen as a Membrane" (Tartu Art College proceedings, 2007), "Social Games in Art Space*"* (EAA, 2013). His Doctoral thesis was "Postmateriality in Art. Indeterministic Art Practices and Non-Material Art" (Dissertationes Academiae Artium Estoniae 3, 2009).

The Unbearable Lightness of Meaning Game

Lindsay D. Grace
University of Miami
Coral Gables, Florida, United States of America
LGrace@Miami.edu

Abstract

This is a brief summary of a creative electronic artwork called the Unbearable Lightness of Meaning. The game is a playable adaption of Kundera's literary work, The Unbearable Lightness of Being. The game attempts to explore heuristically the ambiguity of meaning presented in making a playful experience through abstraction of meaning and representation. This brief summary explores the motivations, philosophical underpinnings, and resulting work as a first exploration into how such themes can be manifest in a creative electronic work. It is offered as a case study in meaning, perceived meaning and the translation of literary works into non-conventional play experiences.

Keywords

Recursive design, game design, social impact games, meaningful play

Motivation

The work is motived from a set of philosophical evaluations of the contemporary experience of being a designer of meaningful play. It plays on the notion that there is an unbearable lightness of being social impact games. The philosophical dichotomy of social impact games is much like other media. It is that either all games have social impact potentials, or they do not. As a creative medium, they might be considered to have at least the same potential for effect as all other media.

In this spirit it is also reasonable to claim that whether or not a game intends to be a social impact game, it may still have the same effect, in much the way a song that is not used as a rally cry for war might become one if used for such intention. On the other hand, it may also be claimed that only games that intend to have specific social impact can have it. This view biases toward intention, recognizes that intention is the difference between happenstance and art.

If all games have meaning, what does it mean to be a social impact game? While we have in the past decade championed a variety of terms that orbit this concept of social impact, how do we, as researchers, designers, and players understand the edges of a social impact game and other types of playful design? How does intention and the reality of play intersect to support or detract from this concept of a social impact game? Whether it is a newsgame [1] developed by a major news organization, an advergame [2] designed by a marketing group, or a game with strong political implications made by a single independent artist [3] it's useful to examine what is meant by social impact and how meaning is both produced and interpreted. While these questions are asked commonly in digital games studies, it is also useful to construct works that aim at providing case study for such questions.

Having previously used empirical foundations to research the way games scaffold information and reward exploratory play, the artistic motivation of this work was to explore how meaning is both created and obscured in playful experiences. It integrates prior writing and research on the notion of taboo play [5], which asks the comically important question – if a game is so taboo no one ever plays it, does it continue to create social impact? It also critically analyses the dominant rhetoric about procedural rhetoric in games [6], drawing on the conventions games researchers contribute to the ambiguity of social impact play design. If a game employs the tricks of it's novel predecessors, invoking the specter of significant works while integrating novel mechanics, does it offer more or less meaning and critique.

These questions are not the mere product of diegetic examination. Instead, they are drawn from the daily operations of directing a variety of purpose-driven games projects for the Smithsonian Museums, the World Bank, the International Finance Corporation (IFC), Education Testing Services (ETS), the US National Institutes of Mental Health (NIMH), several radio, television and news organizations. They are also the product of past explorations in translating literary works into playful experiences that move beyond mere representation of plot. The prior work, The Tell-Tale Heart, completed as a collaboration by the designer and their students, endeavored to combine the core plot points, and themes of Edgar Allen Poe's Tell-Tale Heart into a playable experience that was language agnostic[7]. In that creative exploration players had to employ the key game verbs of the narrative, through accelerometer-based movements of a. Mobile device. The player's actions were meant to follow the erratic breakdown of the short story's protagonist, as players moved from methodical controlled actions to wild, uncontrolled ones.

This creative research examines the unique characteristics of meaning in games, as a medium mid-migration from a disposable commercial product to a meaningful, artistic, political, and experiential communications medium in both analog and digital form. It is built to provide an heuristic, recursive specter of play as a medium who's meaning is cast from the penumbra of traditional, more widely recognized works in literature.

The Unbearable Lightness of Meaning, Game

The work, the Unbearable Lightness of Meaning t (http://lgrace.com/lightness/), translates Kundera's novel, the Unbearable Lightness of Meaning [8] into a text-messaging based interactive narrative driven largely by emoji. The game explores several key questions that relate to meaning in games, particularly social impact games. These include, how meaning is obscured or improved by abstract actions in play? How does such work illuminate contemporary tensions in meaningful play or overly simplify the meaning of prior narratives? In what ways are the electronic explorations in games becoming self-referential iterations on themselves?

The Unbearable Lightness of Meaning is a playful adaption of Kundera's work, playing with the ambiguity of emoji as a unit of meaning and operation. While a playful unit, emoji function as a less robust means of communicating action. They are seemingly fast to translate to meaning and somewhat easily translated across languages. In theory, speakers of Japanese, English, and Spanish, for example, can communicate through emoji.

Figure 1. The Unbearable Lightness of Meaning game start

This makes it a bit of a universal unit of communication, achieving what languages like Esperanto could not. These same claims, about the universality of play abound. What then happens when a work is translated into emoji? Better yet, what happens when the player not only interprets, but acts through those emoji. What elements of meaning are lost? What elements are improved by the experience of having their meaning obscured? Does the work become more or less poetic, when constrained to the language of a pictographic system? These questions can sometimes be best addressed by making something playable, that moves the experience from a hypothetical to the real.

In the game, the player traverses one of two narratives, one about war and the other about love, dissecting the book into thematic tracks of the game's experience. Each track is designed as an adaption of Kundera's own themes. They attempt to turn a body of literature into a traversable collection of key quotes and events, that must be explored. To complete the game, the player must solve its riddles and accept the terms of communication.

The ambiguity of meaning resulting from abstracting the depth of Kundera's work to simple, 140 character or less messages is designed to remind players of the impoverished ways that we can communicate via technology. The death of a lover is minimized to a knife, coffin and skull. The poetry of the novel, which is embedded in the game as quotes through emoji, is diminished into vagaries that have a certain lightness to them. Once the player accepts this lightness, lack of ultimate meaning as a thematic element in the novel, the Lightness of Meaning emoji become a more natural experience. It is when we try to determine exactly what they mean, that the tensions in efficacy and action become strongest. It's a bit like chasing shadows, that seem to have substance but as we aim to grasp them that impression dissipates.

In concert with a theme in the book, there are several paths to be traversed but they function less as a rehearsal and more as an expense. There are, as the first lines of the book allude, "moments eternal return which like an infinite loop ad infinitum." There are moments, as well, when such return seems recursive, only to reveal that the pattern is the only way to move forward. Players experience moments when they must do the same thing over and over again, with what seems like only minimally perceptible differences upon each iteration. Instead, it is in the aggregate of those small iterations that there is a path forward. Much like the focusing of light from wide bands to narrow, to create impression and, the player must move forward by recursively iterating on a slightly narrow set of repeated actions.

As the player is successful at moving the path forward, the emoji retreat to the clearer meaning of the language itself (at least for English speakers). But, rewarding players for the lightness of being, the emoji are the only way to take action in this small, narrative game. In the end the game is an effort in thematic reference to a deeply philosophical novel, designed as a text-messaging game who's adventures

orbit finding a way to philosophize in times of war (hint: stay in the hole), balancing the needs of lovers, and managing the unbearable lightness of being.

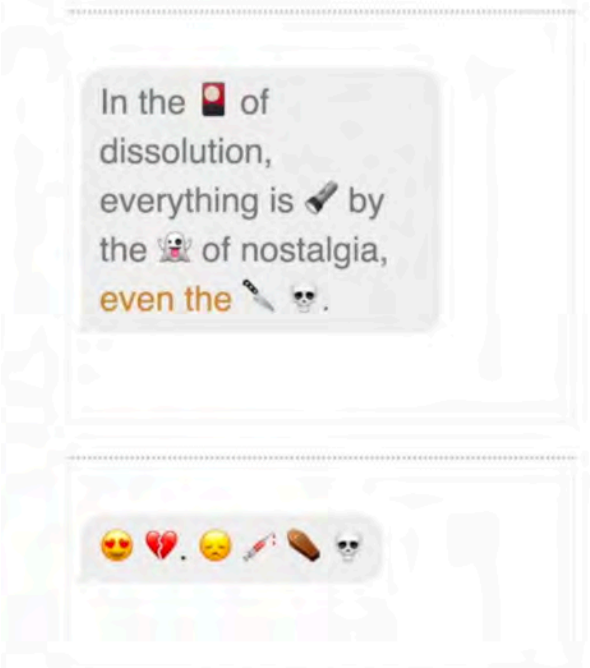


Figure 2. The Unbearable Lightness of Meaning game play, ending in player death and quoting directly from the novel

This recently completed work intersects with the 2019 ISEA theme in its pursuit of the "versatility in which various interpretations" can occur. Instead of interpreting the physical or computer rendered light, the game shines a new light on the ways in which the historical fiction of Kundera's Unbearable Lightness of Being can be interpreted through modern forms of communication.

The obvious reference in the book and game to the "lightness" of being/meaning is most related to the notions of Penumbra and Aeternitas in that both the book and the game reference a longing to repeat, perhaps even recursively the rays that cast from one decision to the next. In the end, there is but one ray, the path that we choose, but there is a perpetually longing to know the innumerable possibilities that emirate from one. This is part of the unbearable lightness of being, the balance of shadow and penetrating light that is at once long ranging but seemingly insubstantial. It is an eternal struggle, one which shows itself in the human struggle to imagine, repeatedly, the other ways in which events can cast their shadows and the projections of our choices that spread across life. The first line of the book illuminates this for the reader – "The idea of eternal return is a mysterious one, and Nietzsche has often perplexed other philosophers with it: to think that everything occurs as we once experienced it, and that the recurrence itself recurs ad infinitum!"

The game plays with these themes but by balancing the old illusion of control with patterns that seem repetitive, and at times even recursive, as the solution that lets the player bring to light the inevitable truth – an unbearable lightness of meaning that is part of our unbearable lightness of being.

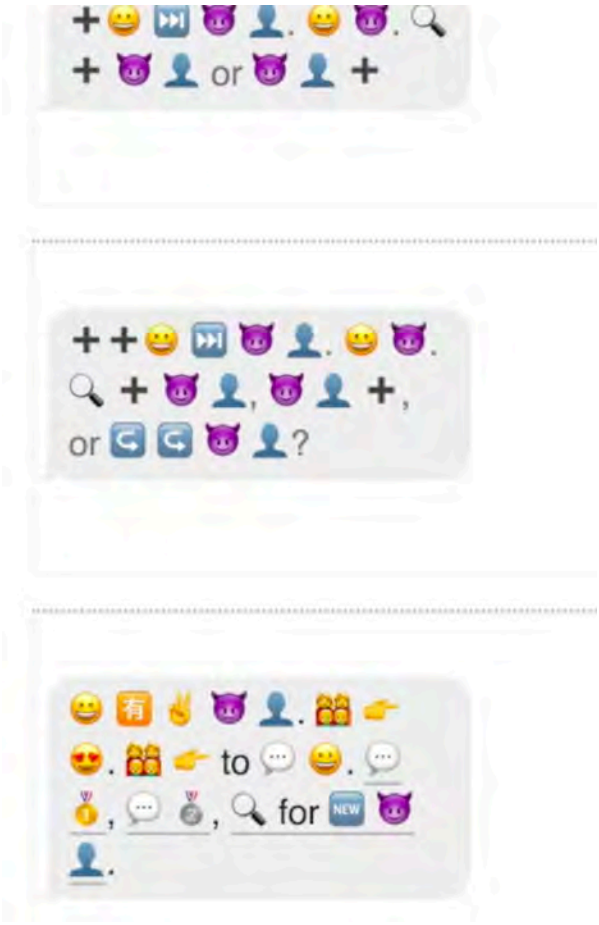


Figure 3. Two levels of the game's recursive selections and the pattern being broken.

Acknowledgements

This creative research was supported in part by the generous funding of the John S. and James L. Knight Foundation.

References

[1] Sicart, Miguel. "Newsgames: Theory and design." *International Conference on Entertainment Computing*. Springer, Berlin, Heidelberg, 2008.

[2] Cauberghe, Verolien, and Patrick De Pelsmacker. "Advergames." *Journal of advertising* 39.1 (2010): 5-18.

[3] Paper's Please, Lucas Pope. 2013. http://papersplea.se/

[4] Grace, Lindsay D. "A topographical study of persuasive play in digital games." *Proceeding of the 16th International Academic MindTrek Conference*. ACM, 2012

[5] Grace, L. "Discomfort design: Critical reflection through uncomfortable play, in proc 17th International Symposium on Electronic Art (ISEA2011)." *Istanbul Turkey* (2011).
[6] Bogost, Ian. "The rhetoric of video games." *The ecology of games: Connecting youth, games, and learning* (2008): 117-140.
[7] Grace, Lindsay. "Adapting games from literature: game verbs for player behavior." In *CHI'14 Extended Abstracts on Human Factors in Computing Systems*, pp. 423-426. ACM, 2014.
[8] Kundera, Milan. "The Unbearable Lightness of Being, trans." *Michael Henry Heim (New York, 1984)* 223 (1984).

Author Biography

Lindsay is Knight Chair of Interactive Media and an associate professor at the University of Miami School of Communication. He is Vice President for the Global Game Jam™ and Vice President of the Higher Education Video Game Alliance.

His work has received awards and recognition from the Games for Change Festival, the Digital Diversity Network, the Association of Computing Machinery's digital arts community, Black Enterprise and others. He authored or co-authored more than 50 papers, articles and book chapters on games since 2009. His creative work has been selected for showcase internationally including New York, Paris, Sao Paolo, Singapore, Chicago, Vancouver, Istanbul, and others. Lindsay curated or co-curated Blank Arcade, Smithsonian American Art Museum's SAAM Arcade, the Games for Change Civic and Social Impact program and others.

He has given talks at SXSW, the Game Developers Conference, Games for Change Festival, the Online News Association, the Society for News Design, and many other industry events.

Between 2013 and 2018 he was the founding director of the American University Game Lab and Studio in Washington, DC. From 2009 to 2013 he was the Armstrong Professor at Miami University's School of Art. Lindsay also served on the board for the Digital Games Research Association (DiGRA) between 2013-2015.

Colors For All : Immersive Narrative 360 Video for Color Blind Awareness

Eun Sun Chu, Jacqueline Gonzalez, Jinsil Hwaryoung Seo, Caleb Kicklighter
Texas A&M University
Texas, United States
chueunsony17@tamu.edu

Abstract

Colors for All is an immersive narrative VR project that allows participants to put themselves in a colorblind person's life through three 360-degree videos. The videos are from daily activities such as walking, shopping, and cooking that resonate different challenges from daily life. This project invites normal vision people to experience different types of color blindness and learn about daily challenges. We apply immersive VR narratives with the first-person perspective. The preliminary studies show that participants were very engaged with the project and felt empathy about people different difficulty conditions. We present the overall process of the project and user feedback in this paper.

Keywords

360 Video, immersive experience, narrative, color blindness, awareness

Introduction

Immersive virtual reality (VR) has shown to have many positive impacts on different areas including education, entertainment, and art: Students use VR to navigate historical sites from the comfort of their own classroom; a gamer plays a shooting game set in a virtual forest; an audience member watches a dance performance occurring live on a stage somewhere else in the world. According to Char Davies, immersion is "a quality of being spatially encompassed by being sensuously enveloped, as if by a lover or sea water or even the air itself pressing upon the skin" [1]. Frank Popper characterized immersion by "diminishing critical distance from what is shown and increasing emotional investment in what is happening" [2]. There are many elements that support immersive experiences. Our research focuses on the narrative aspects of immersion. JH Murray contends that all successful modes of storytelling eventually become transparent. In her view, immersion is the sensation of being surrounded by another reality that feeds our whole perception. She argues that narratives have a critical role in immersion [3].

We concentrate on utilizing immersive narrative as a tool for raising awareness of disabilities and inspiring positive actions. There is a growing immersive art community that explores different social and health issues in various populations using VR technology. The National Autistic Society (NAS) created a 360-degree VR video to encourage public understanding about autism [4]. Dialogue in the Dark is an exhibition which simulates for users the experience of being blind. In this work, people must move about and orient themselves in a darkened space [5]. Our own project, *Colors For All,* is a 360 immersive VR project that consists of three daily scenarios (driving, shopping, cooking) that present different color blind conditions to the user. This project allows normal color vision people to experience different types of color blindness and its impact on their everyday lives.

Colors for All: Project Description

Figure 1. A participant experiencing *Colors for All*

We built an immersive narrative that allows a viewer to put herself into the shoes of someone who struggles with color blindness. We first conducted foundational research about color blindness and incorporated stories from a person who is color blind. To make the experience fully immersed and present, we translated the experience into an interactive 360-degree video on the HTC VIVE platform.

Life with Color Blindness

Color blindness means a person has a reduced ability to distinguish between certain colors. People with color blindness have a difficult time registering changes between certain colors, typically shades of red, green, blue, or a mix of these colors. There are three types of color blindness: Deuteranopia (green deficiency), Protanopia (red deficiency), Tritanopia (blue deficiency) [6], [7]. Figure 2 presents 360 videos with these three types of color blindness.

Figure 2. Three types of color blindness in *Colors for All*

360 Video Production

To create these spherical videos, we used a Ricoh Theta S camera and attached it to a helmet to get first-person, point of view (POV) shots. Point of view shots are a useful technique for storytelling through video because they show what a character is directly looking at [8]. The scenarios in our project highlight the challenges colorblind people face in everyday life. Normally, color blind people have a hard time when they attempt to choose clothing, select between different fruits, read traffic lights,
or cook meat because of color-deficiency [9]. We chose three cases which can happen to color blind people in their daily life. The first scene has the viewer walking to a grocery store. The second scene shows the viewer choosing fruits in the grocery store. People with color blindness usually have to research online or ask a worker at the grocery store to help them select fruits and veggies. In the third scene, the viewer is at home, cooking meat on the stove. When cooking certain foods, people with color blindness often have to use a thermometer to make sure that it's the right temperature, rather than rely on the color changes in the food. We applied color filters to these videos to simulate three color blind conditions. We also added narrative stories that the user listens to when she interacts with our 360-degree immersive videos. Here are some excerpts from the stories.

> *Today, I'm going to the grocery store. I'm going to bring home some food to cook dinner tonight.*
> *Some color blind people have difficulties recognizing traffic signals. I usually remember the position of the red and green lights.*
> *When I go grocery shopping, I usually shop with a friend or ask someone for help. It's usually hard to pick ripe fruit. I learned that ripe apples are darker than unripe apples and that generally, ripe fruit feels softer than unripe fruit.*
> *Reading the labels and prices is helpful for me. It helps me choose some vegetables carefully.*
> *Sometimes, I have trouble choosing what kind of meat I want to cook.*
> *I'm also afraid of cooking meat. I can't tell if this meat is ready or not just by looking. So, I use the thermometer or my hands to check if the meat is cooked properly.*

After filming the videos, we stitched each footage together in Adobe After Effects. After Effects makes creating 360-degree videos with dynamic transitions and effects easy-to-use.

Figure 3. The Procedure of Video Production

360 Video Production

Colors for All was developed using Unity3D game engine and HTC Vive. A user can navigate and interact in the project using a VIVE head-mounted display and controllers. The four sides of the touchpad on one of these controllers were used to view four types of color blindness (Normal Vision, Deuteranopia, Protanopia, and Tritanopia)

(Figure 4). At any stage of the project, a user can press the touchpad to change their current view to another. Because both VIVE controllers are implemented with the same functionality, either a left-handed or right-handed person can use the application without any inconvenience.

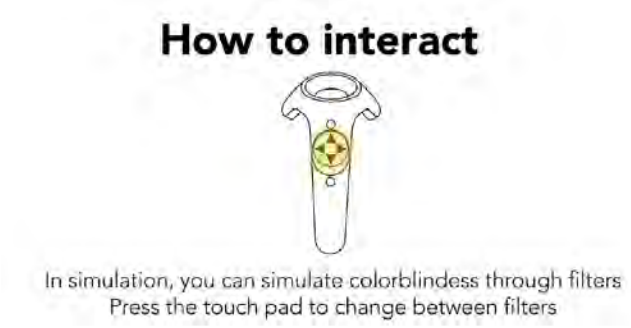


Figure 4. Touchpad interaction

Participant Feedback

We recruited 10 participants who do not have color blindness to experience *Colors for All*. Each session consists of three components: pre-study, immersive VR experience, and post-study. In the pre-study session, we asked their general understanding of VR and color blindness. During the VR experience session, participants were able to freely navigate the 360 immersive space. Once the main experience was over, each participant filled out a post-study questionnaire. Overall, the responses from the participants were very positive. Even though half of the participants did not have any VR experiences beforehand, they were able to easily navigate the stories and learn about different types of color blindness. All participants reported that the project was very engaging and they would like to recommend this project to their friends or family members. Some participants appreciated this opportunity because they would not have been able to experience life with color blindness without the Virtual Reality technology. They also felt empathy towards people with color blindness and felt they had a better understanding of the disability than before experiencing *Colors For All*. They also mentioned that the narration was very useful for following the stories and focusing on the visuals.

Conclusion and Future Work

In this paper, we presented our 360-degree video that is designed for users to experience how color blind people see the world. We found that immersive video can be a powerful tool for helping users think outside of themselves and sympathize with other people's experiences. Future work would include filming more unique scenarios of other disabilities and improving user interaction with the controllers and interface.

References

[1] Davies, C. (2005). Landscapes of Ephemeral Embrace: A Painter's Exploration of Immersive Virtual Space as a Medium for Transforming Perception. University of Plymouth, Plymouth, UK.
[2] Popper, F. (2007). From technological to virtual art. Cambridge, MA: MIT Press.
[3] Murray, J. H. (1997). Hamlet on the holodeck : the future of narrative in cyberspace. Cambridge, Mass.: MIT Press.
[4] Matt, Reynolds, "VR video lets you see the world through the eyes of an autistic boy," Wired, June 13, 2016, accessed January 9, 2019
[5] Dialogue in the Dark, accessed January 10, 2019, http://www.dialogue-in-the-dark.com/about/exhibition/
[6] Color Blindness, accessed January 6, 2019, https://en.wikipedia.org/wiki/Color_blindness
[7] Bansal, Yogender, Dalbir Singh, M. Sreenivas, Puneet Setia, and Vishal Garg. "Color blindness: forensic perspective." Journal of Indian Academy of Forensic Medicine. JIAFM 27, no. 1 (2005): 43-45.
[8] Point-of-view shot, accessed January 7, 2019, https://en.wikipedia.org/wiki/Point-of-view_shot
[9] Colour Blind Awareness, accessed January 8, 2019, http://www.colourblindawareness.org/colour-blindness/livingwith-colour-vision-deficiency/

.

Hong Kong's *Yellow Umbrella* (2014): A Prescient Political Game

James Shea
Department of Humanities & Creative Writing, Hong Kong Baptist University
Hong Kong, S.A.R.
james2shea@hkbu.edu.hk

Abstract

This paper examines the political game *Yellow Umbrella*, a free videogame created during the height of Hong Kong's Umbrella Movement in October 2014 in response to police aggression against pro-democracy protests. The game has been featured recently in an international exhibition (Game and Politics: 2017-2020). Created by Awesapp, a Hong Kong-based company, this work invites a critical reflection on the relationship between videogames, play, and "real time" violence. The game puts the player in the role of defensive protestors in the face of oppositional figures such as policemen with pepper spray, politicians, and gangsters. Reversing our expectation of games as playful and political action as non-playful, *Yellow Umbrella* posits protests as sites of play and videogames as political. The game ultimately instructs the player how the actual demonstrations would eventually conclude: in a peaceful manner without concessions by the central government. The paper also refers to the larger genre of digitalized "derivative works" known as "secondary creation" (二次創作). As Hong Kong's central government considers legislation to regulate "derivative works," this paper raises the concern that the creation of such works may be restricted or prohibited in the future.

Keywords

Hong Kong, Yellow Umbrella, videogame, play, politics, copyright, censorship, détournement, "secondary creation"

Hong Kong's Copyright (Amendment) Bill

In the wake of the 2014 Umbrella Movement and particularly in the past two years, Hong Kong has witnessed acts of self-censorship and restrictions on political speech, such as the abduction of booksellers in Hong Kong; a *Financial Times* journalist denied entry to Hong Kong; the cancellation (and reinstatement) of a Chinese novelist's talks at a government-funded arts and heritage complex; and the cancellation of an exhibition of comic artwork by a Chinese-Australian artist due to threats. [1] In the realm of new media, Hong Kong's central government has been keen to pass the Copyright (Amendment) Bill to "update" its copyright laws, including those that cover online parody. The law's purpose is "to revise outdated laws, prevent online piracy and keep the Copyright Ordinance up to speed with the fast-moving digital world and international standards." [2] What are the implications for digital games that "play" with source texts, such as digital *détournement*, if such forms are restricted or prohibited in Hong Kong? The bill lacks a clear exemption for "fair use" or "user-generated content," so, if the law passes, it may have a chilling effect on the creation of political games in Hong Kong, such as *Yellow Umbrella* (2014), which is the subject of this paper. *Yellow Umbrella* uses the likenesses of political figures such as LEUNG Chun-ying 梁振英, the former Chief Executive, and audio recordings of speech acts, including the phrase, "I will now recap in English" spoken by Steve HUI Chun-Tak 許鎮德, the chief superintendent at the public relations bureau of the Hong Kong Police during the protests, all of which may be viewed as potential copyright infringements. [3] The game itself is no longer available for downloading from the maker's website, even as other games on the site are readily available, inviting speculation that the maker decided to avoid further controversy. If a law such as the Copyright (Amendment) Bill were to pass, the creation of such works may no longer be legal, and free speech, especially political and artistic expression in the realm of *détournement*, would erode further. This paper considers the most important political game created during the Umbrella Movement in 2014 and situates the game as an example of digital *détournement* that relied heavily on "secondary creation" and prefigured the eventual failure of the movement only a few weeks later.

Yellow Umbrella (2014)

The "Umbrella Movement" refers to pro-democracy protests in Hong Kong during the fall of 2014. Informed partly by the worldwide Occupy movement, student groups engaged in street demonstrations and occupations of major thoroughfares. The protestors' central demand was a fairer electoral process ("genuine universal suffrage") for the

election of Hong Kong's Chief Executive in 2017. The police's use of pepper spray to disperse the protesters on September 28 "inspired thousands more people to take to the streets" in subsequent days. Umbrellas served both as a defensive measure against pepper spray during the protests and as a symbol of pro-democracy goals. The demonstrations ended peacefully in early December 2014 without any major concessions by the government. [4]

Figure 1. *Yellow Umbrella*, 2014, Awesapp Limited.

Yellow Umbrella is a video game created as a tool "for intervening in political discourse" during the height of the protests. (It was created over five days in mid-October 2014.) [5] Designed by 31-year old FUNG Kam-keung, CEO and founder of Awesapp Limited, "Yellow Umbrella" depicts a street scene in which student protesters cannot attack, but rather, can only defend themselves from "waves of police officers, triads, angry anti-Occupy protesters and even Chief Executive Leung Chun-ying himself" by "using umbrellas, incense sticks, and durian fruit." [6] [7] (Figure 1) According to Fung, "I wanted to make a game not only for fun but also to show our support to the students and to let others know that they are very peaceful in asking for real elections… After the tear gas, after the violence from gangsters and even police, I thought we needed to do more to show our support." [8] *Yellow Umbrella* arose from the police's use of pepper spray, and it spoke to the fear of protestors that more state violence may erupt, evoking memories of Tiananmen Square for many Hong Kongers.

It was downloaded over 40,000 times as of October 2014, shortly after it was released, however it is no longer available on app stores or the maker's website for download. [9] Repeated attempts to contact the game maker have not been successful. The author played this game by using the APK (Android Package) file for the game by way of Bluestacks, an emulator that allows mobile apps to be played on a Windows PC or Mac. [10] The game has been featured recently in an international exhibition called *Games and Politics* (2017-2020) sponsored by the Goethe-Institut in cooperation with the Center for Art and Media Karlsruhe (ZKM), and it has toured Mexico, U.S., Indonesia, Vietnam, Brazil, Singapore, Thailand, Malaysia, New Zealand, Spain, etc. In 2019 and 2020, it will tour over 10 more countries. Other political games showcased in this roving exhibition include *Madrid*, Gonzalo Frasca (2004); *Orwell*, Osmotic Studios (2016); *Papers, Please*, Lucas Pope, (2013); and *This War of Mine*, 11 bit studios (2014). [11]

Figure 2. Round 3, *Yellow Umbrella*, 2014, Awesapp Limited.

Figure 3. Guan Yu, *Yellow Umbrella*, 2014, Awesapp Limited.

Created in sympathy with the pro-democracy protestors, *Yellow Umbrella* consists of a single scene in which protestors fight against a barrage of policemen, politicians, taxi drivers, etc. (Figure 2) The seemingly all-male protestors behind the barricades include three young leaders of the pro-democracy movement from the actual demonstrations: Joshua Wong Chi-fung 黃之鋒, Alex CHOW Yong-kang 周永康, and Lester Shum 岑敖暉. On their side is also the deified Chinese general Guan Yu 關羽, who appears when incense is deployed by the protestors and says in Japanese, "Enemy officer, defeated!" (*Tekishō, uchitottari* 敵将、討ち取ったり!), an expression of victory used in the *Dynasty Warriors* videogame series, as he wipes out all of the opponents on the screen (Figure 3). Known for his bravery and loyalty, Guan Yu is a deity revered by both the police and gangsters in Hong Kong, however, in the game, he defends the protestors against both the attacking gangsters and police.

The pro-democracy characters are in a defensive posture, weaponless aside from comical tools, such as a birthday cake, durian, and money, which are linked to contemporaneous events. The birthday cake, for example, signifies the practice of protestors singing "Happy Birthday" when confronted with pro-Beijing demonstrators and when

the cake is used, a high-pitched, electronic "Happy Birthday" is heard. The stacks of money signify corruption and bribery, evoking the claim that blue ribbon counter-protestors were paid by pro-Beijing forces to appear at demonstrations, and the stack of gold labeled as 50 million HKD recalls charges that the Chief Executive received 50 million HKD from an Australian firm without disclosing it. The yellow ribbons, which can be accumulated for points and exchanged for defensive items, project a world in which freedom and democracy are equated with commerce in that the ribbons can be exchanged for items, and yet, they fall freely from the sky like rain and remain on the ground to be collected, a natural resource the player is welcome to use at anytime.

The attackers represent specific oppositional figures, including policemen using pepper spray; pro-Beijing lawmaker Leticia LEE See-yin 李偲嫣; blue ribbon protestors; a Triad gang member with a club, SWAT team members with tear gas, shields, and rifles; a man who brought a knife to the demonstrations claiming in an interview that it was because he likes to eat durian; a taxi cab (recalling how taxi drivers opposed the protests due to the effect on their business); a man with red crab-like hands, representing the owner of the restaurant Hee Kee Crab General 喜記蟹將軍 that opposed the Umbrella Movement; the former Chief Executive LEUNG Chun-ying (known as "The Wolf"), depicted as a wolf in a suit; and surveilling the action from inside an orange garbage can is LAU Kong-wah 劉江華, known as "Silent Lau Wah," a pro-Beijing politician appointed as undersecretary for constitution and mainland affairs and tasked with overseeing political reforms in Hong Kong.

Figure 4. Final Screen, *Yellow Umbrella*, 2014, Awesapp Limited.

Defensive items deployed on the street to block an attacker trigger an audio clip when the opponent touches it, such as, "I need to feed them. Come on!" spoken by the owner of the Hee Kee Crab General restaurant in an interview with a reporter about the demonstration's effect on supporting his family; and "I really like to eat fruit" (好鍾意食水果) spoken by the knife-wielding man to the media. The background music is the closing chords of "Boundless Oceans, Vast Skies" (海闊天空), a 1993 Cantonese rock ballad by the Hong Kong band Beyond—the song became the anthem of the protest movement. [12]

The player can replenish energy by simply clicking on the yellow number on the barricade, which begins at 689, indicating the number of votes by which C. Y. Leung won his election among a 1,200-member committee. In later rounds, the opponents come so quickly, that it becomes a challenge to keep one's energy level high and collect yellow ribbons. There is no discernable way to "win" the game, yet when the player's energy level reaches zero, no "Game Over" message appears either. Rather, the screen changes to a final statement in both English and Chinese: "This is not a revolution, we ask for democracy and peace. 這不是一場革命，我們尋求民主與和平！" It also invites the player to "share" the game on Facebook in order to "recover" or to "restart" the game (Figure 4).

A Double *Détournement*

This game offers no sustained triumph or detectable victory; rather, it provides only a sense of stasis or holding one's ground in the face of state aggression. Less bleak than *Every day the same dream* (2009) or *Passage* (2007), it ends with an invitation to share the game and a (hopeful) political demand. The game emphasizes a pacifist message, and its invitation to share the game suggests the desire for communal action. Interestingly, the game prefigures the endgame of the actual demonstrations in December 2014, when the government waited out the protestors and eventually broke up the occupied sites peacefully, with just a scattering of arrests. [13] The game gives the player a window into how the protests would be resolved: without concessions by the central government. *Yellow Umbrella* also can be read as a double *détournement*: it twists police aggression into a videogame format, thereby trivializing state violence and diminishing the status of the police force as a respected public entity, while at the same time, it reroutes the videogame experience itself to the unprecedented, mass public demonstrations, thus bringing the user into a confrontation with contemporaneous political action. *Yellow Umbrella* reverses our expectation of games as sites of play and political protests as non-playful. The game was also part of an urgent panoply of online activity during and after the Umbrella Movement that sought to critique Hong Kong's central government. This kind of collective activity often includes playful, creative works called "derivative works" or "secondary creation" (*yihchi chongjok* in Cantonese and *èrcì chuàngzuò* in Mandarin; 二次創作), including memes, rewritten song lyrics, subtitling videos, etc. commonly found in chatrooms. [14] Digital *détournement* is especially effective in Hong Kong, because Hong Kong's youth are savvy when it comes to new media. Repurposing digitalized texts happens quickly, increasing its appeal, and it is communal in nature, because the works are easily sharable. Yet, given Hong Kong's proposed amendment to its copyright laws, political games face an

uncertain future, despite Hong Kong's position as a site of videogame production. As Rolien Hoyng (2017) argues in regards to play as dissent in Hong Kong, "play is instrumentalised for "creative" economic production, yet… liberal protections of play are not guaranteed." [15] Similarly, Daniel Howe observes that the city's stark income inequality, "highest rents on the planet," closing music venues, and government leaders unaware of what is required to foster "creative industries" means that Hong Kong is constricting as a space for creative expression. [16]

References

1. Amy Qin, "Writer's invitation is pulled, and some ask if Hong Kong is still a refuge," *New York Times*, November 8, 2018, accessed December 19, 2018, https://www.nytimes.com/2018/11/08/world/asia/hong-kong-ma-jian
2. Jennifer Lo, "Furor intensifies over copyright bill," *Nikkei Asian Review Politics*, December 17, 2015, accessed January 5, 2019, http://asia.nikkei.com/Politics-Economy/Policy-Politics/Furor-intensifies-over-copyright-bill
3. Christy Leung, "Hong Kong police Facebook avatar and spokesman who found fame during Occupy Central leaving post," *South China Morning Post News Hong Kong*, November 30, 2015, accessed December 19, 2018, https://www.scmp.com/news/hong-kong/law-crime/article/1885203/no-more-recaps-hong-kong-police-spokesman-who-found-fame
4. Austin Ramzy, and Alan Wong, "Hong Kong's Umbrella Revolution: One year later," *New York Times*, September 25, 2015, accessed January 5, 2016, http://sinosphere.blogs.nytimes.com/2015/09/25/hong-kong-umbrella-revolution-anniversary/?_r=0
5. M.E. Roth, "At the Edge of a 'Digital Area': Locating Small-Scale Game Creation," *Asiascape: Digital Asia*, Vol. 02, No. 03, accessed December 18, 2018, https://doi.org/10.1163/22142312-12340030
6. Jonathan Kaiman, "Hong Kong protests inspire mobile game," *The Guardian*, July 4, 2014, accessed January 5, 2016, http://www.theguardian.com/world/2014/jul/04/hong-kong-protests-mobile-game
7. James Griffiths, "'Yellow Umbrella' video game tasks players with defending Occupy Central barricades," *South China Morning Post News Hong Kong*, October 22, 2014, accessed January 5, 2016, http://www.scmp.com/news/hong-kong/article/1622165/yellow-umbrella-video-game-tasks-players-defending-occupy-central
8. Aaron Tam, "Hong Kong's Umbrella Movement gets computer game makeover," *Business Insider*, October 25, 2014, accessed December 18, 2018, https://www.businessinsider.com/afp-hong-kongs-umbrella-movement-gets-computer-game-makeover-2014-10
9. Awesapp Limited, "Yellow Umbrella", accessed January 10, 2019, https://awesapp.com/
10. "Yellow Umbrella", APKPure.com, accessed December 16, 2018, https://apkpure.com/yellow-umbrella/com.awesapp.umbrella
11. "Games and Politics: 2017-2020", ZKM Center for Art and Media Karlsruhe website, accessed December 18, 2018, https://zkm.de/en/project/games-and-politics
12. Joyu Wang, "The story behind the Hong Kong protests' unofficial anthem," *The Wall Street Journal*, October 1, 2014, accessed December 18, 2018, https://blogs.wsj.com/chinarealtime/2014/10/01/the-story-behind-the-hong-kong-protests-unofficial-anthem/
13. "Police clear final Hong Kong protest site at Causeway Bay," *BBC News Asia*, December 14, 2014, accessed January 10, 2019, https://www.bbc.com/news/world-asia-30474687
14. Peter K. Yu, "Digital Copyright and the Parody Exception in Hong Kong: Accommodating the Needs and Interests of Internet Users", Journalism and Media Studies Centre (JMSC) of The University of Hong Kong website, accessed January 5, 2016, http://jmsc.hku.hk/revamp/wp-content/uploads/2014/01/jmsc_hku_submission.pdf
15. Rolien Hoyng, "Politics by Other Means: Post-Digital Gameplay in Hong Kong," *Javnost: The Public*, Vol. 24, No. 03, accessed December 18, 2018, https://www.tandfonline.com/doi/full/10.1080/13183222.2017.1306189
16. Daniel Howe, "You Have Pressure, I Have Pressure: Hacking, Art & Activism in Hong Kong," in *The Field Guide to Hacking*, ed. Michelle Poon and Mitch Altman (Hong Kong: Dim Sum Labs, 2018), 93.

Bibliography

1. Aarseth, Espen, "Genre Trouble: Narrativism and the Art of Simulation," in *First Person: New Media as Story, Performance, and Game*, ed. Noah Wardrip-Fruin and Pat Harrigan (Cambridge: MIT Press, 2004), 45-55.
2. Baudrillard, Jean, *The Gulf War Did Not Take Place* (Bloomington: Indiana University Press, 1995).
3. Bogost, Ian, *Unit Operations: An Approach to Videogame Criticism* (Cambridge and London: MIT Press, 2008).
4. Debord, Guy and Gil J. Wolman, "A User's Guide to *Détournement* (1956)," in *Situationist International Anthology*, ed. and trans. Ken Knabb (Berkeley: Bureau of Public Secrets, 1981), 14-21.
5. Dyer-Witheford, Nick and Greig de Peuter, *Games of Empire: Global Capitalism and Video Games* (Minneapolis: University of Minnesota, 2009).
6. Ensslin, Astrid, *Literary Gaming* (Cambridge: MIT Press, 2014).
7. Galloway, Alexander R., *Gaming: Essays on Algorithmic Culture* (Minneapolis: University of Minnesota Press, 2006).
8. Huizinga, Johan, *Homo Ludens: A Study of the Play Element in Culture* (London: Paladin, 1970).
9. Juul, Jesper, *Half-Real: Video Games between Real Rules and Fictional Worlds* (Cambridge, MA and London: MIT Press, 2005).
10. Schneider, Florian, "Searching for 'Digital Asia' in its Networks," *Asiascape: Digital Asia* 2, (2015): 57-92.
11. Schrank, Brian, *Avant-garde Videogames: Playing with Technoculture* (Cambridge and London: MIT Press, 2014).
12. Simanowski, Roberto, *Digital Art and Meaning: Reading Kinetic Poetry, Text Machines, Mapping Art, and Interactive Installations* (Minneapolis, MN: University of Minnesota Press, 2011).

Author Biography

James Shea is the author of two books of poetry, *The Lost Novel* and *Star in the Eye*, both from Fence Books. His poems have appeared in various publications, including *Boston Review, Colorado Review, Denver Quarterly, jubilat*, and *The New Census: An Anthology of Contemporary American Poetry*. His translations of Japanese and Chinese poetry have appeared in *Circumference, Gin'yu, The Image Hunter* (The Chinese University Press), and *The Iowa Review*. He has taught for the University of Chicago, Columbia College Chicago's MFA Program in Poetry, and as a poet-in-residence in the Chicago public schools. A former Fulbright Scholar in Hong Kong, he is an assistant professor in the Department of Humanities and Creative Writing at Hong Kong Baptist University.

Transcendence and Microbiopolitics: Art and biology as material speculation

Pérez-Bobadilla, Mariana

City University of Hong Kong
Hong Kong
maro.pebo@cityu.edu.hk

Abstract

Death, decay, and transcendence are transformed if interpreted from a microbial perspective. This paper constructs a non-anthropocentric approach on a microbial scale through the concept of microbiopolitics, an expanded notion of biopolitics with the inclusion of *zoe*, a postanthropocentric interpretation of ecological relations, focused on the life of microorganisms and introducing an ecological thought for the microbial planet. This research explores, in particular, the work of Latin American artists Ana Laura Cantera and Gilberto Esparza as a form of material speculation that opens up alternatives of thought grounded on the accountability of biological and technological matter, its limits and possibilities.

Keywords

Microbiopolitics, Art and biology, Posthuman, Bioart, Bacteria, New materialism.

Introduction

When microbial fuel cells light up, the continuity of energy -chemical and electrical- in a system becomes visible and the continuity of machine organization and biological metabolism is enacted. Through case studies from art and biology, this paper deals with works where a speculative imagination of life as *zoe* instead of *bios* is made present. Attention is displaced from the angst or desire around eternal human life from our finitude, displacing the *bios* from the human.

As a theoretical framework, this paper follows Rosi Braidotti in imagining life in a wider inclusive way as *zoe*.[1] Materially, it presents transdisciplinary art research as an exploration of life in a wider sense allowing for the speculative imagination of a microbial world, microbiopolitics grounded in the materiality of the artworks.

Decay is brought forth in the work of Ana Laura Cantera, who integrates the microbial fuel cells to an ephemeral process, researching ecological possibilities with a microbial perspective.

Ninhos de Equilíbrio by Ana Laura Cantera as decay and transformation.

Ninhos de Equilíbrio is an installation of mud sculptures as an intervention on the landscape. The small structures are built with biodegrading materials found in the place of the installation and look similar to the termite mounds in the landscape, among which they camouflage almost perfectly. Termite mounds are abundant in the hills of the Paraiba Valley in Brazil where the work was installed. Called "nests" because of the word for termite mound in Portuguese and Spanish, the small domes are meant as a dwelling space. These sculptures or "nests" are also biodegradable mud bacterial fuel cells, their structure is built with clay mud, cane leaves, and water from the river. Inside they house bioplastic capsules containing local mud with organic waste in decomposition which allows the flow of energy from bacterial metabolism. This process channels the energy that illuminates the interior with an LED—a tiny luminous sign of the life within the structure—which shines during a short lifespan before the nest disintegrates.

Ana Laura Cantera, an Argentine artist developed this project in 2014 as part of an artistic residence in the rural area of the Paraiba Valley, a region in the eastern part of the state of São Paulo, Brazil.

Figure 1. Ana Laura Cantera, *Ninho de Equilíbrio* [*Balance Nests*], 2015. Courtesy of the Artist.

In *Ninhos de Equilíbrio*, decay occurs in two levels. The first is the transformation of chemical energy within organic matter into electric energy made visible through the light. The second is the biodegradable structure, meant to be ephemeral and dissolve into the landscape.

Cantera's work frames microorganisms as agents for the transformation of energy in microbial fuel cells and in the process of degradation, and it renders the reactions in the ecosystem visible. Microorganisms are present as a tool that releases and conducts electrons to turn on a light; but bacteria are also represented at the base of the ecosystem, in the degradation of organic matter. The processes that take place in this work lie in the continuum nature-culture. The human-made mounds display the energy of the matter and the presence of microbial life, which disintegrate into the landscape again as part of a greater transformation.

A previous project, which informed *Ninhos de Equilíbrio,* is Gilberto Esparza's *Nomadic Plants*. This five-year long project was developed between 2008 and 2013 and explores the ecosystemic relations within machine-microbial entanglement.

Gilberto Esparza's *Nomadic Plants* as figurations of the microbial posthuman

Nomadic Plants is a hybrid creature intended to relate to the polluted water of a river by "feeding" itself with its water high in organic waste. Through the work of bacteria within the microbial fuel cells (also known as MFCs) that make up the body of *Nomadic Plants*, electrons can be harvested as a by-product to be used as the energy source for the creature. This process also purifies the water collected, which is then repurposed for the plants that inhabit the hybrid organism and make it a habitat for other species like ants.

Figure 2. Gilberto Esparza, *Nomadic Plants*, 2008-2013. Displayed at Laboratorio Arte Alameda, Mexico City. Courtesy of the artist.

In this work by Gilberto Esparza, notions of decay, death, and transcendence are present in the graphic narrative that supplements the installation (Figure 3). In the border of fiction and actuality, the story was designed as a comic for the book *Cultivos* [13]. The narration begins when in 1945 the Lerma River—which is a major supplier of water to Mexico City and the Valley of Mexico—becomes a dumping site for private and industrial waste, as well as drainage from Mexico City. As industries keep growing and developing, the river's fauna starts to die en masse. The heavily polluted water also causes the river to catch on fire. As a result, new species of artificial and biological life appear.

Nomadic Plants, the artwork and main character of this story, is a symbiont of local plants, bacteria, and a machine. The creature lives from the polluted water thanks to its symbiosis with bacteria within its microbial fuel cells. At night, the organism utilizes the surplus of energy generated throughout the day to produce sound. The clean water welcomes other species to cohabitate on the its structure. When the environment finally changes and the river is restored, the creature can no longer feed on wastewater and dies. In this narrative, a Mexican cypress grows on the robot's corpse. Decay and death in *Nomadic Plants* is the sign of life for the river and other plants.

A common misinterpretation of Esparza's work [14] is the idea that microbial fuel cells could solve the water pollution problem of Mexican rivers and that, therefore, no

difference in the current ecological relations would be necessary. However, what Esparza's collection of microbial and organic matter within MFCs points to is actually a postanthropocentric view on our relationship to water. The project also makes visible a specific ecological condition: it imagines the life of machines and presents death in a diversity of perspectives— the death of rivers, the symbiosis of microorganisms, machines, and plants without the presence of humans, and the death of *Nomadic Plants* itself.

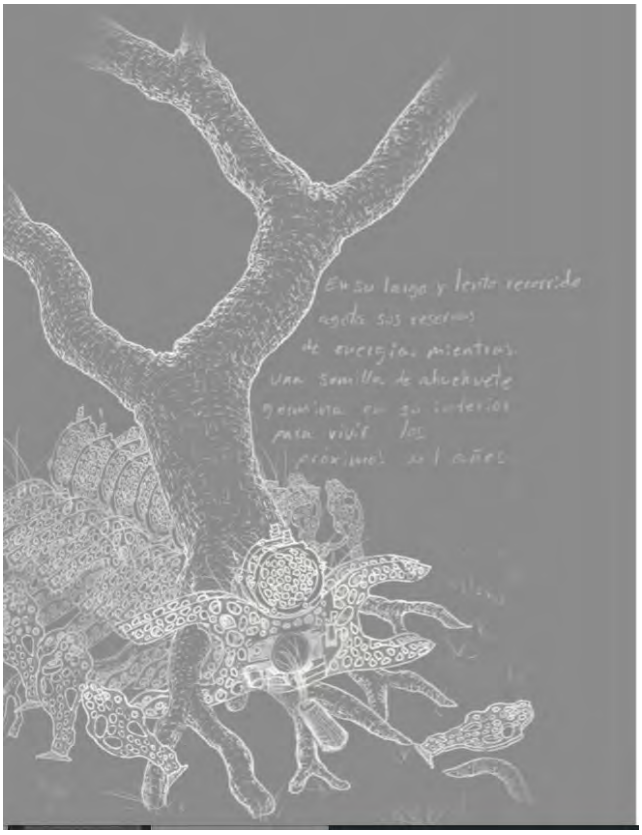


Figure 3. "In its long and slow journey, it exhausts its reserves of energy. Meanwhile, a seed of *Ahuhuete* [Mexican cypress] germinates inside it to live for a thousand years." Gilberto Esparza, Illustration from *Nomadic Plants*' Story, *Cultivos*, 2014. Courtesy of the artist.

Nomadic Plants has been interpreted in their environmental and political stand within the Latin American context [16][17]. In this article, however, I would like to focus instead on how microbiopolitics is also related to an alternative view of life. *Nomadic Plants*, in a condition where rivers are no longer polluted, dies and allows its plants to take over. Again, in this fictional narrative about the work, death and decay are the possibility for other life forms to take over.

These two artworks, *Ninhos de Equilíbrio* and *Nomadic Plants*, allow us to re-think *bios* understood in a wider way beyond human life, and, particularly, in the postanthropocentric turn it can bring in what I call the microbial posthuman.

Microbial Posthuman

The core proposal to begin thinking postantrhopocentrically through microorganisms, in this case about decay and transcendence, has to be contextualized in the convergence of posthuman and postanthropocentric thought and, specifically, within feminist research.

Among the many possible ways the posthuman has been defined, I subscribe to a tradition of feminist posthuman thought, specifically in the non-essentialist cyborg described by Donna Haraway [4], in Rosi Braidotti's notion of the condition of 'human' or 'man' as a prerogative of privileged, white males that needs to be questioned [5], and in Karen Barad's Agential Realism [6], which interprets the relation of matter and meaning beyond anthropocentric limitations, establishing non-hierarchical relations among species and understanding humans among other physical systems as part of "natural" processes. A more recent approach to the posthuman is also found in the fungal critiques to capitalism by Anna Tsing [7]. Among all these feminist posthuman positions, my microbial posthuman builds on the biological materiality of microorganisms as the minimal form of life to challenge human exceptionalism.

Within this cartography, the microbial perspective adds a layer to the posthuman. In several levels, microorganisms challenge anthropocentric epistemologies and our understanding of what life is. Starting from the familiar ground of the human body, the microbiome is a first step in acknowledging the fundamental need of bacteria and other microorganisms for the possibility of any form of macroscopic life, including, of course, animal and human life.

Second, instead of understanding individual humans as unitary discrete entities, the microbiome challenges our concept of self [8]. Tobias Rees portrays humans as a dynamic, constantly transforming interacting community of animal and microbial cells. Rees deals with the three main elements that are thought to constitute the basis of an individual human self—the immune systems, the brain, and the genome system—to describe how they are deeply affected by and entangled with microorganisms. The self

and individuality of humans, therefore, is set in question by microorganisms.

Third, the predecessors of all forms of life are microbial. Human identity, besides its necessary relation to microorganisms and its bacterial origin, is also entangled deeper by the endosymbiotic origin of plant and animal cells. The fourth element of the microbial posthuman stems from what Lynn Margulis described in 1967 [9]: the bacterial origin of the mitochondrion, the organelle in charge of energy metabolism in the cell, which was originally a bacteria engulfed by a bigger microbial cell. Mitochondria keep their own genome independent from the nucleus. An equivalent case is that of cyanobacteria engulfed by chloroplasts in plant cells, pointing at a deep entanglement into what we now often understand as independent species.

Fifth, microorganisms also question notions of individuality by performing multicellular behavior such as cell differentiation, communication, and apoptosis [10]. These are also signs of organization and cognition in microbial forms of life.

The interest in observing microbial organization and microorganisms as life, as the expanded *bios* or *zoe* is also present in the emphasis on a microbial planet,[11] a view from microbiology inviting to consider microorganisms not anthropocentrically—that is as pathogens or those directly involved in food production—but in its wide diversity and omnipresence.

The microbial posthuman is a perspective underlying the work of Ana Laura Cantera and Gilberto Esparza as a postanthropocentric approach to ecosystems, particularly, as a machine, plant, and bacterial intra-action. Sustained on microbiome research, the microbial origin of life, and in endosymbiosis as part of a project to reimagine microbiopolitics, ecology beyond speciesism and beyond a capitalist distribution of pain, death, and life.

Microbiopolitics

The interpretative notion I want to introduce in this paper departs from Heather Paxon's "Microbioplitics" [12] as the anthropocentric measures, politics, and policies in relation to microorganisms. Paxon's concept is already a crucial step in acknowledging the fundamental role of microorganisms in human lives. It is centered in food and also highly focused on the human experience of microorganisms in disease and nourishment. Beyond acknowledging an entanglement with microorganisms or their relevance for human life, microbiopolitics can give a postanthropocentic perspective in the categorization and management of life. This transformation in relations and structures of subjectivity stems from the concept of *zoe*. *Zoe*, is a wider notion of life [5] that includes all forms of life–starting with microorganisms–not centering the debate around human life only.

Microbiopolitics, therefore, is the concept I am reworking to underscore the transformation in relations and structures of subjectivity when a broader, microbial notion of life or *zoe* is the framework to map the distribution of pain, life, and death. What these artworks research and the way microbiopolitics, therefore, has an important posthuman turn inspired by Rosi Braidotti [5] expanding the notion of life with the inclusion of *zoe*, a non-anthropocentric interpretation of ecological relations when life is understood as its minimum condition in microorganisms.

The microbial fuel cells in the work of Ana Laura Cantera and Gilberto Esparza, are the material imagination and case studies for this expanded notion of life, the place for research on the possibility of microbiopolitics and its ecosystemic implications.

The use of MFCs as an artistic medium offers the possibility of thinking of life as a network of chemical reactions, a nanoscale organization in continuity with other larger scale mechanisms. Many artists including Mick Lorusso, Laura Beloff, Carlos Castellanos, and Insterspecifcs have explored MFCs as an artistic medium, using living microorganisms not only as the physical medium of the artwork but also as the source of power, data, and discursive focus. MFCs transform chemical energy from organic compounds into electric energy by completing a metabolic process of oxidizing organic matter [2]. Endosymbiosis, as theorized by Margulis [3] describes the physiology of animal cells only possible after the engulfment of a bacteria, in an a bigger cell. The mitochondrion, a previously independent bacterium, functions as a 'power plant'. Similarly, bacteria of the genus *Geobacter* perform as the cyborg symbiont of the microbial fuel cells, as they release electrons then collected and expressed as light or as data. In this way, microbial fuel cells as an artistic medium allow for the speculation and material presence of posthuman symbiosis. Moreover, by metabolizing organic waste microbial fuel cells relate to decay more specifically; it is in the degradation of organic matter that electrons are released and it is from muds and "dirty" waters that the new light in these artworks emerges from.

Art as Material Speculation

I build upon Alfred North Whitehead's concept of "imaginative generalization as 'the play of a free imagination controlled by the requirements of coherence and logic'"[15]. As the opening up of possibilities of thought, without losing the capacity to act in the present, I am interested, firstly, in the power of imagination to propose and transform the present, particularly in the form of propositions of post-anthropocentric approaches about decay and death. I am thinking of art as speculation, but not speculation as a groundless or uninformed conclusion, but as an acknowledgment of the impossibility of complete information. Speculation and imaginative generation in Whitehead's thought are, therefore, useful concepts to understand the double operation of opening up of possibilities in fictions and in setting up limits in the operation of thought, as I argue, material and situated. The speculation in the works I present here is about the distribution of life and death. Perhaps, more relevant themes where bacteria challenge our notions of death are the altruist apoptosis or the spore stages that I will not develop in this paper.

Closing remarks

From a microbiopolitical perspective, life, death, decay are displaced. In the death process of the *Ninhos de Equilíbrio*, as in the decay process of other bodies, microorganisms thrive. Ana Laura Cantera's installation lights up with the electrons released by the decomposition of the organic elements that constitute the nests, framing microorganisms and making them visible to humans as light. As they dissolve, *Ninhos de Equilíbrio* portray decay as transcendence of life beyond the human-centred *bios*.

In Gilberto Esparza's *Nomadic Plants*, the speculative imagination is that of death as a possibility of a new start for water and for other species, granting protagonism to water and non-human forms of life. These cases deal with how reestablishing our cartographies of power relationships into the wider notions that open up in microbiopolitcs, the concepts of the self or of individuality are modified, as well as that of decay and death. The use of microbial fuel cells as an artistic medium, besides its implications of collaboration, and grant visibility to microorganisms, is also a form of portraying decay as transformation, as life in continuity, as energy transforming, and therefore as transcendence.

The material grounding is artworks of art and biology from Latin America giving a non-anthropocentric reading on ecological relations, focused in the life of microorganisms. In their situated knowledge, these works were produced as an answer to the specific condition of water and ecosystems in Latin America. In them, microorganisms are visible in art as joyful acts of insurrection that allow for a particular, less naive ecological thought, a microbiopolitics, thinking biological matter and on the other of a biopolitics expanded by the inclusion of *zoe*, that more than a superficial "green attitude", introduces an ecological thought for the microbial posthuman.

References

[1] Rosi Braidotti, 'Biomacht und nekro–Politik. Uberlegungen zu einer Ethik der Nachhaltigkeit' (Bio–Power and Necro–Politics), *Springerin, Hefte fur Gegenwartskunst*, (2007), 2, pp 18–23.

[2] Bruce E. Logan, 'Exoelectrogenic bacteria that power microbial fuel cells', *Nature Reviews Microbiology*, (2009) 7, pp. 375-381.

[3] Lynn Sagan/Margulis 'On the origin of mitosing cells', *Journal of Theoretical Biology,* (1967), 14:3, pp.225-274.

[4] Donna Haraway, "A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century", in *Simians, Cyborgs, and Women: The Reinvention of Nature,* (New York: Routledge, 1991), pp. 149–81.

[5] Braidotti, *The posthuman*. (Oxford: Polity Press, 2013) p.65.

[6] Karen Michelle (Barad 2007), 2007).

[7] Tsing, Anna Lowenhaupt, T*he Mushroom at the end of the world: on the possibility of life in capitalist ruins* (Princeton and Oxford: Princeton University Press, 2015)

[8] Rees T, Bosch T, Douglas AE ´How the microbiome challenges our concept of self.´ *PLoS Biol* (2018) 16(2): e2005358. https://doi.org/10.1371/journal.pbio.2005358

[9] Lynn Margulis on endosymbiosis.

[10] Roberto Kolter and Scott Chimileski, 'The end of microbiology', *Environmental Microbiology,* (2018) 20:6, https://doi.org/10.1111/1462-2920.14240. Accessed 2 November 2018.

[11]McFall-Ngai, Margaret, Hadfield, Michael G., Bosch, Thomas C. G., Carey, Hannah V., Domazet-Lošo, Tomislav, Douglas, Angela E., Dubilier, Nicole, Eberl, Gerard, Fukami, Tadashi, Gilbert, Scott F., Hentschel, Ute, King, Nicole, Kjelleberg, Staffan, Knoll, Andrew H., Kremer, Natacha, Mazmanian, Sarkis K., Metcalf, Jessica L., Nealson, Kenneth, Pierce, Naomi E., Rawls, John F., Reid, Ann, Ruby, Edward G., Rumpho, Mary, Sanders, Jon G., Tautz, Diethard and

Wernegreen, Jennifer J. (2013),ʻAnimals in a bacterial world, a new imperative for the life science' *PNAS*, 110:9, pp.3229-3236.
[12] Paxson, Heather, ʻPost-Pasteurian Cultures: The Microbiopolitics of Raw-Milk Cheese in the United States', *Cultural Anthropology* (2008), 23:1.
[13] Gilberto Esparza, et.al. *Cultivos*. (Mexico: CONACULTA, 2014).
[14] Interview with Gilberto Esparza, San Miguel de Allende, January 2018.
[15] Alfred North Whitehead, *Process and reality: an essay in cosmology*, (New York: Free Press, (1978).
[16] T. J. Demos, *Decolonizing nature: contemporary art and the politics of ecology. (*Berlin: Sternberg Press, 2016).
[17]María Fernández, ed. *Latin American Modernisms and Technology*, (Cornell Institute for Comparative Modernities, ICM :Africa World Press, 2018)

Bibliography

Barad, Karen Michelle. 2007. Meeting the Universe Halfway. Durham: Duke University Press.
Braidotti, Rosi. 2007. 'Biomacht und nekro–Politik. Uberlegungen zu einer Ethik der Nachhaltigkeit' (Bio–Power and Necro–Politics), Springerin, Hefte fur Gegenwartskunst, 2, pp 18–23.
Braidotti, Rosi. 2013. The posthuman. Oxford: Polity Press.
Braidotti, Rosi .2015. ʻPunk women and riot grrls', Performance Philosophy, 1.
Braidotti, Rosi . 2018. 'A Theoretical Framework for the Critical Posthumanities', Special Issue: Transversal Posthumanities, Theory, Culture & Society, https://doi.org/10.1177/0263276418771486. Accessed 2 November 2018.
Demos, T. J. *Decolonizing nature: contemporary art and the politics of ecology. (*Berlin: Sternberg Press, 2016).
Esparza, Gilberto, et.al. *Cultivos*. (Mexico: CONACULTA, 2014).
Fernández María, ed. *Latin American Modernisms and Technology*, (Cornell Institute for Comparative Modernities, ICM :Africa World Press, 2018)
Foucault, Michel (2008), The Birth of Biopolitics: Lectures at the Collège De France 1978-79, (ed. M. Senellart, trans. G. Burchell), Basingstoke: Palgrave Macmillan.
Haraway, Donna (1991), 'A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century', Simians, Cyborgs, and Women: The Reinvention of Nature, New York: Routledge, pp. 149–81.
Kolter, Roberto and Chimileski, Scott , ʻThe end of microbiology', Environmental Microbiology, (2018) 20:6, https://doi.org/10.1111/1462-2920.14240. Accessed 2 November 2018.
Logan, ʻExoelectrogenic bacteria that power microbial fuel cells', *Nature Reviews Microbiology*, (2009) 7, pp. 375-381.
McFall-Ngai, Margaret, Hadfield, Michael G., Bosch, Thomas C. G., Carey, Hannah V., Domazet-Lošo, Tomislav, Douglas, Angela E., Dubilier, Nicole, Eberl, Gerard, Fukami, Tadashi, Gilbert, Scott F., Hentschel, Ute, King, Nicole, Kjelleberg, Staffan, Knoll, Andrew H., Kremer, Natacha, Mazmanian, Sarkis K., Metcalf, Jessica L., Nealson, Kenneth, Pierce, Naomi E., Rawls, John F., Reid, Ann, Ruby, Edward G., Rumpho, Mary, Sanders, Jon G., Tautz, Diethard and Wernegreen, Jennifer J. (2013),ʻAnimals in a bacterial world, a new imperative for the life science' *PNAS*, 110:9, pp.3229-3236.
Paxson, Heather (2008), ʻPost-Pasteurian Cultures: The Microbiopolitics of Raw-Milk Cheese in the United States', Cultural Anthropology 23:1.
Rees T, Bosch T, Douglas AE ´How the microbiome challenges our concept of self.´ *PLoS Biol* (2018) 16(2): e2005358. https://doi.org/10.1371/journal.pbio.2005358
Weiss MC, Preiner M, Xavier JC, Zimorski V, Martin WF The last universal common ancestor between ancient Earth chemistry and the onset of genetics. *PLoS Genet* (2018) 14(8): e1007518. https://doi.org/10.1371/journal.pgen.1007518
Whitehead, Alfred North, (1978), Process and reality: an essay in cosmology, New York: Free Press.

Author Biography

Mariana Pérez Bobadilla is an Art Historian specialized in the intersections of art, science, and technology, particularly in the Mexican media art scene. She received an Erasmus Mundus Scholarship to study a master in Gender Studies at the University of Bologna, Italy, researching Feminist Epistemology and Contemporary Art. She has presented her work at ISEA, EVA, ISCMA, the Ammerman Symposium of Art and Science, and has been involved in the Mexican Pavilion of the 56th Venice Biennale. Her academic training includes courses with Rosi Braidotti, and the international curators' course of the 2014 Gwangju Art Biennale, in South Korea. Awarded by the Hong Kong Ph.D. Fellowship Scheme, her research in the School of Creative Media revolves around art and biology, epistemology, history of science, new materialism, biohacking, wetware, and bacteria.

Memoirs of the Blind: surveillance, speed, and interaction

Tomas Laurenzo
School of Creative Media – City University of Hong Kong
Hong Kong
tomas@laurenzo.net

Abstract

This paper presents the interactive installation Memoirs of the Blind, using it to reflect on the impact of surveillance technologies in contemporary and future society. The installation consists of an acrylic box containing a screen showing a desaturated face with its eyes closed.
When the visitor blinks, the installation detects it and photographs them at the exact time of blinking, replacing the face displayed with the new photograph. The artwork subverts the subject-object relationship between itself and its visitors, while reflecting on our relationship with technology, providing a contemplative reflection on its aesthetics.
The paper discusses our relationship with automated surveillance, and the impact of the difference between machine time and human time exploring the role that artistic production can play in the analysis of contemporary socio-political issues.

Keywords

Interaction, blinking, surveillance, computer vision.

Introduction

"The task of a philosophy of photography is to reflect upon this possibility of freedom –and thus its significance– in a world dominated by apparatuses." Vilém Flusser. [1]

Memoirs of the Blind is an interactive installation, part of an on-going series of artworks that explore spatial augmented reality, non-verbal communication, and their relationship with interactive technologies and new media art, focusing on their socio-political impact.

The presented artwork aims at reflecting on these subjects as well as at exploring the poetics of digital manipulation of our relationship with physical space.

Even if the relationship between art and politics has always been a contentious one, in spite of the self-evident impact of the political context in artistic production, the creation of art (regardless of a 'new materialistic' setup) is able to offer orthogonal constructions able to escape the dichotomy of policy-making vs social analysis. This research proposes a contemplative ontological strafe that reclaims the sensible as a cognitive tool with which we can, if not better comprehend reality, at least understand it differently.

The piece

Memoirs of the Blind (Figure 2) is an interactive installation consisting of a screen showing a black-and-white picture of a face with its eyes closed. This image at first remains still, however, when the interactor blinks, the installation detects it and takes a photo at the exact time of the blinking. Once the new face is obtained, it is processed (cropped, desaturated, and adjusted), the installation then substitutes the displayed face with the new one.

This way, the artwork becomes a testimony of its visitors interacting with it, but not seeing it, captured in a moment where the visitor becomes at the same time subject and object of the artwork.

The piece reflects on the power asymmetries that technology crystallises, providing a contemplative reflection on the aesthetics of our relationship with it, while simultaneously showcasing the advancements in computer vision that allow for supra-human abilities. In effect, the piece highlights the differences between what Paul Virilio called "metabolic speed"–the speed of the living being–and "technological speed", the artificial speed of machines.

Implementation

The installation comprises an Apple iPad Pro (2018) together with an acrylic laser-cut case.

Using Apple's computer vision API, the installation is able not only to track the face in low illumination conditions but also to track the users' eyes and detect their blinking.
The software, after the interactor has being tracked for a random-length short interval, enters into blink-detection mode. When a blink is detected, the piece extracts a bitmap corresponding to the user's face, desaturates it and further processes it. It then substitutes the existing face.

Art as research

Arts-inflected research has proved being very successful in creating design alternatives, with artists not only contributing at keeping things culturally relevant but also offering original approaches that expand the scope of existing analysis [2].

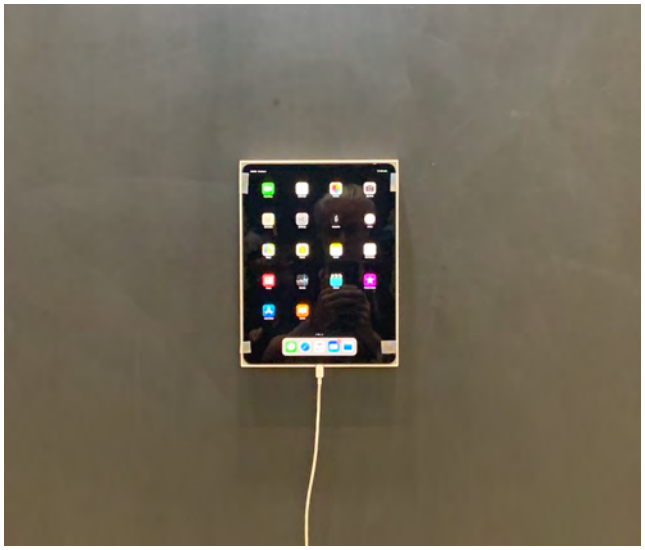


Figure 1. The piece runs on an Apple iPad

This approach is particularly valuable in the context of *Memoirs of the Blind* for it simultaneously offers axes of theoretical exploration in both the technological aspects and their social impact.

In effect, new media art allows researchers to escape the re-creation of existing forms of human-computer interaction, allowing to taking advantage of the complexity and expressiveness of technology as a new medium [3].

If new interaction schemas are capable of affecting users' life, it follows the soundness of reflecting on what design strategies permit a better understanding of the possibilities of augmented environments? What are their aesthetic possibilities and constrains?

Memoirs of the Blind offers an alternative approach to investigating these questions, focusing on interactivity underlying phenomenology. It instantiates the digital realm in the crystallization of our helplessness with respect to the contemporary ubiquitous exposure to digitality. By making explicit the communication between an architectonic space and its users, it allows for a reclaiming of the underlying artistic and interaction languages.

This phenomenon (the construction of an artistic language from a making-explicit) appears systematically in new media art (with interaction, randomness, politics, etc. being made explicit and thus becoming part of a new, original artistic language) [4]. In Traces, it is in this aesthetic reclaiming that we can start searching for different modes of relation between ourselves, the spaces we inhabit, and the technologies that form part of those spaces.

Figure 2 Two pictures of *Memoirs of the Blind*

This explicitation brings into the conversation phenomenological aspects otherwise hidden that may play a fundamental role in our understanding of the involved technology and on our analysis of their potential success.

Picture 8 For example, *Memoirs of the Blind* directly makes explicit, and therefore reflects on, the differences between machine time and human time; what Paul Virilio called "metabolic speed"–the speed of the living being–and "technological speed", the artificial speed of machines. [5]

In Virilio's terms, *Memoirs of the Blind* is a dromological piece, or, better put, it's explicitly dromological.

The interactor blinks and is momentarily blind. We all blink and experience an imperceptible moment of blindness that is imperceptible for it is too short for the metabolic speed. The piece's explicitation brings this into its language, the blindness becomes relevant in the technological speed, with the piece bringing this otherwise invisible reality into light.

But in the rhetorical fictions of the computer, speed brings something else: a future not only more fully integrated with technology, but a promise to recover precisely that which had been destroyed by modernity in the first

place. Claims are made for the recuperation of community, self, political space, precision craft, and local identity. – Stan Allen. [6]

There is, however, an ontological difference between what we have evolved to perceive as the human universe, the universe which directly interacts with us, a universe that exists in human time, at human speed, and the universe that exists at technological speed.

The machine-speed universe exists in a new metaphysical realm, which allows for a trans-humanity resulting from the translation of the metabolic speed into an inherently non-human universe. The machine-universe does not offer a meta-humanity vantage point but instead constructs a "parallel humanity" where what defines us is stripped of its humanity.

This ontological fracture, however, is not absolute: the technical-speed-universe resonates with ours; while only obeying its internal rules, it reflectively mimics the human realm, hubristically void of purpose.

This clash between human and non-human is fractally present in the artwork, and the mimicry surfaces in the piece's interaction design.

It is here, perhaps, where the most interesting aspects of the piece reside. The work reminds us that the very concept of interaction is always anthropocentric. There is interaction only because there are humans. We create a virtual space not by the manipulation of atoms but by a conceptual labelling. Again, an ontological metamorphosis that is emulated by the piece.

This labelling, however, is bidirectional. What makes us humans is our labelling gaze, the anthropomorphisation of the universe. The piece makes this explicit, the interaction allowing the physical object to communicate it back to us.

What does, then, the piece grant us? Who are we that now exist under its gaze? *Memoirs of the Blind* creates a mirror that is not a mirror. If a mirror exists when we look at ourselves, the piece instead offers an anti-mirror, a reflection of blindness, a subversion of the subject-object relationship. It reminds us that we are fragile, helpless, when we are seen by our creation, yet blind to it.

And this is not a metaphor but a direct recreation of all human activity. The social structure that we call culture, automatically becomes invisible when we, unfailingly, interiorise it as a natural order. Every instantiation of applied scientific knowledge creates a new world where the power asymmetries it introduced are self-replicated.

We, then, propose a reflection on this and on its constant evolution. The piece aims at reclaiming the poetics of these relationships: if we are doomed to be oppressed by our creations, it becomes fundamental to understand the aesthetic components of this oppression.

Artistic surveillance

Art is intrinsically deregulatory for it exists on its own epistemological framework, on its own ontological universe. Art that appropriates scientific and technological processes stands on an advantageous situation, with a unique position to reflect on contemporary political issues.

New media art, then, is able to explore the relationship between art, technology, and politics, subverting existing canons, simultaneously expanding the poetic dimension of technology while hinting potential alternatives.

If we are to explore the political significance of new media art, we should frame it in terms of the general intellect. That is, the cognitive faculties common to the species, which constitutes a new kind of richness: *cognitive wealth* [7] arising from the cognitive dimensions of labour.

It is no accident that new media art co-exists with cognitive capitalism: both are result of the valorisation of knowledge. What capitalism does in terms of commoditization, art does in terms of re-definition and re-edition of its own praxis, and it is in this duality where the dialectal relationship new media art–politics exists: in the orthogonal (if not antagonistic) approaches to knowledge creation and societal administration.

Conclusions

The paper presents an interactive installation that, using blink-detection, proposes a contemplative philosophical reflection on our relationship with technology and physical space.

In particular, the piece investigates the power relationships between technology and its users.

The paper also holds that artistic research can provide new perspectives on technological and social developments. In Wyndom Lewis words (quoted by Marshall McLuhan) the artist is "engaged in writing a detailed history of the future because he is the only person aware of the nature of the present" [8].

As mentioned, the relationship of art and politics has always been complex. On one hand, Kenning argued that art betrays itself if it is too direct in its opinion, especially in its political opinion, while Rancière stated that "an art is emancipated and emancipating when it renounces the authority of the imposed message, the target audience, and the univocal mode of explicating the world, when, in other words, it stops wanting to emancipate us." [9]

If politics refers to large global structures that imply cultural or symbolic power in knowledge practices García Canclini, 2007, #11813, it is then a problematic field, and we need tools that allow for an informed reflection.

Moreover, as Emile Devereaux puts it some works, like Derrida's "extend the framework of the symbolic and destabilize spatial locations through demonstrating the postal principle" (how a letter may not arrive to its destination). Our proposal, whose title is inspired ion Derrida's book "Memoirs of the blind: the self-portrait and other ruins", artistically appropriate this principle, proposing a poetic dimension of the power choreography in human interaction.

References

[1] Flusser, V. 2013. Filosofia da caixa preta: ensaios para uma futura filosofia da fotografia (Coleção Comunicações) (Portuguese Edition). 66.
[2] Brand, S. 1993. Creating Creating. Wired. 1(01), 01.
[3] Steimle, J., Benko, H., Cassinelli, A., Ishii, H., Leithinger, D., Maes, P., and Poupyrev, I. 2013. Displays take new shape: An agenda for future interactive surfaces. CHI'13 Extended Abstracts on Human Factors in Computing Systems, 3283-3286.
[4] Laurenzo, T. 2016. Media Appropriation and Explicitation. Journal of Science and Technology of the Arts. 8(2), 2, 27.
[5] Virilio, P. and Lotringer, S. 2008 Pure War (Semiotext(e) / Foreign Agents). Semiotext(e).
[6] Allen, S. 2009 Practice: architecture, technique+ representation. Routledge.
[7] Virno, P. 2004 A Grammar of the Multitude. Semiotext(e).
[8] Williams, F. A. D. A. D. 2008 Modernist Group Dynamics: The Politics and Poetics of Friendship. Cambridge Scholars Publishing.
[9] Klee, S. 2009 The Politics of Ambiguity. In Spin[Freee]oza (Shop Windows and Balloons), SMART Project Space.

Acknowledgements

The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. CityU 11674416), and partially supported by a CityU Strategic Research Grant (Project No. CityU 11615218).

Author Biography

Tomas Laurenzo, PhD, is an artist, computer scientist, and academic working with both physical and digital media. His work explores the artistic construction of meaning and its relation with power and politics. Laurenzo's production spans across different practices, including installation, interactive art, music, live cinema, creative machine learning, and digital lutherie. His artworks and performances have been shown globally. He is Assistant Professor at the School of Creative Media, City University of Hong Kong and has published extensively in the areas of New Media Art, and HCI.

Flower Wall Project: A Case Study in Participatory Art Utilizing Social Media

Gyung Jin SHIN
School of Creative Media, City University of Hong Kong
Hong Kong
gjinshin@gmail.com

Abstract

Among the various labels for art's social engagement that have diversified since the 1990s, "participatory art," as first coined by Claire Bishop, theorizes and emphasizes its "participatory" rather than political characteristics. In the recent "nonviolent" tendencies of political protests around the globe, this "artistic" collaboration of citizens has been facilitated by social media, lowering the threshold for participation. This study aims to investigate this new emergent genre of art, namely "participatory art utilizing social media," through a case study of *Flower Wall Project* conducted in South Korea's 2017 "Candlelight Protest." Rather than assessments based on political achievement or technological determinism, this paper seeks to lay the groundwork for establishing sophisticated evaluation criteria with a balanced perspective between esthetics, politics, and technology.

Keywords

Participatory art, social networking service, social media, Web 2.0, Candlelight Protest, participation, authorship, spectatorship, patronship

Introduction

Social Media, which is the most dominant modality of the modern Internet, has changed both how we create and share content and how we collaborate and participate in society. In the current worldwide political protests, including the Occupy Movement and the Arab Spring, telecommunication technology has had a major impact on building solidarity, encouraging citizen's participation, and even leading creative collective actions.

Tracing back to the historic avant-garde in the early 20th century, the discourses and practices of art's social engagement have been rethought and flourished since the fall of communism in 1989. Of the various facets of socially engaged art, Claire Bishop emphasized its distinct methodological approach as an art form rather than as a social practice, which would be the pursuit of collective authorship and collective spectatorship, by suggesting the term "participatory art." [1]

"Candlelight protest," a unique protest culture in South Korea that has developed since the 2000s, has recently proven its political validity by accomplishing the first presidential impeachment in Korean history in March 2017. The use of social media based on South Korea's high-speed Internet infrastructure played a pivotal role in encouraging an unprecedented scale and range of citizen participation and inspiring collective artistic activities such as concerts and performances, in this festival-like protest.

The *Flower wall project*, conducted November 2016–March 2017 at the candlelight rally, provided a rare example of "participatory art utilizing social media platforms." First suggested in a Facebook post by artist Kang-hoon Lee, 15 final performances of covering the barricades of riot police buses with flower-print stickers were completed with both online and offline citizen participation. [Figure 1.]

Figure 1. A Riot bus covered by flower stickers after the project *Flower Wall Project*. © Han-gyul Lee

Not merely showing the general features of participatory art such as process-based experiences, collaboration between multiple authors, non-commerciality, and anti-institutionalism, this project creates idiosyncratic collective experiences and esthetic achievements by actively utilizing social media throughout its whole process.

Objectives, Questions and Methodology

This study aims to shed new light on an emerging form of participatory art that utilizes social media and bring up controversies and possible discourses around it through a case study of the *Flower Wall Project*.

Given that assessments of the *Flower Wall Project* have generally focused on its political achievements, I problematize the recent tendency of socially engaged art critiques centered on political efficacy and social change. Borrowing Jacques Rancière's notion of the esthetic regime of art and Claire Bishop's concept of participatory art, I propose an esthetic assessment based on the fundamental interrelationship between art's social engagement and digitality. [2] This analysis will include how the modern participatory modality of the Internet as represented by social media is correlated with and facilitates participatory art projects and how it introduces an extended concept of participation that has overturned conventional ones.

In detail, the questions of this study are as follows: "How can we assess this project politically, esthetically, or technologically?" "What is the correlation between social media and participatory art?" "How can social media facilitate both online and offline participation in participatory art project?" "How does the project invalidate or reconceptualize conventional notions in art?" The case study will be conducted through interviews with the artist and collaborator; a review and analysis of online and offline documents; and relevant theoretical texts.

Correlation between Social Media and Participatory Art

To understand how social media has actualized participatory art projects, we should look at and analyze deep-rooted commonalities and correlations between "participatory art" and "social media" in terms of their motivations and achievements. Discussions revolve around the vicissitudes of participatory art embracing the history of the avant-garde and the characteristics of Web 2.0 as social media's ideological and technological condition.

The advent of participatory art, which has been growing and become widespread over the last two decades, has coincided with the rise of the concept of "Web 2.0." [3] Even though it is difficult to pinpoint what takes precedence, it seems no coincidence that both phenomena have co-occurred since the 2000s. As opposed to technological determinism, social scientist Clay Shirky points out that "the use of a social technology is much less determined by the tool itself" than by our innate desire "to be connected to one another."[4] In other words, the constant desire for social participation, which had been depressed by the atomization and isolation of social life in the age of mass media, has in turn manifested as participatory culture by means of the rapid development of network technologies in the 21c. Given this hypothesis, it is therefore necessary to analyze how the specifics of Web 2.0 as an infrastructure of social media have facilitated the key agendas of participatory art.

According to Bishop, the most notable motivations of participatory art since the 1960s have included activation, authorship, and community. [5] The first agenda of participatory art is to create an "active subject" that is able to build "their own social and political reality" through "the experience of physical or symbolic participation." The second concern is collaborative authorship, which pursues a more positive and democratic social model as opposed to conventional authorial control by a single artist. The third desire involves art's responsibility to recover social bonds and community in response to a crisis of alienated individuals in capitalist society. These three agendas seem related to the achievements driven by Web 2.0.

Although it does not have a concrete definition, the features of Web 2.0 are often compared with the previous state of networks, Web 1.0. While Web 1.0 offered centralized or one-sided information, Web 2.0 provides users with the freedom to positively produce information, communicate interactively, and share their own content through comment functionality, blogs, social networking platforms, Wikipedia, etc. In his 2008 essay "Art After Web 2.0," Lev Manovich outlines two major characteristics of Web 2.0: the nonprofessional creation of content and a shift from a publishing medium to a communication medium. [6] User-created content created by nonprofessionals allows grassroots communities to express their own voices and even create their own reality, which is related to the first agenda of participatory art: activation.

In addition, converting passive audiences into positive creators encourages collective authorship, altering ideas on originality and authorship, which is the second concern of participatory art. Web 2.0 also facilitates the process of co-individuation among people to recover communication, solidarity, and social bonds by connecting them across locations, ages, genders, and political engagement types, which is related to the third motivation of participatory art. In the following, I will take a closer look at how specific structures of social media platforms or Web 2.0 support participatory art projects and convert conventional concepts in art through the example of the *Flower Wall Project*.

Pervasive Authorship and Pervasive Patronship through Networks

Participatory art overturns the conventional relationship in art between single authorship and passive spectatorship and was also witnessed in the "Flower Wall Project." Artist Kang-hoon Lee, who mostly acts as an illustrator, creative director, and curator, posted the idea to cover riot buses with flower stickers symbolizing peace on his Facebook page in November 2016. Replies and feedback in support of his idea rapidly accrued and he finally realized his idea through 15 performances during the protests held November 2016–

March 2017. Even though the project was initiated by a single artist, its whole process was completed with both online and offline citizen participation.

A closer look at the whole process of the project, repeated in all 15 performances—including idea suggestion, image collection, crowdfunding, production, volunteer recruitment, and final performance—shows how citizen participation was encouraged by the use of social media. [Figure 2.] It was not an artist-centered project but process-based, idea-centered, and participatory project in which participants' ideas and intentions had a significant impact on every part of the project's creation by means of easy and fast communication through social networking platforms such as Facebook, Twitter, etc. In the sense that it gives greater significance in collective creativity than an aesthetic taste sophisticatedly contrived by a single artist, the *Flower Wall Project* is close to a kind of anti-authored project.

Figure 2. A procedural diagram of *Flower Wall Project*.

Lee's first post, for example, which quickly spread to unspecified crowds through the "share" function on Facebook, received hundreds of comments and suggestions in several days, which he selected and gathered to outline the initial plan. What Lee actually did was collect the images of flowers produced by over a hundred of citizens and print them with manufacturers. From the idea development to final performances, the project was mostly completed by participators.

An interview with the artist Kang-hoon Lee revealed how the power of single authorship was intentionally distributed to participants by the artist through social media.

> "It was not that important for me to stand out, declare my authorship, or announce something with my watermark on it. What was more meaningful was to create a phenomenon per se by spreading the idea in a vague state. I was merely the one who asked the initial question, and my role was just to observe and document it."

This illustrates how the artist abandoned single authorship and why he chose social media platforms as the project's major vehicle. He also stated that since the project's motivation originated from the pursuit of social solidarity and the need to question, he never insisted on ownership of the initial idea. Neither the idea nor the outcome has a single author, meaning that all participants are authors.

It is noteworthy that this kind of anti-authored tendency of participatory art can be maximized by the special features of social networking platforms. In the light of the anti-authorship critique as suggested by Roland Barthes in the 1960s, Roy Ascott developed the concept of "dispersed authorship" in "telematic art" in relation to network technology in 1984. [7] As a consequence of the network's telematic process, he contended that this new kind of authorship generates gigantic diversities within the virtual and immaterial space of a network. [8] Although Ascott's concept was based on the technological environment of the 1980s as represented by early network technology and the digital reproduction of images and text, his perspective that relates authorship with networking remains convincing. Modern advanced networking technology has also promoted the dispersion of authorship by means of various software technologies in networks.

The "architecture of participation" in Web 2.0, for example, is a kind of software technology that encourages users' positive participation. Through those kinds of technologies, indeed, most major social networking platforms have developed their value on the database produced as a byproduct or side effect from their users' daily uses. Despite some concerns associated with marketing manipulation, these network technologies have revitalized online participation and its creative application that facilitates collective authorship. Referring to and developing Ascott's notion of dispersed authorship, here I use the word "pervasive" rather than "collective" to emphasize the viral action of anonymous multitudes.

Meanwhile, "pervasive" patronship is another challenge of the project. The history of patronship is as extensive as the history of authorship in art. An interview with the crowdfunding company 7Pictures shows how this old concept can be transformed by the use of social media. 7Pictures is an online crowdfunding company that supports artists and designers through its "pre-order, post-production" system. The company proposed that Lee should collaborate on the project, particularly in fundraising based on donation-based crowdfunding, which is a kind of crowdfunding for charity or the public good. They opened an event page on Facebook and posted images and videos in real time to attract citizen's attention and promote their participation in funding.

About 1,000 US dollars were raised in the first batch, which was comparable to the production cost of almost 30,000 stickers, and this amount was even gradually increased in the consecutive batches. As crowdfunding pursues a shared vision with participators, participatory art also aims to share common values and ideals through collective experiences. This case exemplifies how the use of social networks based on empathy and solidarity can build a new

model of collective patronage supporting participatory art projects. It also implies that artwork does not necessarily rely on a "rich patron," such as commercial galleries, collectors, or institutions (and their process of censorship), any longer.

Participation beyond the Online/Offline Binary

The last question is "Can participation in participatory art also involve online participation?" According to Bishop's definition rooted in the history of theatrical performance, the term "participation" refers to that "in which people constitute the central artistic medium and material, in the manner of theatre and performance." It basically centers on physical actions. Given the post-digital situation, however, in which Internet connectivity has become widespread and most participation inevitably involves online processes of any kind, a clear distinction between online and offline participation is regarded as no longer possible.

Through the *Flower Wall Project,* we can witness that real and virtual participation coexist in our reality. Each participator contributed to some part of the whole process, which is either online or offline, through replying to the post, sending flower drawings, distributing stickers, or performing in the rallies. It might be more important that participators took part in the project in the hopes of changing the "real world" through an experience of collective creation than whether it was executed online or offline. As Shirky pointed out, events and existence in the world of social media contribute to improving the "real world" as part of it rather than existing separate from it. To the extent that participatory art has recently coupled with social media use, the evaluation of participatory art should also focus on what kinds of new collective social experiences can be ultimately generated by participatory art appropriating new participatory modes of social media beyond the binary of online and offline.

Conclusion

Through the term "*pharmakon*," French philosopher Bernard Stiegler illustrates how technology acts as intoxication and a cure at the same time. [9] Even though there are some concerns and skepticism associated with marketing manipulation, self-indexation, amateurism, controlling the power of the web, etc., social networking platforms have promoted not only online communication and solidarity but also offline gathering, collaboration, and even social engagement, which support the process of co-individuation. Participatory art utilizing social media, which has the potential to perceive and respond to a crisis of control society under neoliberal capitalism, is an example of a pharmacological method of using technologies as a good *pharmakon*.

According to Rancière, the political power of art stems not simply from direct political action but from its potential to change the way we perceive the world. As found through examining the example of the *Flower Wall Project*, participatory art utilizing social media has aesthetic potential in that it invalidates or reconceptualizes conventional notions in art, such as authorship, spectatorship, sponsorship, and physical participation, through its idiosyncratic pervasive experiences. In an interview, Lee described the ultimate purpose of the project as "peaceful illegal participation," which can stir controversy and open up the debate on political issues rather than support a specific political orientation. Given the recent trend of political propaganda in social media, participatory art utilizing social media should perhaps provide a place of constant dissension constituted by a positive multitude rather than passive, standardized masses.

References

[1] Claire Bishop. *Artificial hells: Participatory art and the politics of spectatorship* (New York: Verso Books, 2012).
[2] Jacques Rancière. *The Politics of Aesthetics: The Distribution of the Sensible* (trans. Gabriel Rockhill) (London: Continuum, 2004).
[3] Tim O'Reilly. "What is Web 2.0. (2005)", Tim O'Reilly's website, accessed December 24, 2018, https://www.oreilly.com/pub/a/web2/archive/what-is-web-20.html
[4] Clay Shirky. *Cognitive Surplus: Creativity and generosity in a connected age* (London: Penguin, 2010).
[5]Claire Bishop, "Introduction: Viewers as Producers." In *Participation* (London: Whitechapel/Cambridge: MIT Press, 2006), 10-17.
[6] Lev Manovich. (2008) "Art after Web 2.0". In *The Art of Participation 1950 to now* (London: Thames and Hudson, 2008). 67-80
[7] Roland Barthes. "11 The Death of the Author," in *Media Texts, Authors and Readers: A Reader* (Portland: Book News, 1994): 166.
[8] Roy Ascott. *Telematic embrace: Visionary theories of art, technology, and consciousness* (Berkeley: Univ of California Press, 2007).
[9] Bernard Stiegler. *What makes life worth living: On pharmacology*. (Cambridge: Polity, 2010)

Bibliography

Claire Bishop. "Antagonism and relational aesthetics." *October* (2004): 51-79.
Claire Bishop. "The social turn: Collaboration and its discontents." *Artforum* 44.6 (2005): 178.
Alexander R Galloway. *Protocol: How control exists after decentralization* (Massachusetts: MIT press, 2004).
Alexander R. Galloway and Eugene Thacker. *The exploit: A theory of networks* (Minneapolis: U of Minnesota Press, 2007).
Andreas M Kaplan and Michael Haenlein. "Users of the world, unite! The challenges and opportunities of Social Media." *Business horizons* 53.1 (2010): 59-68.
Jacques Rancière. *Dissensus: On politics and aesthetics* (London: Bloomsbury Publishing, 2015).
Henry Jenkins and Ebrary, Inc. *Fans, Bloggers, and Gamers : Exploring Participatory Culture*. (New York: New York UP, 2006).

Howard Rheingold. "Using participatory media and public voice to encourage civic engagement." *Civic life online: Learning how digital media can engage youth* (2008): 97-118.
Clay Shirky. *Here comes everybody: The power of organizing without organizations* (London: Penguin, 2008).
Edward A Shanken. "Art in the information age: Technology and conceptual art." *Leonardo* 35.4 (2002): 433-438.
Nato Thompson, ed. *Living as form: Socially engaged art from 1991-2011*. (Cambridge: MIT Press, 2012).
Brad Troemel. "Art after social media: as a rejection and reflection of free market conventions." *Unlike Us reader: Social Media Monopolies and Their Alternatives* (2013): 264-268.

Author Biography

Gyung Jin Shin is artist, researcher, and PhD candidate of the School of Creative Media in City University of Hong Kong. She received an MFA from Columbia University in 2010 and a BFA from Seoul National University. Her art work has been exhibited and screened in the US, Europe, and Asia. Her research interest includes art's social engagement (socially engaged art, participatory art, politics and aesthetics, etc.), post-media discourse, post-digital/post-internet art, new materialism, media archaeology, and Critical Theory.

Misplaced Euphoria: Developing Kinesthetic Empathy Through Interactive Performance

Kyungho Lee
Illinois Informatics Institute
University of Illinois at Urbana-Champaign
klee141@illinois.edu

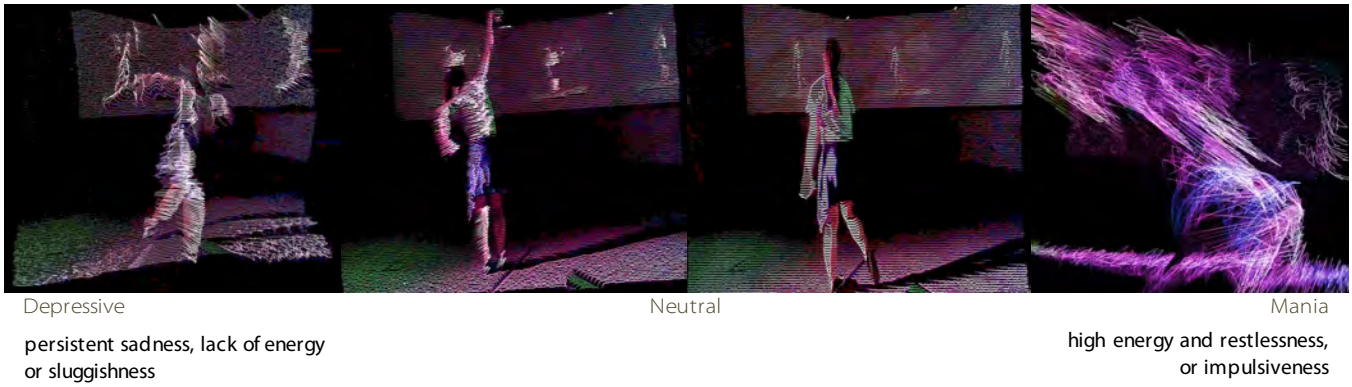


Figure 1: Each picture show how our model recognizes expressive movements and visualize the parameter.

Abstract

Misplaced Euphoria is an interactive performance that consists of expressive movement, expressive gesture recognition, and interactive visualization that aims to develop empathy for people with bipolar disorder. This project explored the characteristics of those with bipolar disorder through the mediums of dance and interactive visualization driven by expressive gesture recognition. To develop an interactive performance, we conducted an interview with a person to gather information. We used the insights collected from the interview processes as a base for our creative process. To convey the inner state of the dancer to the audience, 6-DOF acceleration sensors, attached to the dancers arms, were used to capture her movement. We then used the Support Vector Machine (SVM) to parameterize the dancers expression, and the results were visualized through the Rutt-Etra algorithm on a real-time basis.

Misplaced Euphoria

Violent. Unpredictable. Dangerous. Crazy. Distrustful. Outcast. These are just some examples of the stigmas against people with mental illness to which we hope to bring awareness. Because misunderstanding and prejudgment may even hurt further people who are suffering from bipolar disorder.

Scientifically speaking, bipolar disorder, also known as manic-depressive illness, is a brain disorder that causes unusual and unpredictable shifts in mood, energy, activity levels, and the ability to carry out daily tasks. It has been reported that bipolar disorder symptoms can result in damaged relationships, poor job or school performance, and even suicide. However, it is also believed that bipolar disorder can be treated, and people with this illness can lead full, ordinary and productive lives.

To develop empathy for people with bipolar disorder and open a new dialog for them, we present an interactive dance performance, Misplaced Euphoria.This project explored the characteristics of those with bipolar disorder through the mediums of dance and emerging technology that recognize the characteristic movements and represent it through an interactive visualization using machine learning.

This interactive performance aims to provide an opportunity to take the time to think about and discuss the way we look at these issues through an aesthetic experience, hoping an audience may be able to experience some inner mimesis, where they felt as if they were suffered from bipolar disorder while they were observing the interactive visualization. To collect information that may use as a base for our creative process, we conducted a series of interviews with a person with bipolar disorder. In particular, we are carefully looking into the changes in emotions and their relationship to the objects and events that occur around them. Then, we form a series of expressive movements that represent the two extreme moods.

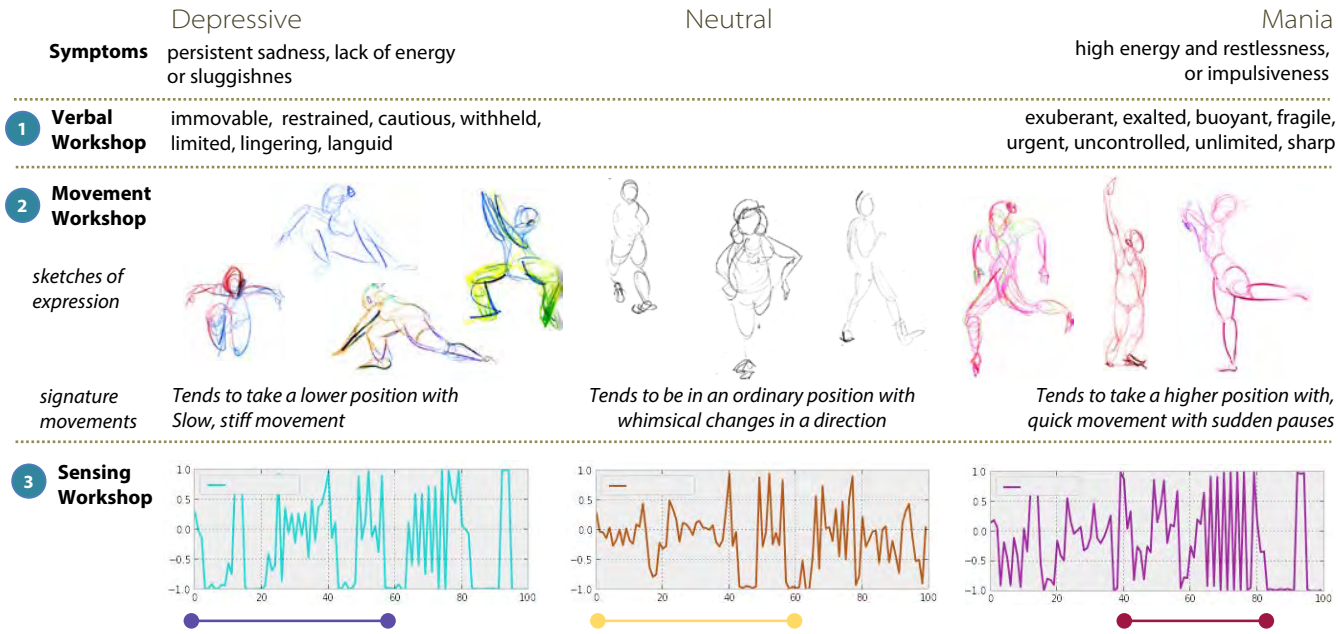


Figure 2: This picture illustrates how we create an interactive visualization through multiple workshops.

By doing so, we incorporate a concept of a corporal expression as a theoretical background which means that the body can be the medium used to tell stories, express emotions and thoughts, and interact with the environment in a contemporary dance performance. We also believe that we can evoke a kinesthetic empathy for the general audience who will be watching the interactive visualization as shown in Figure 1 as Ann Daly argued [1] that spectators of dance performance may experience kinesthetic empathy when, even while standing still, they feel like as if they were participating in the movements, and experience related feelings and ideas through the movement.

Based on the conceptual design, we went through multiple workshops from a verbal workshop, a movement workshop, and a sensing workshop as shown in Figure 2. We firstly conducted a verbal workshop where both the designer and dancer tried to build conceptual consensus about the symptoms.

We verbalized the feelings and emotions using a thesaurus. For example, we chose some words that were collected in the interview and use them as a starting point. We kept finding some other words that may represent the meaning of such words in a more precise and accurate manner so we can build strong consensus. Then, the dancer started to create expressive gestures to represent the feelings and inner states that were sought in the verbal workshop. While the dancer focused on the movement, the designer had huge visual inspirations from the process and did some sketches to convey the dancer's intention as well as feelings effectively.

Lastly, the sensing workshop was conducted. During the workshop, we used two 6-DOF acceleration sensors, attached to the dancers right and left wrists, were used to capture her movement. We collected 10 hours of the expressive movement datasets that represent the feelings and inner states. We used a Support Vector Machine (SVM) with a Gaussian kernel to train and recognize the dancers expression. The results were visualized through the Rutt Etra algorithm [2] on a real-time basis as Shown in Figure 1.

In this project, we designed an interactive performance that aims to develop empathy for people with bipolar disorder. To evoke the audience's emotion, we incorporated the concept of kinesthetic empathy and implemented it with a machine learning approach to drive the interactive visualization. We hope the audience can get a chance to experience the inner life of people with bipolar disorder and catch a glimpse to understand about what it feels like to avoid any further misunderstanding and prejudgment that may hurt them.

Video Link: https://vimeo.com/163578423

Acknowledgments

This research was supported by the Fiddler Innovation Research Fellowship. We wish to thank Jerry Fiddler and Melissa Alden for their generous support. The authors also gratefully acknowledge the use of the services and facilities of the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign.

References

[1] Daly, A. 1992. Dance history and feminist theory: Reconsidering isadora duncan and the male gaze. *Gender in performance: The presentation of difference in the performing arts* 239–59.

[2] Kane, C. L. 2014. *Chromatic algorithms: Synthetic color, computer art, and aesthetics after code*. University of Chicago Press.

Rediscovering Korea's Ancient Skies: An Immersive, Interactive 3D Map of Traditional Korean Constellations in the Milky Way

Sung-A Jang[1], **Benjamin L'Huillier**[2]
[1]Human Computer Interaction Institute, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA 15213, USA, sunga@cmu.edu
[2]Korea Astronomy & Space Science Institute, 776 Daedeok daero, Yuseong-gu, Daejeon 34055, Korea, benjamin@kasi.re.kr

Abstract

In this work, we visualized Korea's traditional constellations within an interactive 3D star map we created of the Milky Way. Unlike virtual planetariums based on celestial star coordinates from Earth's viewpoint, our visualization enables people to experience and interact with Korean constellation forms and its constituent stars in 3D space, and appreciate their historical, cultural significance from a contemporary perspective. Our interactive constellation map is based on the most detailed and accurate information on the stars in our Galaxy to date, and combines our expanding scientific understanding of the stars with contextual information reflecting Korea's unique astronomical culture and heritage.

Keywords

Immersive Data Visualization, Virtual Reality, Korean Constellations, Star Maps, Astronomy

Introduction

Korea has a rich astronomical culture and history, based on a deeply rooted belief that celestial and terrestrial events are inextricably linked, and that the skies essentially hold the secrets to the Universe [4]. The considerable attention ancient Koreans paid to observing the skies is apparent in the detailed historical records of astronomical observations and interpretations, which reveal how integral and critical the skies were to their worldview [9]. Much of this is lost, however, in how Koreans see the stars today. The constellation shapes and stories Koreans have grown most familiar with are predominantly from Western cultures. The rich tapestry of Western celestial myths and starlore lives on to this day, in how we casually identify the stars and through popular superstitions. We aim to challenge this status quo by introducing different cultural perspectives to our modern star charts. Our goal is to encourage people to explore and enjoy the cutting-edge astronomical advances that enable new, exciting discoveries about the stars that populate our Galaxy, in tandem with the rich contextual information of the diverse ways in which we humans historically perceived and made sense of celestial movements and events, and the intricate systems we developed for interpreting them across different cultures and civilizations over centuries.

Our specific focus was on visualizing Korea's ancient constellations and embedding its information within the interactive 3D star map we had created of our Galaxy. The purpose was twofold: (1) to encourage a rediscovery of Korea's own historical view of the skies, which has been woefully neglected and buried under prevailing Western conventions, and symbolically connect Korea's astronomical traditions and culture with current advances in modern astronomy; and (2) to show how much our connection with and knowledge of the skies have evolved since those ancient times. Interactive 3D visualization in virtual reality (VR) opens doors to new creative possibilities. By encouraging users to fly to anywhere in the Galaxy space inside the visualization, we want people physically experience how the constellation shapes become almost instantly unrecognizable when one breaks away from fixed viewpoint from Earth, and how two connected stars that appear close to each other may actually be separated by a vast distance in reality. These scientific truths are what ground our perception, and help us appreciate our rich cultural heritage in astronomy from a critical perspective.

The project's overarching aim is to inspire people to rediscover the depth of history and culture hidden in the stars, and to explore the layers of meaning associated with the patterns and movement of celestial bodies exuding light, which guided our ancestors through the long dark nights.

Related Work

The open software Stellarium[1] is a virtual planetarium for desktops that enables amateur astronomers to simulate the sky at a desired time and position. It has 600,000 stars, and allows users to turn on constellations from different cultures, including Korean. Their planetarium visualization of the sky, however, is based on 2D coordinates of the stars and is only capable of showing how the stars and constellations appear from locations on Earth. There are constellation labels in English available for viewing, but users cannot interact with the constellations to learn more about their underlying stories and cultural significance. The data for the Korean constellations is also solely based on the open contributions of a Korean Stellarium user made over a decade ago, whose sources are not identified and unverifiable.

Figures in the Sky[2] is a data visualization on the web by designer and astronomer Nadieh Bremer which compares the

[1] https://stellarium.org/
[2] http://www.datasketch.es/may/code/nadieh/

constellation shapes of different sky cultures. It features a selection of famous stars and visualizes the different constellation shapes they form depending on the culture. Her work also includes a full sky view of Korean constellation shapes, but it only appears as a static 360-degree panoramic view and we cannot interact with the shapes for additional information. The data used for the Korean constellations is also from Stellarium and hence unreliable.

Star Chart[3] is a VR planetarium app that provides an immersive real-time simulation of the night sky. The app allows users to view the entire sky and access information on constellations and individual stars. Despite the immersive view, however, the stars visualized only convey 2D information from the Earth's point of view, and only show the standard Western constellations. StarTracker VR[4] also maps the star field onto a sphere surface and allows users to view the stars from outside the sphere. This, however, is also based on 2D data and falsely conveys the notion that the stars are all an equidistance from Earth.

The European Space Agency (ESA) has released a full-sky interactive visualization of the stars[5] based on their Gaia mission data, which shows an accelerated view of how stars move with time, from Earth's point of view. Western constellation lines are visualized, for the primary purpose of effectively showing the movement of the stars. Gaia VR[6] and Gaia Sky[7] are both 3D visualizations of the stars based on Gaia's data releases, and allow users to view Western constellation lines in 3D space. Neither visualization, however, allows users to explore additional information on the constellations nor includes constellations from other cultures.

Data Collection & Curation

Cheonsang-yeolcha-bunya-jido

Made in the early *Joseon* dynasty (1395) based on an ink rubbing of an ancient stele originating from the *Goguryeo* kingdomm(37 BC–668 AD) according to its epitaph, the *Cheonsang-yeolcha-bunya-jido* (a planisphere chart of different celestial zones [4], hereafter CS-map) is a monumental historic artifact representative of the East Asia's early advances in astronomical knowledge and tradition [9, 11, 3]. A celebrated national treasure, the CS-map is a full-scale star chart that shows 1,467 stars forming 283 constellations [4], a considerable proportion of which substantially differ from those in Chinese maps of a similar era [7, 11]. The constellations are arranged according to the traditional East Asian constellation system (3 *won* 28 *su*), which divides the observable sky into 3 circles and 28 star groups. The 28 *su* (lunar lodges) are constellations that appear in the celestial equator and mark the passage of the Moon in a sidereal month [10], and they determine the boundaries which divide the 28 star groups [5].

Building the Korean Star & Constellation Database

There is unfortunately no digital database of the CS-map that we could reliably use to cross-match and identify modern catalog stars that form the constellations. The only pertinent data openly available online is the data used in Stellarium, which is allegedly based on the CS-map but unverifiable. This dearth of usable data prompted us to build our own digital database of Korean traditional constellations and stars, which consolidated information from reputable, validated academic sources detailed below to identify core constellation stars and extract their 3D position and magnitude[8] from modern catalogs via cross-analysis and verification.

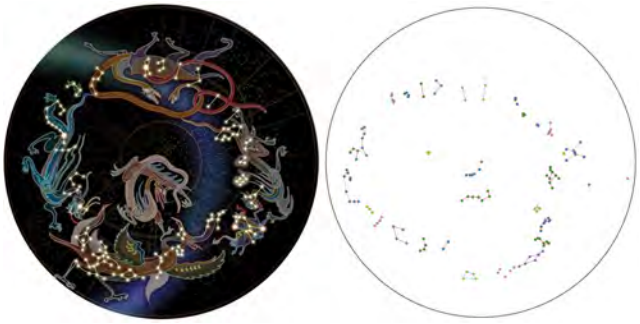


Figure 1: Visual verification via 2D and 3D mapping of compiled data. (Left image: ©Hong-Jin Yang)

Our starting point was Park's 1998 research paper on the CS-map [8], which through rigorous computational analysis succeeded in identifying 375 of the 1467 stars that constitute the CS-map. Since approximately 3 quarters of the stars in the map were missing, we decided to constrain our initial visualization to the 28 main constellations that represented each *su*, in addition to a selective number of culturally significant constellations that lay beyond this scope such as the *Bukdu-Chilseong* (Seven Stars of the Northern Dipper), which corresponds to the Big Dipper asterism in Western astronomy and plays a pivotal part in East Asian mythology and starlore [5].

Various supplementary historical astronomy sources [1, 3, 12] were used as reference to complement Park's findings and fill in critical gaps in data as much as possible. Edge tables for each constellation were manually created in order to visualize the constellation forms. The identified constellations and stars were then visualized in 2D using modern catalog coordinates and compared with the CS-map for visual verification (Figure 1).

Our ancient Korean constellations and stars database includes the traditional Korean names and meaning of each constellation and star, based on Ahn's book on unique Korean constellations [2] and King Sejong's court astronomer Lee Sunji's classic astronomical text *Cheonmun-Ryucho* from the

[3] https://www.oculus.com/experiences/rift/877457905696954

[4] https://www.oculus.com/experiences/gear-vr/1438854922813902

[5] http://sci.esa.int/gaia/60224-parallax-and-proper-motion-on-the-sky/

[6] http://sci.esa.int/gaia/60036-gaia-data-release-2-virtual-reality-resources/

[7] https://zah.uni-heidelberg.de/institutes/ari/gaia/outreach/gaiasky/

[8] An astronomical unit proportional to the logarithm of the luminosity.

15th century [6]. The database also details the stars' Western names, the Western constellations they respectively belonged to, and scientific information such as their exact magnitudes and Hipparcos IDs.

We used ESA Gaia mission's first data release (Gaia DR1[9], released in September 2016) as our primary star data source, since it was the most up-to-date and comprehensive star map available at the time and groundbreaking in its unprecedented coverage and accuracy. The positional information of the stars in the Gaia catalog is three-dimensional, in a spherical coordinate system: two angles (right ascension and declination) describing their position in the sky, and parallax. Parallax refers to the apparent motion in the sky of an object as seen from two opposite points of the Earth revolution around the Sun, and is used to infer the distance to "close" objects, i.e., within the Milky Way. Our data fused the portion of Gaia DR1 which provided the 3D position and brightness of 2 million stars, with the data of 24,320 bright stars from the Hipparcos catalog[10] that were not included in Gaia DR1. From Ref. [8], we obtained the Yale Bright Star Catalog IDs of the identified stars on the CS-map, and used them to retrieve their respective IDs in the Hipparcos catalogue via the Hipparcos-Yale-Gliese (HYG) compilation. We then obtained their astrophysical information (2D/3D positions, magnitude) from the Hipparcos and Gaia catalogues. We derived the Cartesian coordinates of the stars from the angular coordinates and parallax data, and converted their apparent magnitude (as seen from Earth) to absolute (as seen from a distance of 10 parsecs, or 30 light-years) for visualization in Unity3D. We removed all stars with non-positive parallaxes.

System Design

Figure 2: A view of the lunar lodges from the perspective of Earth.

The system presents an immersive data-driven experience of Korean constellations and stars in our Galaxy. 25 of the 28 *su* are visualized, along with a select number of important constellations inside the circle of perpetual visibility (Figure 2), which encircles an area of the sky that could be observed in all seasons. Users are free to roam anywhere in the Galaxy and view the constellations from constantly changing perspectives. Specific information on every constellation and its stars are accessible by pointing the reticle in its direction and clicking the trigger button with the touch controller (Figure 4).

Figure 3: The Southern Dipper constellation shown is drastically different from its iconic shape from Earth displayed in the info panel.

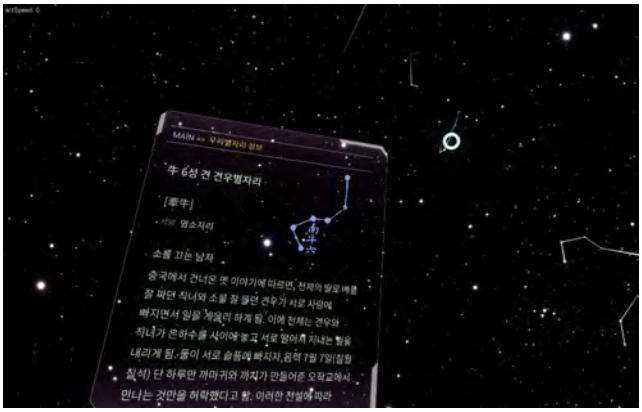


Figure 4: The selected constellation's information panel appears in world space, facing the user from a comfortable viewing distance.

The system was implemented in Unity3D and designed to work with the Oculus Consumer Version 1 VR headset and Oculus Touch controllers. The experience starts from the position of Earth and our Solar System. The left controller thumbstick controls the 3D navigation in space, and the navigation speed changes according to the degree to which the stick is pushed. Users can choose to move forward in the direction of their gaze, or set to absolute directions. The right controller's thumbstick controls the rotation of their view, and enables them to zoom in and out of our Galaxy (Figure 5).

We intentionally designed a world-space interface instead of a classic heads-up display (HUD) view for toggling view options and displaying the information of selected constellations. As opposed to information being presented on a helmet-like display that moves with the users, the display panels dynamically appear in their world space out of thin air, facing the viewer from a comfortable distance, maximizing the users' sense of space. The displayed content is swiftly replaced when users remain in place and change their selections. Even when users are on the move, open panels stay fixed in world space where they first emerged until users close

[9] https://gea.esac.esa.int/archive/

[10] https://www.cosmos.esa.int/web/hipparcos/catalogues

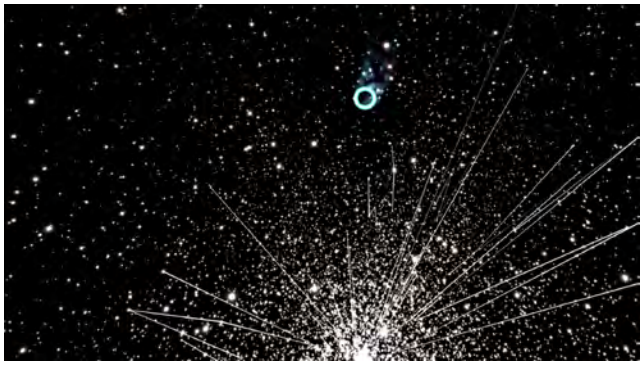


Figure 5: The view of constellations and constituent stars from a point of view greatly removed from the Solar System.

them or make a selection from a different point in space, at which point any previously open panels are instantly cleared.

Some constellations such as the *Buk-du* (Northern Dipper) have important constituent stars that can be individually selected for detailed information. To access this information, users must hold the trigger button and release it when the reticle is hovering over the star. Users can also fly away from our Galaxy to gain a distant view, promptly return to their starting point (Earth), and toggle star and constellation names on and off in the view settings (Figure 6).

Figure 6: When the star labels are turned on, it prioritizes unique Korean names over Western ones when available. Hipparcos IDs are displayed for stars without distinct names.

Conclusion

The system enables users to move freely in any direction they want in variable speeds faster than the speed of light, and explore constellations and starscape in motion. Freed from physical constraints that limit their views to a fixed position on Earth, users can experience how dramatically the constellation shapes and star configurations change depending on their viewpoint in space (Figure 3). Imbuing the stars in the Galaxy with cultural history and context makes the Galactic data itself more engaging and approachable to the public. This project is part of a broader effort to connect recent astronomical advances with Korea's historical astronomy, and enliven interest in the new discoveries made as well as Korea's rich astronomical tradition and cultural heritage. We also strive through these endeavors to broaden access to rich sources of open data and transform it into public knowledge and appreciation.

Acknowledgements

We thank Goeun Choi, Changbom Park, Cris Sabiu, and Hong-Jin Yang for their help in gaining access to CS-map data and much constructive feedback. This project was funded by the Korea Culture Technology Institute in Gwangju, Korea.

References

[1] AEEA (Activities of Exhibition and Education in Astronomy). National Museum of Natural Science, Taichung, Taiwan. http://aeea.nmns.edu.tw/index1.html.

[2] Ahn, S.-H. 2000. *Unique Korean Constellations We Must Know*. Seoul: Hyeonamsa.

[3] Ahn, S.-H. 2015. Astronomical characteristics of *Cheonsang-yeolcha-bunyajido* from the perspective of manufacturing methods. *Journal of Astronomy and Space Sciences* 32(1):51–62.

[4] 2012. '*Cheonsang yelocha bunya jido*' planisphere chart culminates astronomical science of joseon. *Korean Heritage* 5(1). Culture Heritage Administration.

[5] Kim, I.-g. 2008. *Retracing the Ancient Korean Sky and Its Myths: The Celestial Utopia Depicted In Koguryo Tomb Paintings*. Paju: Sakyejul Publishing Co.

[6] Lee, S. 2005. *Cheonmunryucho: Selected and Classified Writings on Astrology)*. Seoul: Daeyou Hakdang.

[7] Lee, Y. 2006. *Cheonsang-yeolcha-bunyajido* as korean constellations. In *Korean Historical Astronomy and Cheonsang-yeolcha-bunyajido Workshop*. Korea Astronomy and Space Science Institute.

[8] Park, C. 1998. Analysis of the star map in *Chon-Sang-Yol-Cha-Bun-Ya-Ji-Do*. *Journal of the Korean History of Science Society* 20:113–150.

[9] Park, C. 2008. *Astronomy: Traditional Korean Science*. Seoul: Ewha Womans University Press.

[10] Stephenson, F. R. 1994. Chinese and korean star maps and catalogs. In Harley, J., and D., W., eds., *The History of Cartography, Volume Two, Book Two: Cartography in the Traditional East and Southeast Asian Societies*. Chicago & London: The University of Chicago Press. 511–578.

[11] Yang, H.-J., and Choi, G. E. 2012. A study of stone star charts in korea and china. In *Proc. of 2012 International Symposium on Historical Astronomy*, volume 81.

[12] Yang, H.-J. 2014. *Digital Cheonsangyeolchabunyajido*. Daegu: Kyungpook National University Press.

Authors Biographies

Sung-A Jang is an artist and HCI researcher working in the intersection of art, science and technology. Benjamin L'Huillier is a cosmologist and astrophysicist who seeks to understand the content of the universe and the laws that govern its evolution.

Inside the Geometry - Double language

Chiara Passa
Artist and lecturer at Fine Art Academy
Rome, Italy
chiarapassa@gmail.com

Abstract

Inside the Geometry - Double language is a virtual reality art-project, which takes the form of diverse site-specific video-installations. The artworks involve the use of various 3D viewers, plus related smartphones playing all different virtual reality animations.

Keywords

Art, virtual reality, video-installation, virtual-art, immersive, abstract, architecture, sculpture, light, generative, geometry, minimal, conceptual.

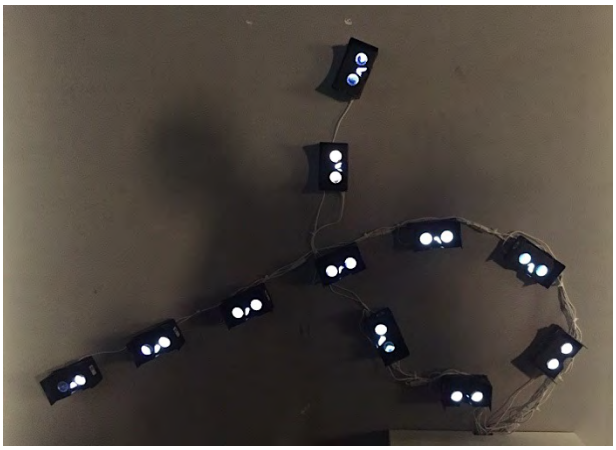


Figure 1: From the series Inside Geometry Double language – Area between curve, VR video installation MAXXI Museum Rome 2017.

1. Inside the Geometry – the concept

For *Inside the Geometry - Double language*, the 3D viewers are arranged in the exhibition space to orchestrate on wall, or from ceiling, a series of geometric figures conceived site-specific for diverse occasions. Each geometric design hosts different 360° animations in continuous transformation. The virtual reality animations, previously generated by a software, via the language of geometry within its unpredictable variations, once into the liquid dimension, overturn completely Cartesian coordinates. Therefore, inside each viewer, the audience can take a journey beyond the physical space, exploring the virtual reality artworks from their initial virtual point – and move in all directions depending on our own intuitions of the real world with its material bodies. *Inside the Geometry - Double language* dilate this perceptive possibility thanks to a sensitive, mental and transitory vision of space linked to aspects of minimalist aesthetics and the tensions of new technologies.

I use the geometric semantic combined to the virtual reality medium to question the real space, exploring it as virtual membrane by searching for the limitlessness through minimalism and abstraction in art. *Inside the Geometry - Double language* highlight the paradox generated by our contemporary condition, which we are living even more diluted in-between physical and liquid space.

The whole virtual reality series (more than thirty-five figures created, and here probing: *Two Times Four and Earth Spiral*) is part of a research project which I began in 2015 and which slots into my artistic journey since 1997. *Inside the Geometry - Double language* is the fruit of a deep interest I have always had in space and how it is transformed and shaped *in* and *by* the language of informatics. In software and electronic devices, I find potential vehicles for the investigation and visualization of my artistic research and theories. *Inside the Geometry - Double language* led to the materialization of these theories in the most original forms as part of the *Live Architectures* series (1999-ongoing); artworks I designed to behave as if they were alive, to move beyond their own functionality. These are *Super places*, a definition coined by me in 1999 to connote the dynamic places in my cybernetic artworks. These performing sites, project the spectator into a digital and mediated reality, so shaking-up and challenging the static notion of both real and virtual places, to render all vibrant and participatory, achieving in art a strange oscillation between spaces.

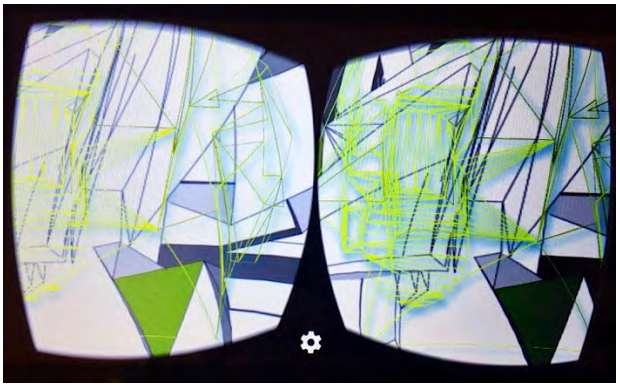


Figure 2: Still from a VR animation, 2016.

1.1 Two Times four, virtual reality video installation, 2015.

Mostly of my virtual reality artworks, as for example, *Two Times Four* are based on the idea of the *Super place* explained previously. With *Two Times Four,* we become blind and ultra-seeing at the same time. Blind because we lost any Cartesian reference, and ultra-seeing while we are forced to immerse ourselves into twelve

Figure 3: From the series Inside Geometry Double language – Two times four, VR video installation, Spectra Festival, Aberdeen 2018

abstract animations playing with the concept of infinite;including infinitely large and infinitely small (micro and macro dimensions), I designed through minimalist nuances and conceptual degrees, so mixing geometry, painting and sculpture praxis all together, with an apparently icy and impersonal kind of conceptual view. The virtual reality animations playing in *Two Times Four*, construct a sort of *Mise en abyme* (Droste effect), in which an element shifts the other in depth, merging until the origin of the digital artwork itself. Therefore, spectators can even cross and penetrate the artwork as far as the very womb of its origin, watching the core point, or the first line that was designing the basis to the entire virtual reality artwork.

Figure 5: Earth Spiral, VR video installation, Rocciamorgia Land Art Festival, 2017.

1.2 From the series into the Land art: Earth Spiral, virtual reality video installation 2016.

Earth Spiral is an experimental virtual reality art-project, which challenges environment to render it fully partaking. Spectators through the 3D viewers, bow down to nature while kneel to technology using it to see in depth, just beyond the ontological vision of nature itself. Therefore, in *Earth Spiral* the underground is animated and lives existing beyond is own functionality. The twenty virtual reality animations show modified versions of Google Earth Maps, where bizarre dynamic shapes turning into abstract 3D sculptures, and super-objects.

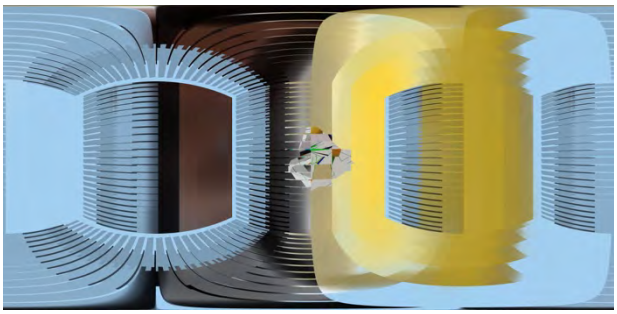


Figure 4: Still from a VR animation, 2016.

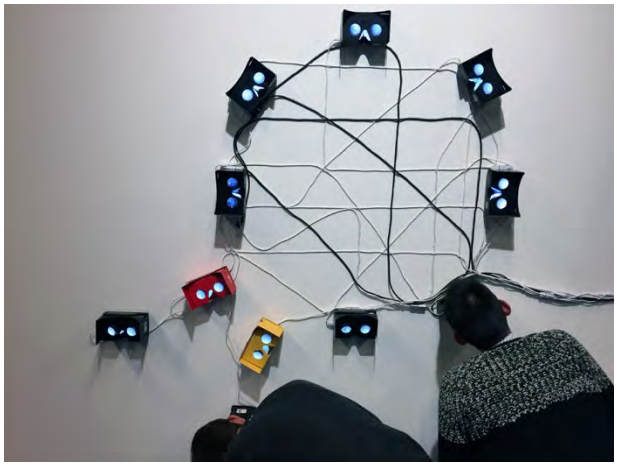


Figure 6: From the series Inside Geometry Double language – Space filling curve, VR video installation, ZKM Museum Karlsruhe 2017.

References

1. Passa, C. From the *series Inside the geometry double language: area between curve* 2015, performing at MAXXI Museum, Rome April 2017.
https://www.youtube.com/watch?v=_3cjVuK6xLs
2. Passa, C. From the series *Inside the geometry double language, a frame from Area between curve* 2015.
http://www.chiarapassa.it/photosatmyopenings.html
3. Passa, C. From the series *Inside the geometry double language: Two times four* 2015. Performing at Spectra Festival, Aberdeen February 2018.
https://www.youtube.com/watch?v=r7yora7hcfI
4. Passa, C. *From the series Inside the geometry double language*, a frame from *Two times four* 2015.
http://www.chiarapassa.it/photosatmyopenings.html
5. Passa, C. From the series *Into the Land art Earth spiral* 2016. Performing at Rocciamorgia Festival, Salcito 2017.
https://www.youtube.com/watch?v=xFe6v1lpsyM&t=1s
6. From the series *Inside the geometry double language: Space filling curve* 2015. Performing at In-Sonic group show, ZKM Museum Karlsruhe, December 2017.
https://www.youtube.com/watch?v=1cPzjhStFrc&t=53s

Author Biography

Chiara Passa (1973, Italy). M.F.A. from the Fine Arts Academy of Rome, Master in new audio-visual mediums at the Faculty of Modern Literature. Currently, I am living and working in Rome.

I work since 1997 analyzing virtual spaces through a variety of techniques and devices. My artwork ranges from interactive video installations and net-based art to site-specific digital interventions, while mostly deploying augmented reality and virtual reality technologies. The work process includes research targeted at the different ways space is configured, from the interaction with humans to the way they blend and melt together at a given point.
My artwork was internationally exhibited from museums, galleries and conferences. A selection:
«Virtual Natives – Sculpture», Roehrs & Boetsch gallery, Zurich (2019); «Oslo Night show», HEK Museum Basel (2018); «InSonic», immersive art show, ZKM | Center for Art and Media Museum, Karlsrhue (2017); «From live architecture: Dimensioning», solo show at Furtherfield gallery, London (2016); «Off Biennale Cairo» (2015-2016); «ISEA Disruption», Conference and exhibition at Vancouver Art Gallery. (2015); «Morphos», Vortex Dome - immersion media, Los Angeles (2014); Media Art Histories IV - RENEW conference, Riga. (2013). FILE | Electronic Language International Festival, São Paulo. (2011); Electrofringe - festival of new media art, Newcastle, Australia. (2008); BizArtCenter, Shangai (2005); MACRO – Museo di Arte Contemporanea, Roma (2004), 11° Biennale of young artists of Europe and the Mediterranean countries: «Cosmos - a sea of art», Athens. (2003); 48a Biennale di Venezia (with Oreste group), Venezia (1999) e Fondazione Bevilacqua La Masa, Venezia (1999).

http://www.chiarapassa.it

Enlightening Intelligence: Behaviors from Synthetic Psychology

Rodolfo Cossovich
Interactive Media Arts, Shanghai New York University
Shanghai, China
cossovich@nyu.edu

Abstract

Long exposure photographs from the trajectory of a set of autonomous vehicles trigger question about our understanding of intelligence. The design of the behaviors of the mobiles was inspired in the previous work of Braitenberg and other scholars, whom have considered the vehicles artificial creatures that respond to the environment with many similarities to the way other living animals behave. The pictures reflect the colors and movements that characterized the trajectory of the mobile when interacting with the environment, leaving questions about their interpretation and the connection with synthetic psychology within artificial life. Future work with different environments, more advanced algorithms and several different vehicles is discussed.

Keywords

Braitenberg vehicles, emergent behavior, robot art, biomimicry, light sculptures, artificial intelligence

Background

The work presented here was originally inspired by the pieces realized at NYU Shanghai by Jack B. Du with MinusE[1]. He presented his robot as the participant of a Robot Art Competition[2] and this claim led to questions about whether a machine could author an art piece.

Braitenberg vehicles are thought experiments inviting to replicate the animal behaviors in the natural world[3]. These fictional mobiles derive from previous work explaining the principle of the representation of objects in "internal maps" of the environment within the brain with the phenomena of taxis, kinesis and decussation. [4]

MIT Media Lab prototyped these ideas into physical robots and described the results as a way to explore the nature of intelligence[5][6]. Other researchers have created virtual simulations of them in order to study the behaviors emergent from their simple rules. [7]

Iñaki Rañó produced a series of pictures where he uses a common technique of trajectory recording of an autonomous mobile[8]. With them, he builds a relationship between the environment, the behavior of the mobile and the nature of chaos theory.

Figure 1. Repetitive behavior iterating both movements and color. The light traces left behind invite to feel awe and to wonder if life is exclusive to carbon forms.

Description

Focusing in the way that these artificial behaviors are reflections of simple biological relationships, it was planned to record the trajectories of specially designed Braitenberg vehicles. The initial results are shown in Figure 1, awakening curiosity about whether their handcrafted circuits can be considered artificial creatures.

As a contrast to those deterministic trajectories, in Figure 2 we can start seeing a resonating "taxis" organic behavior giving other understanding of reality and our role as programmers of creatures or creators.

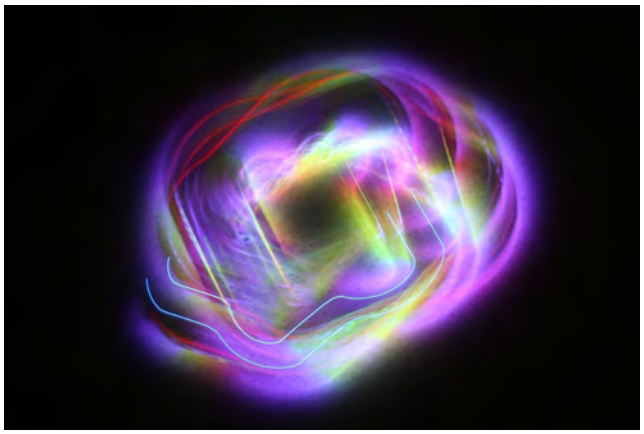


Figure 2. A generative algorithm that uses environment changes to affect the trajectory or "taxis". Sound was used as input. Color was used to represent the level of stimuli.

Figure 3 shows the results of an algorithm programmed into the vehicle reacting to external environmental variables, inviting to think about what Braitenberg describes as "kinesis". This reaction to the environment, while it does not contain carbon as other organisms, shows a behavior that might have some similarities to underwater snakes or microscopic protozoa.

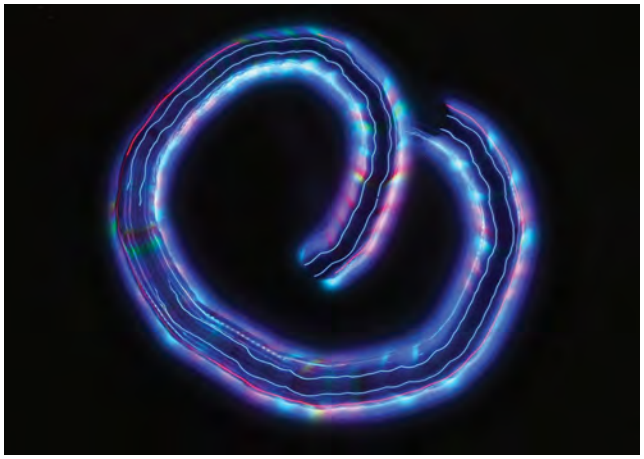


Figure 3. Attractor behavior or "kinesis", following an external stimulus. A light operated externally, not seen in the picture, guides the trajectory.

Technique

Pictures were taken using a DSLR camera[9] with different shutter speeds that variate from 8 to 30 seconds. The circuits used were handcrafted around an ARM0 based Open Source controller[10], driving two D.C. motors and sensing ultrasound, infrared and sound signals. The algorithm programmed had a pseudorandom timer related to the environmental changes and using five full color programmable LEDs[11] to indicate the current behavior mode, the external stimuli and the internal power status.

Future Work

Further exploration of how do these creatures interact with the environment will be done. As an example, in Figure 4 depicts "decussation" from the surroundings. The background of the picture was set up to reflect a mundane reality where these organic behaviors are acting, triggering meaningful conversations about artificial life and intelligence.

Figure 4. Similar algorithm to the one in Fig. 3 but in this case the background image was carefully chosen to make a statement of the surroundings that affect behavior.

The aesthetics of taking long exposure pictures matched the theme of biologically inspired robot behaviors. In figure 5 an experiment demonstrates two vehicles in an outdoor setup, behaving like a complex system that reacts to the environment but also affecting it. Future experiments will include algorithms that utilize machine learning to adapt themselves to the environment and interactions between different mobiles.

Figure 5. Outdoor setup with two Braitenberg vehicles moving while interacting with each other and the environment. "Decussation" behavior is evident in red color to avoid collisions.

References

[1] MinusE. Website, accessed November 25, 2018, http://minusetheartbot.me/about/
[2] RobotArt. Website, accessed November 25, 2018, http://robotart.org/
[3] Valentino Braitenberg, *Vehicles, Experiments in Synthetic Psychology* (MIT Media Press, 1984), 2
[4] Valentino Braitenberg, "Taxis, Kinesis and Decussation", *Progress in Brain Research,* Vol. 17, 1965.
[5] Video MIT Braitenberg Vehicles, 2014 , accessed November 25, 2018,
https://www.youtube.com/watch?v=VWeRC6j0fW4
[6] Hogg, Martin and Resnick, "Braitenberg Creatures" in *Epistemology & Learning Group, 1991,*
http://cosmo.nyu.edu/hogg/lego/braitenberg_vehicles.pdf
[7] Website, accessed November 25, 2018,
https://people.cs.uchicago.edu/~wiseman/vehicles/
[8] Iñaki Rañó, The bio-inspired chaotic robot, 2014 IEEE International Conference on Robotics and Automation (ICRA) , accessed November 25, 2018,
http://uir.ulster.ac.uk/29750/1/rano13chaos.pdf
[9] Canon EOS 6D. Website, accessed November 25, 2018,
https://en.wikipedia.org/wiki/Canon_EOS_6D
[10] mico:bit ARM0 microcontroller. Website, accessed November 25, 2018,
http://microbit.org
[11] Smart LED WS2812b Datasheet. Website, accessed November 25, 2018,
https://www.seeedstudio.com/document/pdf/WS2812B%20Datasheet.pdf

Getting Together: Biomorphism and Emergence

Kathrine Hardman
School of Art, Art History, and Design / DXARTS, University of Washington
Seattle, WA, United States of America
katmanhardrine@gmail.com

Abstract

Getting Together is an interactive electronic sculptural experiment in wireless social interaction, applying biomorphic textures to fabric, and emergence by failure. The work consists of several tentacles, which imitate, both in texture, and motion, living beings. They may coil away, out of reach, as the audience interacts with them. Originally, the work was a negotiation between the audience at large, and one audience member whose body was electronically connected to the sculpture. Touches to the sculpture were transferred to the person. The interface wearer, reacting to their situation, could cause the tentacles to coil away. This work changed over time, technical issues giving a new kind of biomorphism to the machine. Breaking free from an audience-driven motion, the tentacles developed their own independent, fearful consciousness. Now, rather than question the audience's physical interactions with itself, the work questioned the audience's interactions with this strange new entity, and by extension, questioned their interactions with "outsiders" in general.

Fig. 1, Wide view of *Getting Together* as it appeared at the Machines of Becoming exhibition.

Keywords

Biomorphism, Texture, Interactivity, Consent, Sculpture, Motion, Emergence, Otherness

Introduction

Getting Together (GT) is an interactive electronic sculptural experiment in applying biomorphic textures to fabric, wireless social interaction, and emergence. The work consists of several biomorphic tentacles hanging from the ceiling of a gallery space (see Fig. 1). The tentacles hang where the audience may touch them, but also have the ability to coil away from this touch. This was originally controlled by a consenting member of the audience. Through this, they could feel others touch the tentacle, and control the tentacles in reaction.

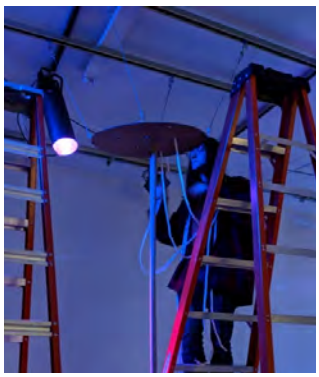


Fig. 2, Installation of *Getting Together* on the ceiling at The Grocery.

This work changed over time, technical issues giving new life to the machine. The interface device was abandoned, and the tentacles were made to move of their own accord. The freedom of giving the tentacles control of themselves gave new life to the project. Now it was not an audience exploring consenting touch by interacting with itself, but by illuminating their latent preconceptions about consent and touch through a biomorphic mechanical outsider.

Design

The construction of these tentacles consists of long lengths of rope, threaded through a large baseplate hanging from the ceiling, reaching almost to the floor (see Fig. 1 and 2). The tentacles have fishing lines hooked to stepper motors for movement, and copper wire sensors, running down their length. The wire serves as an antenna for a capacitive sensor system operated by an Arduino UNO.[1]

This system connects via XBee communications to a second wrist-mounted device. Through this device, touch sensed by the tentacles would be copied into a tug on the wrist, and motion of a finger bend sensor (made with velostat and e-textile techniques from KOBAKANT [2]) would be turned into movement of the tentacles.

Texture

The tentacles are wrapped in sewn fabric sheaths of a silky-smooth cloth the color of my own skin. These sheathes have a coating of two-part silicone mold mix thinly applied to them. After hand coating a ninety square foot piece of lightweight fabric with this and allowing time to dry, the fabric takes on a strikingly biomorphic texture. It is thickened by the silicone, and gains a skin-like texture. Imperfect drying practice, or rough touch, rips the skin and causes it to shed like artificial dandruff, or scabs, improving its biomorphism.

Interactivity

The audience was originally to interact with *Getting Together* by observing the tentacle's reactions to their touch. Some touches might cause no motion, while others might have the tentacle fly away. This mystery would climax when the audience discovered the tentacles were connected to another viewer (Fig. 3), casting light on how differently they behaved, with just a layer of separation.

Intent vs. Execution: Emergence

Prior to the gallery debut of *Getting Together*, the wrist-mounted device proved to be error prone, and the design had to evolve.

The original device relied on human choices to move the tentacle and facilitate interaction, but with the worn interface inoperable, I gave this choice to the Arduino mounted up on the baseplate. The sculptural machine now would react to touch by coiling up automatically.

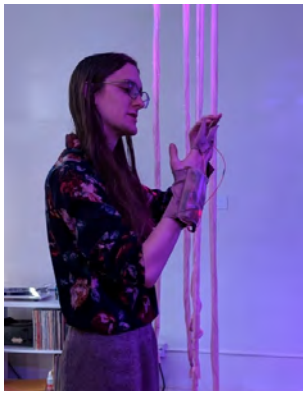


Fig. 3, Detail of Getting Together and its wearable interface at the Machines of Becoming exhibition.

In this *GT* became a key actor in its own existence. It grew an identity of its own. Now free from the weight of focusing on the human audience, it served itself. The rickety motor mount that would creak and whir when it moved, and its shivering jitters were no longer bugs of a machine struggling in its duty to humans, but personality traits of a mechanical individual.

The original philosophy of the work was to question the audience's interaction with itself, using the tentacles as a proxy for desired and undesired touch between humans. Whether the wearer of the interface moved their tentacles away was their choice. They could tacitly consent or disconsent, based on how they felt about how they were being interacted with. *Getting Together* sought to make ridiculously obvious the implicit play of consent with interaction. The tentacle represented a person, who demanded respect.

Instead, now, the tentacles were not just representing a person. *GT*, shivering with worry when audience members approached, would leave of its own volition when touched. By giving it a personality, a fear of touch, *GT* also gained its own personhood.

It was this biomorphism, not just in texture, but in character, that drove audience interaction. Rather than being a mask for audience interactions, *GT* was now a mirror for them. They were made to confront, by seeing this strange being's frightened reaction to their touch, the possibility that their actions could do harm. By being made to pay attention to how they behave around this strange being, they are called to pay attention to their behaviors around "strange," or "queer" beings outside of the gallery as well, and to take responsibility for their behaviors.

Acknowledgments

Thanks to everyone in the DXARTS program at UW, and in particular, my fellow students in DXARTS 472: Spencer Bowen, Chanhee Choi, Brenna Gera, Stevie Koepp, Will Perry, and Maxx Yamasaki. Most importantly, I must thank Afroditi Psarra and Cameron Frasier for teaching me everything I know about electronics, and arranging *Machines of Becoming*, where *GT* debuted. Thanks also to the good people at The Grocery: Janet Galore and Demi Raven, and their many friends who came along to help set up. I couldn't have come this far without all of your wisdom, and hard work.

References

[1] Badger, Paul. "Capacitive Sensing Library," Arduino Playground - WhatAdapter, accessed November 30, 2018, https://playground.arduino.cc/Main/CapacitiveSensor?from=Main.CapSense.

[2] KOBAKANT, HOW TO GET WHAT YOU WANT, accessed November 30, 2018, https://www.kobakant.at/DIY/

Author Biography

Kathrine Hardman is a senior at the University of Washington studying Interdisciplinary Visual Arts with a minor in DXARTS. Her primary interests are in queer art, and experimental interactive sculpture (art machines). Sexuality, and physical audience contact with her work are consistent themes. She recently had work appear in *Machines of Becoming* at The Grocery in North Beacon Hill, Seattle. She is transgender and proud.

Flower – inspired by the poem 'Flower' by Chun-Su Kim

1st Jeong Hyun Kim, 2nd Yang Kyu Lim
Advertising & Public Relations, Chung-Ang University[1] ,
School of Advanced Imaging Sciences, Multimedia and Film, Chung-Ang University[2]
Seoul, South Korea
mildjay16@gmail.com, lim0386@gmail.com

Abstract

This work is a consideration of the essence of existence. We need someone to really make us who we are. Inspired by the poem 'Flower' by the poet Chun-Su Kim, this work visualized the process by which meaningless thing turn into meaningful things when someone recognizes them. Participants interact with the artwork and complete it technically, and also its concept of existence. This work will provide participants something to ponder about the essence of existence.

Keywords

Flower, Interaction, Poem, Existence, Azalea, Face

Introduction

The 'Flower' is a poem by Chun-Su Kim, the poet of South Korea[1]. The poem is about a true meaning of existence. It says we can only be something from nothing, from a meaningless gesture to a flower it says, by someone calling our name. If someone wasn't recognized by no one, then we can't say that someone has existed truly. And maybe that's why all human beings always try to be somebody's something, something meaningful. This essence of existence is also true about any forms of artworks, including songs, movies, paintings, and poems. Especially an interactive art, it always be complete technically with some participants. Hence, the purpose of the artwork presented in this paper is to visualize the essence of existence intuitively. The visualization tool for this artwork is processing 3.3.7.

The poem – 'Flower'

Chun-Su Kim's poem 'Flower' reads as follows:

Before I speaking her name, she had been nothing but a gesture. When I spoke her name, she came to me and became a flower. Now who will speak my name, one fitting this colour and fragrance of mine, as I had spoken hers. So that I may go to her and become her flower. We all yearn to become something, yearn to become an unforgettable meaning to you. And you to me.

As it has been translated, this English version of poem may not deliver its own impression fully. But it conveys the meaning of poem almost same compared to the original one.

Basic components of the artwork

The idea is to turn a poem to a picture by a participant's interaction. Figure 1 shows the basic components of the artwork. Left side is the poem 'Flower' translated to English. And other side is the image of flower 'Azalea', which is also known as 'Korean rosebay' and 'Jin-dal-le' in Korean. 'Azaela' blooms in group, and all over the Korea. As this artwork's basic concept is to turn words into flowers, 'Azaela' is fitted with the visualization of this concept. The image of flower will be a brush that turns a poem into a picture. And the last component, not seen in Figure 1, is the face of a person to be painted with the brush of flowers.

By this concept, I expect the participants to be a part of

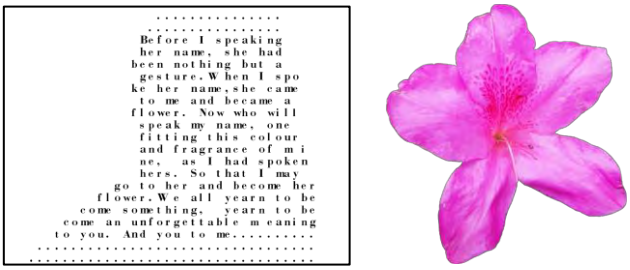


Figure 1. The poem 'Flower' and the flower 'Azalea'. ©2018 Jeong Hyun Kim

this artwork as they complete it technically, and thing about the true meaning of existence.

Process of the artwork

Figure 2 shows the process and the end-result of this interactive artwork. The words of poem are written in the position of hidden face of person. At first, they only provide abstract form of hidden person's face. But as the participant touches screen, the flowers' brushes reveal the true appearance of the artwork. As the words turning to a flower which has same color of touched position of hidden face of person, the abstract form changes obvious more and more.

The hidden picture could be a face of anyone. And of course, the result of artwork will be clear if the background

color of picture is one-colored, and significantly different with the face of person.

Figure 2. The process and the end-result of the artwork. ©2018 Jeong Hyun Kim.

References

Books

[1] C.S. Kim, *The sketch of the flower* (Baek Ja Sa, 1953), B6 Edition, Page92.

Origin of Contemporary *in situ*

Remediation of sound art and cognition

Jisoo Park[1, †], Beomseok Seo[2, †], Sangjun Park[3, *]

[1] Major of Media Interaction Design, Ewha Womans University, Seoul, South Korea
[2] School of Biological Science, Seoul National University, Seoul, South Korea
[3] Department of Physics and Astronomy, Seoul National University, Seoul, South Korea
[†] Equal contributors
* Corresponding author: cygnus30@hanmail.net

Abstract

This research employs a cognitive and neuroaesthetical perspective, focusing on the private/public duality that exists in each of us. Whether one prefers to be alone or in an intimate relationship, it is always possible to experience individual feelings among other people. We define the duality of this experience as a remediation of sound art and cognition. The concept of remediation allows us to connect the personal sounds people experience alone and the social sounds they experience collectively. As this study shows, this process extends through the bodies of others and serves as a mechanism by which individual experience is redrawn within a social context.

Keywords

contemporary, remediation, sound art, cognition, glitch, minimal music, neuroaesthetics, Iannis Xenakis, social context

Introduction

Discussions of beauty in the visual arts are common. We process most information through the eyes, and there has been extensive research on the brain responses that are linked to vision. On the other hand, people are less accustomed to talking about beauty in music, and the neural networks connected to hearing are less well known than those related to vision.

This research focuses on the experience of music. Music is as pervasive as the images inundating social media. Popular television talent competitions mainly involve singing. (Only one such program has focused on the visual arts in Korea, and it was largely ignored.) Yet although music continues to be widely heard on a range of platforms—from YouTube and Apple Music to television and radio—there has been little research analyzing it and the aesthetic concepts for doing so are underdeveloped. Neuroaesthetics, which studies the experience of beauty using cognitive and experimental methods, has mainly dealt with the visual arts, rarely analyzing changes in the brain or body in response to music. And while discussions on the relationship between the visual arts and society are common, research into the social context of music and sound is comparatively rare.

The music people listen to together has special importance for them. Most Koreans live in similar apartment houses but rarely communicate with their neighbors. However, in the winter of 2016, we had an unforgettable experience of making sounds with strangers in Gwanghwamun Square, the principal public gathering place in Seoul. One person's voice was small, but the sound of one million people filled the square. As the situation evolved, isolated individuals were transformed into a powerful community. Songs or chants that involve singing together in theaters and plazas as well as music heard alone on the bus or subway are equally important. This variety of musical experience reflects the degree to which we are both independent individuals and social beings.

This research employs a neuroaesthetical perspective, focusing on the private/public duality that exists in each of us. Whether one prefers to be alone or in an intimate relationship, it is always possible to feel individual feelings among other people. We define the duality of this experience as a remediation of sound art and cognition. Using a concept from J. David Bolter and Richard Grusin's book, *Remediation: Understanding New Media*, we connect the personal sounds people experience alone and the social sounds they experience collectively [1]. This process extends through the bodies of others and serves as a mechanism by which individual experience is redrawn within a social context.

Materials and Methods

Our research consists of three stages: (1) creating a musical experience, (2) conducting a neuroaesthetical experiment, and (3) developing an artwork.

Stage 1. In the musical experience stage, we compare listening to sound in collective environments with listening to sound alone. Experiencing one's own emotions while listening to music through earphones and playing music in a singalong in a festival are substantially different. The music we make with others, such as singing in public rituals, singing a chorus in a traditional Korean song like "Jindo Arirang," or singing a song "The First Clause of the Constitution" in candle protests, creates powerful feelings of solidarity. In this stage of research, we design a musical experience based on such public situations, creating a composition that involves the audience in a sound performance.

The work of Iannis Xenakis, who composed music using computer programs, provides the theoretical background. Xenakis studied the relationship between physical space and sound, and his efforts have led to the emergence of electronic music, glitch, and minimal music. For us, the transformation of sound by Xenakis's algorithm represents a process in which foreign theories and art forms were imported and transformed within Korea. This type of cultural recontextualization of aesthetic theories and forms can produce odd, disorienting, or novel effects. Using Xenakis's algorithm to transform familiar songs, we are able to develop completely new musical experiences.

Stage 2. Our neuroaesthetical experiment measures emotional reactions and brain responses to various musical experiences. Just as listening to music alone is different from hearing it together, the experiences of listening to western classical music and traditional Korean music are distinct. Any comparison of the two should also take into account the social context of someone living in 21st-century Korea. Listening to music in the contemporary U.S., U.K., or France will be different from the experience of Koreans. We therefore conduct a cognitive experiment to analyze how variables such as gender, culture, and religion contribute to different musical experiences. To do so, we collaborate with an expert on neuroaesthetics while taking Xenakis's methodology as a model for showing differences in musical experience.

Stage 3. In creating an art work, we aim to make new music that highlights the possibilities of sound art. To this end, we bring Xenakis's formalism into a contemporary context in order to propose a novel music and to develop a new algorithm with artificial intelligence such as machine learning. We then measure how traditional Korean music is influenced by electroencephalography (EEG) when new music is generated algorithmically. In this final stage, we collaborate with a group of experts, including a western classical music major, a traditional Korean music major, and a sound engineer to develop new sound works.

Discussion

Each weekend, musicians perform on the streets of Hongdae. As pedestrians stroll among singer-songwriters, hip-hop artists, and other performers, spectators and artists intermingle, sharing the same space, and the audience participates naturally and enthusiastically in an unfolding art situation. By contrast, contemporary art exhibitions attract far fewer viewers, even when the youth and accessibility of the artists on display might seem to encourage similar social interactions. Why this difference? Perhaps music operates on a more instinctual level than the visual arts. Whether through the singing of labor songs or religious hymns, or in the playing of music, this art form seems capable of touching everyone.

This study aims to defamiliarize contemporary music whose beauty may have become too familiar. We emphasize the great variety of sound artworks and musical experiences—from late-19th-century phonographs to music heard online and on smartphones, from music composed and performed by professional musicians to music that anyone can create with a computer. Of course, the basis of this work is the art experience. The healing and catharsis that can be achieved through art are ultimately the most important subjects of this research.

Reference

[1] Jay David Bolter and Richard Grusin, *Remediation: Understanding new media* (Cambridge, Mass.: MIT Press, 1999).

Bibliography

Bolter, J.D., Grusin, R. *Remediation: Understand-media* (Cambridge, Mass.: MIT Press, 1999).

A Social Robot design project by Project-based learning (PBL) for STEAM education

Jae Hwan So, So Hyeong Lee, Yeon Hyeoung Kim, Jin Young Youn*
Art Center Nabi
Seoul, Korea
Contact Emails: jyyoun@nabi.or.kr

Abstract

This study aims to develop an integrated education program that allows future users of social robots to personally contribute to the design process of social robots through project-based learning. Toward this aim, we selected a theme for the program that is relevant in modern school environments by examining the latest trends in the subject area. This program enables users to understand robot interactions based on basic knowledge of electronic circuits and to develop cooperative problem-solving skills in the process of designing emotional interactions between the user and the robot through engineering procedures.

Keywords

Social robot; Emotional robot; STEAM education; Project-based learning

Introduction

This study attempts to develop an engaging education program for students involving social robots that will enable them to experience designing social robot interactions that they feel are necessary from their perspective. The goal of this study is to allow future consumers of social robots to use their imagination in various ways through project-based learning and to create ways for social robot developers to reference these results.

Since Unimate, the first industrial robot, was added to the assembly line in 1950, robots have generally been limited to industrial roles that replaced physical human labor or aided in operations that required precision and were mostly designed to perform only specific functions [1]. However, recent technological developments have led to research on robots that can perform psychological roles, including interactions and physical demonstrations of emotions, beyond roles focused on calculated efficiency and accuracy. This has led to the emergence of social robots [2]. According to the market research organization Tractica, the world's social robot market has grown rapidly every year and is estimated to reach $4.57 billion in 2018. Determining how to establish social robots as engineered robotic devices used in our daily lives has become an important element in robots' continued development [3]. Therefore, this study strives to enable consumers who will live among social robots in the future to think about the necessary functions and interactions of social robots through project-based learning and to contribute to their research and development.

Additionally, robots are favored by teachers as effective teaching tools for introducing students to important areas of science, technology, engineering, and math [4]. Moreover, this study incorporates robot media art as content for integrated art and technology education. Thus, the program can be extended to offer students a chance to learn broadly, exploring topics from interaction characteristics to application examples, by teaching the concept of social robots through a combination of case studies and robotic artwork.

Material and Methods

The target demographic for the proposed program is 5th–6th grade elementary students who are between 11-12 years old. We analyzed topics that could be learned effectively using social robots and based on the analysis, designed the STEAM educational content.

Based on this design, a project-based structure was chosen for effective learning. The following elements constitute the project-based learning program:

- WONDER + ENGAGE
- INVESTIGATE + CREATE
- SHARE + REFLECT

The program consists of three classes, each fifty minutes long. Tables 1, 2, and 3 illustrate the structure of each class. The first session, "Understanding Robots," consists of research, exploration, and information-sharing activities on the topic of robots in general. Through this session, students will be able to discover robots that surround their lives and form criteria in order to categorize these robots. Moreover, the session provides a chance to learn more broadly, including examples of robots used in creative activities in artistic areas in addition to industrial.

Table 1. Understanding Robots

Topic	Understanding Robots	
Steps	Teaching/Learning activities	Time

Introduction	● WONDER + ENGAGE · Think about the definition of robots and share thoughts.	10 minutes
Main session	● INVESTIGATE + CREATE - Research robot varieties on the Internet and categorize them according to your own criteria. - Investigate various robot examples. - Inform students that robots can be used in creative activities in addition to labor through examples of robots used in artistic areas. - Students pick their favorite robot and present it to the class.	30 minutes
Conclusion	● SHARE + REFLECT - Reconsider and share thoughts about the definition, categorization, and roles of robots.	10 minutes

The second session, "Designing Social Robots," consists of exploration, activities, and expression on the topic of social robot design. Students will be asked to imagine future robots, understand what social robots are, and design their own social robots. By presenting their own social robots to the class, students can experience the pleasures of applying art and technology and a sense of achievement from their designs.

Table 2. Designing Robots

Topic	Designing social robots	
Steps	Teaching/Learning activities	Time
Introduction	● WONDER + ENGAGE - Students will be asked to share the roles and functions of their imaginary robots and the reasons behind them with the whole class or within their group.	15 minutes
Main session	● INVESTIGATE + CREATE - Inform students about robots that will be used in our daily lives in the future. Utilize videos to explore the definition of social robots. - Students design their own social robot · Imagine: a robot friend lives in my future home.	25 minutes
Conclusion	● SHARE + REFLECT - Students introduce their imaginary social robot.	10 minutes

The third session, "Building Social Robots," consists of experiences, activities, and expression on the topic of building social robots. Students will learn to understand electronic robot parts based on their designs and build their own social robots using basic equipment. The robots' exteriors will be built using a variety of materials. This session will help students develop analytical and visual-expression skills through understanding and experiencing the main elements of robot interaction with a social robot circuit-building kit.

Table 3. Teaching Plan Example for Building Social Robots

Topic	Building social robots	
Steps	Teaching/Learning activities	Time
Introduction	●WONDER + ENGAGE - Learn about sensors used for human recognition, actuators used for communicating with or alerting humans, and power sources that provide electricity to the electronic parts.	5 minutes
Main session	●INVESTIGATE + CREATE - Investigate materials to build social robots. - Students build their own social robots with a variety of materials. - Students add interaction functions to their social robots with the robot parts provided.	40 minutes
Conclusion	●SHARE + REFLECT - Students exhibit social robot.	5 minutes

Conclusion

This study proposed an education program for designing social robots that consists of three sessions. The program allows students to collaborate with each other and understand the engineering procedures behind robots and interactions with humans through the process of using their creativity to design social robots. Because the subject matter of social robots is interesting and attractive to children, the program will be highly effective in educating students in mathematical logic and art appreciation. Pilot sessions are planned through which we will build collaborative networks with other educators for future studies.

Acknowledgements

This work was supported by the Korea Foundation for the Advancement of Science and Creativity(KOFAC) grant funded by the Korea government(MOE)

References

[1] N. Scheidhauer and S. Assous, Generation robots (Actes Sud, 2015), 28.

[2] K. Ceceri and S. Carbaugh, Robotics: DISCOVER THE SCIENCE AND TECHNOLOGY OF THE FUTURE with 20 PROJECTS (Nomad Press; Build It Yourself, 2012. Mikhail Bakhtin), 149-154.

[3] John M. Jordan, Robots, (The MIT Press Essential Knowledge Series, 2016), 105-106.

[4] Johnson, Jeffrey, "Children, robotics and education," Artificial Life and Robotics, Vol. 7, No. 1-2, (2003): 16-21.

Hello, I am: Wearable to visualize personal digital data

Sindhu Giri, Khanin Sae Lim
University of Michigan—Ann Arbor, Stamps School of Art and Design
500 S State Street, Ann Arbor, MI United States
sindhgir@umich.edu, rsaelim@umich.edu

Abstract

Hello, I am is a futuristic prototype to embody digital identity. *Hello, I am* dynamically generates visualizations each day (24 hours) based on keyword usage in an individual's software applications. The visualizations metaphorically represent an individual's holistic mood throughout the day. *Hello, I am* is a personal emblem to the wearer. Thus, its physical design extends beyond decorative jewelry and becomes a bolder part of an individual's appearance.

Keywords

Data Visualization, Digital Fabrication, 3D Modeling, Programming, Speculative Design, Wearables, Processing

Introduction

Identity Construction In the future, personal identity will likely be more self-defined and regulated. Traditional identifying factors—name, gender, ethnicity, etc.—will become increasingly less important as people define themselves through their profession, political views, etc. Thus, the "invisible" and subjective aspects of an individual will be the most representative [2].

Digital Identity Disparities between an individual's portrayal physically in reality and virtually on digital platforms have and will become more apparent. Thus, when witnessing and assessing a person in reality, it is important to note that only a fraction of their self is revealed. It would be best to understand an individual through a combination of their digital data and physical demeanor [5].

Data Gathering

Software Applications *Hello, I am* uses three software applications—Google Mail, Twitter, and Google Calendar—to derive user data. These three applications encompass a range of digital communication and activities. Typically, Google Mail serves as an official method of communication between an individual and their coworkers and/or colleagues. Twitter is a much more casual environment with honest, unedited dialogue. Google Calendar is an event scheduler.

Programming Decisions Visualizations are constructed through controlled decisions and randomization. Each keyword are grouped into six broad emotions and each emotion is characterized by a set of five colors and three shapes. For each keyword, the specific shape and color is randomly chosen. Additionally, a randomization function is used for each color's Hue, Saturation, Brightness (HSB) values to create variation within set parameters.

Emotion Choices The six emotions holistically portrayed through *Hello, I am* are Anger, Sadness, Joy, Disgust, Surprise, and Love. The emotion choices were based on psychological theory on emotion categorization and universal emotions [3]. Each emotion has twenty keywords associations. The keywords range from being the most extreme manifestation of the emotion to being more ambiguous and neutral.

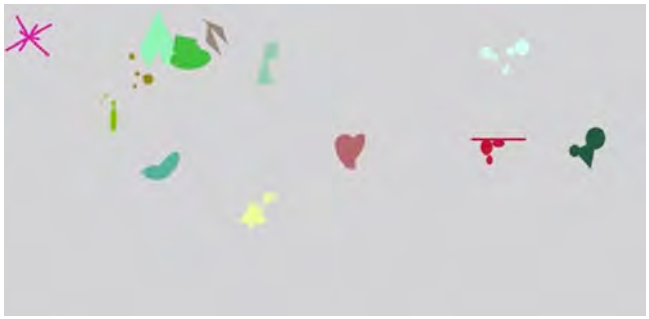


Figure 1. Screenshot of Processing generated visualizations based on personal Twitter data.

Design and Fabrication

Visual Design The style guide for the keyword visualizations defines colors and shapes for each emotion. The colors choices are grounded in existing societal and cultural connotations of emotion expression. Additionally, color theory and psychology were used to create a coherent color palette [1][4]. The emotion-shape associations were done in a similar way as the emotion-color decisions.

Brooch Design The physical design of *Hello, I am* should embody a special keepsake and positively emphasize the wearer. The aesthetics of statement jewelry and science fiction movies were highly influential in defining the form and material choices of *Hello, I am*. The organic, expansive form extends onto the wearer's shoulder and creates a sense of drama. The material choices of clear resin and steel streamline the form.

Figure 2. Front of *Hello I am* brooch

Conclusion

Proof of Concept *Hello, I am* uses a set of custom Processing/Python software that maps keywords to a complex set of visuals, but it is updated once per day rather than in real-time. In future iterations, *Hello, I am* should use an algorithmic method of generating the visualizations that accounts for intensity of feeling as opposed to solely the data quantity.

Future Uses In the future, *Hello, I am* might become a more expressive personal identifier transcending the ubiquitous but currently very limited nametag. Digital data visualizations can reveal aspects of an individual's inner identity which might not otherwise be seen. Thus, *Hello, I am* creates a starting point for better understanding each other and developing more meaningful relationships.

Figure 3. *Hello I am* worn and a close up of the visualization

References

Journal article (online)

[1] Dael, Nele, Marie-Noelle Perseguers, Cynthia Marchand, Jean-Philippe Antonietti, and Christine Mohr. "Put on That Colour, It Fits Your Emotion: Colour Appropriateness as a Function of Expressed Emotion." *PsycEXTRA Dataset*, 2013. doi:10.1037/e636952013-143.

[2] Epps, Sarah Rotman. "The Digital Self." *Journal of Marketing Theory and Practice*22, no. 2 (2014): 137-38. doi:10.2753/mtp1069-6679220204.

[3] Ou, Li-Chen, Yinqiu Yuan, Tetsuya Sato, Wen-Yuan Lee, Ferenc Szabó, Suchitra Sueeprasan, and Rafael Huertas. "Universal Models of Colour Emotion and Colour Harmony." *Color Research & Application*43, no. 5 (2018): 736-48. doi:10.1002/col.22243.

[4] Thorstenson, Christopher A., Andrew J. Elliot, Adam D. Pazda, David I. Perrett, and Dengke Xiao. "Emotion-color Associations in the Context of the Face." *Emotion*18, no. 7 (2018): 1032-042. doi:10.1037/emo0000358.

[5] Yee, Nick, Jeremy N. Bailenson, and Nicolas Ducheneaut. "The Proteus Effect." *Communication Research*36, no. 2 (2009): 285-312. doi:10.1177/0093650208330254.

Bibliography

Albers, Josef. *Interaction of Color*. Yale University Press, 2009.

Christian, Brian. *The Most Human Human: What Talking with Computers Teaches Us about What It Means to Be Alive*. Anchor Books, 2012.

Itten, Johannes. *The Art of Color: the Subjective Experience and Objective Rationale of Color*. Reinhold Pub. Corp., 1961.

Munari, Bruno. *Bruno Munari Square, Circle, Triangle*. Princeton Architectural Press, 2015.

Author(s) Biography(ies)

Sindhu Giri is pursuing a BA in Art/Design and a BS in Information at the University of Michigan—Ann Arbor. Her creative work is focused within a few areas: programming, user experience, future studies, and digital fabrication. Sindhu is interested in the disparity between emotional humans and detached machines. She hopes to develop digital artifacts—interfaces, systems, or services—to best achieve people's goals.

Khanin Sae Lim is pursuing a BS in Computer Science and a BA in Art /Design student at the University of Michigan—Ann Arbor. He has a range of interests from conceptual painting to software development. He hopes to bridge the gap between functionality and aesthetics in his future endeavors.

Gendynish: Stochastic Synthesis on the Arduino

Andrew R. Brown
Griffith University
Brisbane, Australia
andrew.r.brown@griffith.edu.au

Abstract

The Gendynish algorithm is software that runs on Arduino-class microprocessors to produces sounds similar to Iannis Xenakis' dynamic stochastic synthesis. This article outlines the origins of stochastic synthesis and describes the Gendynish algorithm and associated electronic instrument development and performance outcomes. This algorithm takes a somewhat unconventional approach to Arduino audio. In doing so it demonstrates how once cutting-edge computer music practices are now much more accessible and that the spirit of creative expression through audio technologies remains alive and well.

Keywords

Sound, music, audio, software, hardware, computer, microprocessor, Arduino, performance, interactive.

Introduction

In the 1990s Iannis Xenakis developed a new probabilistic audio generation method called Dynamic Stochastic Synthesis that produced quite unconventional sounds. This process reflected his interest in "human intelligibility [of] temporal periodicity and the symmetry of the [waveform] curves" generated by digital devices [1: 289]. Two notable works using this technique were composed by Xenakis, *Gendy3* and *S.709*. Xenakis applied probability theories to the construction of both musical structure and the generation of sound. This synthesis technique applies constrained random processes to waveform construction. The amplitude and time position of each break point are varied at each cycle of the wave by a constrained random walk function. The original implementation of dynamic stochastic synthesis was in the *Gendyn* (GENeration DYNamique) program, written by Xenakis in BASIC with the assistance of Marie-Hélèn Serra and rendered audio files to disk [2].

Inspired by this process and the works the Gendynish project took advantage of the rapid advances in technology to produce a simile of stochastic synthesis on the low-cost Arduino microcontroller. The algorithm runs in real time and emulates the four-voice architecture of Gendy3 and outputs quadraphonic audio.

The author previously engaged with dynamic stochastic synthesis in 2004 coding the first real time, interactive, implementation of the process. The IDSS (Interactive Dynamic Stochastic Synthesizer) is an implementation of the dynamic stochastic synthesis algorithm in the jMusic environment (Java programming language).

IDSS

The IDSS system was presented and performed with at the Australasian computer music conference in 2004 [3] and the International computer music conference in 2005 [4]. As well as being real time, IDSS enabled some other extended features. Stochastic percussion sounds were achieved by automating a quick reduction in all random walk time-step amounts. This resulted in a rapid change from a bright complex timbre to a fixed and stable tone. The interpolation between breakpoints in the waveform could be switched from linear to cosine interpolation with the effect of smoothing the wave and controlling harmonic complexity. IDSS was designed as a real time instrument performed via MIDI controllers. The performers guide the software between sets of probabilities that determine the sonic microstructure.

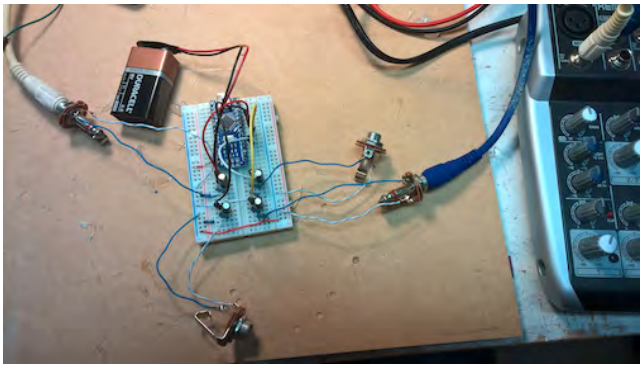


Figure 1: A Gendynish instrument prototype

Gendynish Algorithm

The Gendynish algorithm on the Arduino produces sounds similar to Iannis Xenakis' dynamic stochastic synthesis but is technically only 'in the spirit' of that process and is not a literal reconstruction, unlike IDSS. The Gendynish project arose as the aurthor was experimenting with generating audio directly from the pin outs on Arduino microprocessors, and noticed that some of the sounds were reminiscent

of those produced by the GENDY program. On the Arduino, a pin on the microprocessor produces a monophonic output, so four pins were used for the desired polyphony. Voltage output from a pin typically ranges from 0-5 volts and so scaling and DC offset was required to make the output suitable for connecting to a line level audio input. Figure 1 shows an early prototype with resistors and a capacitor on each of four pins to manage the output voltage.

The pin outs of an Arduino microprocessor lend themselves to pulse width modulation (PWM) output. This is what was used in the Gendynish algorithm and why is was only an approximation of the dynamic stochastic synthesis. To maintain the independence of the four pin outputs the timing of the pulse wave frequency was controlled within the main loop of the code, rather than by manipulating the microprocessor timers. This is computationally inefficient but allows more polyphonic flexibility. Because of the inefficiency a Teensy LC microcontroller was used for the performance because it is faster than many genuine Arduino microprocessors, yet software compatible. By probabilistically varying the frequency and pulse width of the pin output a surprisingly wide variety of timbral results were possible. Code for the Gendynish algorithm is available on GitHub.[1]

Performance 1 - A.001

The first performance of the Gendynish system was a composition by the author titled A.001 which ran in real time without human intervention and was played through a quadraphonic sound system. The work, performed in early 2018, had a number of contrasting sections and automatically moved between sections during the performance. A stereo recording of this piece is available online.[2]

Performance 2 – A.001.i

A second performance of the Gendynish system in late 2018 incorporated interactive control of parameters by the

performer. The software was updated to include three rotary-push controls that adjusted probabilistic boundaries for frequency and timing and enabled manual sectional changes. LED lighting that synchronized with audio was also added for visual interest. The performance was based on the first composition, and thus titled A.001.i acknowledging the addition of interaction. A recording of this performance is available online.[3]

Figure 2: Performing A.001.i

Conclusion

This project demonstrates that the past and present can come together in interesting and expressive ways. The Gendynish project draws inspiration from Iannis Xenakis and his innovative use of probabilistic processes to explore the nature of digital sound making. The project also utilizes accessible contemporary computing hardware whose cost to compute-power ratio would have astounded pioneers such as Xenakis. The value of open hardware and open source software, that is a feature of the Arduino project, is clearly demonstrated through outcomes such as these. Yet despite building on widely available platforms the Gendynish algorithm uses them in unconventional ways, continuing the artistic tradition of bending technologies to meet expressive desires.

References

[1] Xenakis, Iannis. *Formalized Music: Thought and Mathematics in Music*. Stuyvesant NY: Pendragon Press, 1992.

[2] Serra, Marie-Hélèn. “Stochastic Composition and Stochastic Timbre: Gendy3 by Iannis Xenakis.” *Perspectives of New Music* 31, no. 1 (1993): 236–57.

[3] Brown, Andrew R., and Greg Jenkins. “The Interactive Dynamic Stochastic Synthesizer.” In *Proceedings of the Australasian Computer Music Conference*, 18–22. Wellington, New Zealand: ACMA, 2004.

[4] Brown, Andrew R. “Extending Dynamic Stochastic Synthesis.” In *International Computer Music Conference*, 111–14. Barcelona, Spain: ICMA, 2005.

Author Biography

Andrew R. Brown is an active computer musician, computational artist, builder of creative software tools, researcher and supervisor of research students. He is Professor of Digital Arts at Griffith University in Brisbane and Program Director for the Bachelor of Creative and Interactive Media.

[1] https://github.com/algomusic/Gendynish/tree/master

[2] https://soundcloud.com/thejmc/a001

[3] https://soundcloud.com/thejmc/a001i-at-os11

A study on images that can give intensive perception in photo archive exhibition

Dongwoo Shin, Yongsoon Choi
Dept. Art & Technology. Sogang University
Seoul, 04107, Republic of Korea
deows@sogang.ac.kr, goodsoon96@gmail.com

Abstract

The use of photographs for records is still being done as a significant medium for archives. The museum uses those photo-graphic records to organize exhibitions so that visitors can experience educational, aesthetic, and emotional experiences. However, the perception in a diversified digital medium has a form different from that of existing photographs. This is caused by common digital devices and by a visually stimulating form when exposed to the user by them. Therefore, this study aimed at proposing a display method using cinema graphs as a photograph that visitors can focus more on an exhibition consisting of photo archives. Art galleries and museums plan or archive exhibitions by using that collected pho-to graphs as visual materials.

Keywords

'Aesthetic Experience', 'Complex perception', 'Digital Photo Archive', 'Digital Exhibition'

Introduction

Photographs have enabled the realistic reproduction of fine details beyond describing objects with human hand [1]. In particular the pictures are being considered as a medium used mainly today as a major one for recording and collecting [2].

Figure 1 *Boulevard Henri IV (from the rue de Sully) (fourth arrondissement),* c. 1877, Charles Marville: Photographer of Paris © Musée Carnavalet & The Metropolitan Museum of Art

It is available to organize exhibitions by directly creating records of artifacts, remains, cultures, customs, etc. in a form using the digital composite media like VR(Virtual Reality), addition to traditional photographs and videos, according to the exhibition plan, and to experience the exhibition space and content with VR on the web. New media art that emerged due to the development of digital technology allows viewers to have a more expanded visual-perceptual immersion, compared to photographs, the traditional visual media arts [3].

In particular, the exhibition made up of traditional visual media, including paintings and photographs, are currently made in various ways through digital media because of technical and environmental changes, but they appear in a form similar to traditional media in the aesthetic experience of the visitors who appreciate artworks [4]. However, a different form of perception appears from classic works in content displayed around digital media [5].

This is due to media differences by the differences of perception methods, meaning that people are familiar with the digital media they usually encounter, and there are differences in the factors that they can focus on the image itself in due to different perception methods in viewing static images, so that this study suggested a content method of photograph archive exhibitions using cinema graphs allowing them to focus a little more by considering the differences of perceptual elements.

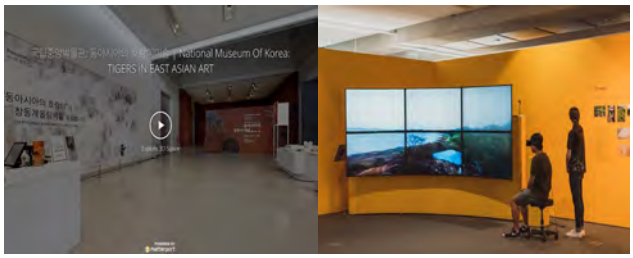


Figure 2 Tour using VR on the web of the National Museum of Korea, VR Media of "Sri Lanka Modern Architecture" Exhibition at Asia Culture Center © National Museum of Korea & Asia Culture Center

Form of perception

Images composed of photographs and videos have a more powerful perceptual effect that is looking through the eyes [6]. Human perception representations are organized through a kind of forms or arrangement, the sort of photographs using the Gestalt elements [7], appears in the way of 'intensive perception,' but on the contrary, the image appears as 'distributed perception'[8]. For this reason, it has a different acceptance method from the stationary image. Also, 'complex perception' appears, which there are multiple senses on images, in the diversified digital media.

Proposal for cinema graphs with the complex perception

The cinema graph used in this study utilized 'After Effect' as a method to achieve little motion in a single picture unlike GIF images that several pictures move with its similar effects, and the creation of the prototype is described below, and the overview of system operation as exhibition methodology is as follows.

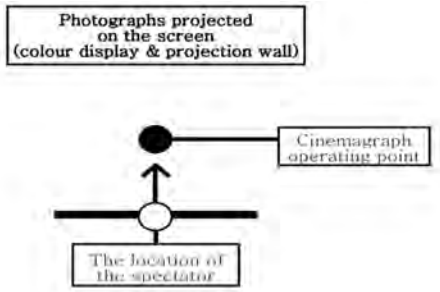


Figure 3. cinema graph system overview.

Creation of a cinema graph's prototype

The photograph used to make the prototype is the one for the whole view of The Greenhouse of Changgyeonggung Palace, and the Japanese Room of Chundangji Pond recorded in the period of Japanese occupancy and held in the Seoul Museum of History. Also, the creation of the prototype implemented movement ele-ments in the pond area at the bottom among the remaining parts except for the top field in the picture. The movement implemen-tation was carried out to allow interaction with visitors in a short time within 20 seconds unlike existing still photos and was de-signed as a way to induce their progressive attitudes of apprecia-tion as a digital medium with a complicated perception method. Especially, for this study, it is to propose a method of the exhibi-tion through Cinema graphs in a way that allows visitors to focus visually on viewing works at the traditional medium, photo-ori-ented data exhibition. We can see files such as pictures and videos built on the Web regardless of the time and space that are different from traditional methods of exhibits by advanced digital technol-ogy and environment, and display using VR con-tents is becom-ing possible. However, the way these various technologies are displayed can hurt the nature of the image itself in an exhibition of photos kept for historical facts and records.

Figure 4. A photograph for the whole view of The Greehouse of Changgyeonggung Palace and the Japanese Room of Chundangji Pond used for the prototype implementation(left) and a photograph comparing the implementation of the movement elements when working with the prototype(right). © Seoul Museum of history

Figure 5. The final product of the prototype

https://drive.google.com/file/d/196VxTWqf6kS32_R7GHuPTI6rkmuah7Gl/view?usp=sharing

Conclusion

Interaction with visitors is achieved through acceptance based on 'complex perception' unlike traditional perception methods in appreciating works using digital media. However, content in photograph archive exhibitions using cinema graphs, proposed in this study, was examined through different perception methods for each medium under the premise that the audience who are accustomed to digital media and content can't focus on the exhibition composed only of photographs.

It is expected that it will be able to be used as content that is easy for the audience who are familiar with the digital environment to focus more on the exhibition using photograph archives collected for recording.

Acknowledgements

This research was supported by the MIST(Ministry of Science ICT), Korea, under the National Program for Excellence in SW)(2015-0-00910) supervised by the IITP(Institute for Information & Communications Technology Planning & Evaluation)

References

[1] Newhall, B. (1982). The history of photography: from 1839 to the present (p. 129). New York: Museum of modern art.

[2] "What is Anthropology?", American Anthropological Association web-site, accessed December 05, 2018, https://www.americananthro.org/AdvanceYourCareer/Content.aspx?ItemNumber=2150&navItemNumber=740

[3] GRAU, Oliver. Virtuelle Kunst in Geschichte und Gegenwart. *Visuelle Strategien, Berlin*, 2001.

[4] YoungEun Kim, "The research of survey on Interaction and Immersion experience", *(Journal of Next-generation Convergence Information Services Technology)* 2013, vol.2, No2, pp. 67-7255

[5] Jowon Park, 2011, "Experience Economy of Cultural Consumption : A Survey of Museum Visitors," The Journal of Cultural Policy, Vol. 25, No. 2, pp. 217~241.

[6] *Berger, J. (2008). Ways of seeing (Vol. 1). Penguin uK.*

[7] *Zakia, Richard D. Perception and imaging: Photography—A way of seeing. Focal Press, 2013*

[8] *Benjamin, Walter. The work of art in the age of its techno-logical reproducibility, and other writings on media. Harvard University Press, 2008*

VR Content 'Four Seasons' for Alzheimer

***Bo-Yeon Kim, *Joo-Chan Kim, *Sunny Thapa Magar, *Min-Hye Pak, **Hae-Jung Suk**

Affiliation (s): *Life-media Department, Ajou University/ **Department of Digital Media, Ajou University

Location, Country: 206, World cup-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea

Contact Emails: dbdip@ajou.ac.kr

Abstract

'Four Seasons' is a Virtual Reality (VR) interactive content specially designed for the dementia patients, allowing them to enjoy the scenery of the four seasons of Korea and to interact with the 3D models representing the phenomena of nature based on Gesture-based user interface. It proceeds using the user's hands movements and following the voice narration of a character (NPC) in the background of illustrated art. When the user interacts with the 3d models, it can help dementia patients engage and enhance their intuitiveness. This project shows that using Human-computer Interaction of VR and bio-sensors could help not only the patient's cognition but also support the emotional state.

Keywords

Virtual Reality (VR), Gesture-based User Interface, Alzheimer patients, Human-computer Interaction

Introduction

Dementia, one of the causes of Alzheimer, is a family illness that needs to be taken care of by the patient's family or caregivers for 24/7, and the burden spreads to not only the family, but also the whole country. In the case study of patients with dementia, it is known that game-based contents require their judgment and reactions are more effective in suppressing dementia rather than passive acceptance like watching videos [3]. Therefore, this content is intended to extend the patient's playing time by giving various game factors along with the illustrated art and the character (NPC) and inducing the interest of the patient.

Gesture Based Interface

The theory of Presence used in the content applied the gesture interface in the form of a transparent interface, which is a non-meditated expression concept as Bolter & Grusin [1] advocated. The interacting element is based on the sense of liveness and interaction of sense among the presence determinants claimed by Sung-Jin Kim [2]. There is a Natural User Interface (NUI) that directly interacts with a user's body without any additional device to help realistic interaction and natural experience in a virtual en-vironment [4]. Therefore, in this content, we used Leap Motion for the gesture-based control interface and the voice narration replacing the text-based information which is one of NUI type for cognitive transparency or interface which does not bother the immersion of virtual reality ex-periences [1]. Thus, it minimizes Graphic User Interface (GUI) which is not accommodating with HMD based VR by using different media characteristics.

The Scenery of 'Four Season'

This content was intended to reproduce the scenery of a beautiful village in the countryside of Korea in VE. So, the traditional mountain valley, the stream flowing between the

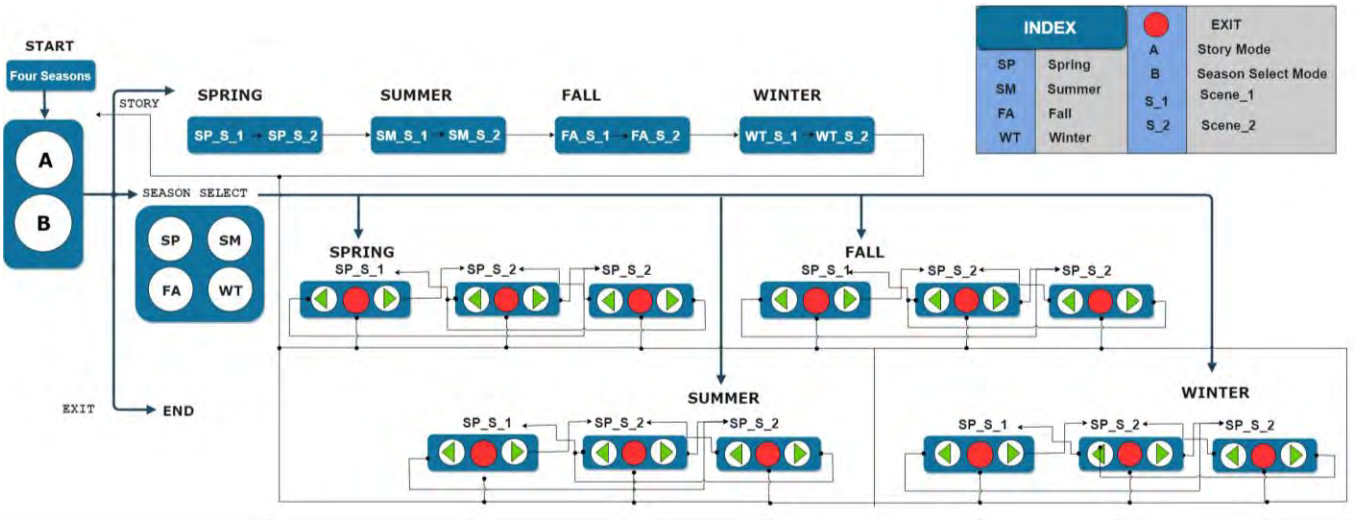


Fig 1. 'Four Season' flow chart

foothills and the sound effect that seems to be in nature is implemented, which brings the nostalgia to the elderly and a new experience for young people. The scarecrow, snowman and the cow on the screen in each season are the elements that help the dementia patients feel relaxed.

Interactive Elements

3D Character

A little girl welcomes the user using the voice, gestures, and emotions.

Fig 2. 3d Character (Host) greeting.

Selection Mode

The scene appears after the user touches the butterfly. There are two options: 'Story' mode and 'Season select' mode, where the user can select either one by grabbing the virtual button with the hand gesture. The story mode proceeds sequentially according to the story, and the season select allows the user selects each season and play in the season.

3D Assets

In spring, the user can observe the surrounding flowers and perform the hand gesture for blooming as the buds are touched by following the little girl's guidance.

Fig 3. User performing hand gesture on flower buds making them bloom and butterfly sit on hand.

The butterflies can be seen in spring, fireflies in a summer night and dragonflies in autumn. The character's voice guides the interaction so that the user can perform accordingly. Interactions of butterflies, fireflies, and dragonflies can be simulated according to the user's hand gestures and even make them sit on the hand.

During summer, there is a stream flowing down the mountain towards the valley, visualizing the pleasing moments of playing ducks and drakes rippling the calm water. The user enjoys grabbing a small rock and throwing in the stream. As the rocks skim the water surface, bubbles pop up with a sound.

In autumn, the reeds are visible, and a background voice of the little girl guides the user. The user can experience the natural movement like shaking the reeds as his/her hand gesture.

Acknowledgement

The software list that are used in production is Unity, Maya, 3D Max, and Adobe Photoshop. HTC VIVE, and Leap Motion were used for the device. This product belongs to TeamZepa Inc, and the production was collaborated with Eunhye hospital and IE lab. in Ajou University.

Reference

Books

[1] Jay David Bolter & Richard Grusin, Jea-Hyun Lee Translate, *Reparamet: Genealogy of New Media* (Seoul: Communication Books, 2006).

Journal article (print)

[2] Kim Sung-jin and Kim Se-Hwa, "Interactive design study for enhancing presence experience in an experiential exhibition space", *Conference of Korean HCI Society*, (2010): 547-553.

[3] Jiaying Zheng, Xueping Chen and Ping Yu,"Game-based interventions and their impact on dementia: a narrative review", Australasian Psychiatry, (2017), Vol 25(6) 562 – 565.

Websites

[4] June.ee "Natural User Interface(NUI) ", accessed June, 2013, http://story.pxd.co.kr/731

Bibliography

[5] Bo-Yeon Kim and Hae-Jung Suk, "A case study on Metaphor forms of User Interface in HMD based Virtual reality FPS games," *Korea Game Society Journal* Vol.18, (2018).

[6] Gene D. Cohen and Kimberly M. Firth, "The First Therapeutic Game Specifically Designed and Evaluated for Alzheimer's Disease", *American Journal of Alzheimer's Disease & Other Dementias,* Vol. 23, accessed November (2008): 540-551. https://journals.sagepub.com/doi/abs/10.1177/1533317508323570

[7] Sang-won Kim, "Development of Functional Game Contents for Dementia Treatment and Prevention", *Korea Computer Game Society Journal,* No.4, accessed June, (2004). http://www.dbpia.co.kr/Journal/ArticleDetail/NODE02372605#

Authors Biographies

DF (Digital Film) Lab is an academical digital film laboratory at the Department of Digital Media, Ajou University. The lab has accomplished the several studies on interactive media contents, VR, AR contents. as well as traditional computer animation, films.

The New ways to express music with Virtual Reality

1st Yang Kyu Lim, 2nd Jung Ho Kim, 3th Jin Wan Park
School of Advanced Imaging Sciences, Multimedia and Film, Chung-Ang University[1, 2],
College of Software, Chung-Ang University[3]
Seoul, South Korea
lim0386@gmail.com, jungho10050@gmail.com, jinpark@cau.ac.kr

Abstract

We visualized music on the assumption that we can see music without limiting it to simply listening. Visualization was done using VR method using Unity 3D. Visualization through VR was able to confirm the developmental potential in terms of educational and artistic aspects.

Keywords

VR, Virtual Reality, Musical Visualization, Music

Introduction

Music is an art genre that is transmitted through the sound of waves. But what we have noticed is that we can visualize music. Many researchers have tried to visualize the sound. Especially, attempts such as Windows Media Player have become a meaningful visualization, and new attempts such as musical skyline are appearing steadily.

There are many reasons for visualizing music. There are two reasons why we try to visualize.

The first reason is an attempt as a new educational method for human senses to interpret and learn music through the eyes. The second is the composition of new art works through music visualization. The person who plays and selects music is called DJ. Recently, besides simple music, there is a job called VJ that synchronizes with the video. VJ brings visual maximization by showing images that respond to music.

To visualize music, we use score information. The score can be converted to digital information such as midi or musicXML. The transformed information shows real-time movement in a block and colored form in our virtual reality space. VR is a technology used for games and experiences that have become a recent issue. However, in our VR world, music information comes out like Figure 1.

Each block color represents the pitch and the X-axis represents the elevation of the octave. Blocks that oscillate in real time have the same feel as waves.

The VR world is made up of three dimensions as opposed to a flat monitor, allowing multiple viewing angles.

Figure 2 shows VR music visualization from different angles.

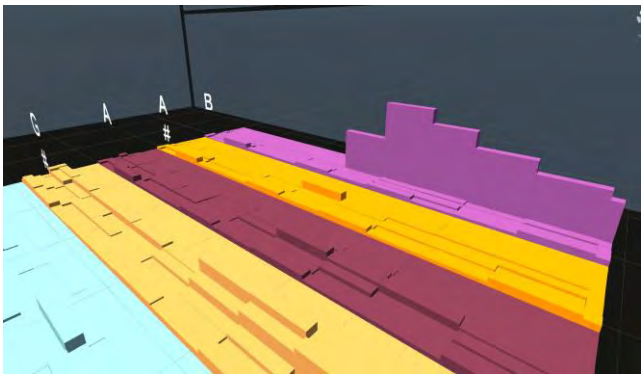


Figure 1 Each block color represents the pitch and the X-axis represents the elevation of the octave

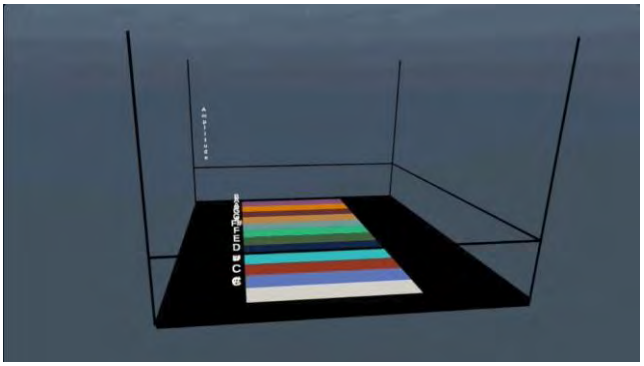


Figure 2 In the VR environment, you can freely change your gaze.

Result

In this study, we created a program to visualize music as VR and experimented with the prototype. Music visualization implemented through Unity 3D is now implemented in simple block form through VR, but it will pursue visual polyphony by adding various 3D objects in the future.

References

[1] Wikipedia, “Skyline”, Wikipedia website, accessed December 20, 2018, https://en.wikipedia.org/wiki/Skyline

Music Creation Tool using Hangul, Korean Alphabet

1st Yang Kyu Lim, 2nd Gang Ta Choi, 3th Jin Wan Park
The Graduate School of Advanced Imaging Sciences, Multimedia and Film, Chung-Ang University[1],
School of Computer Science and Engineering, Chung-Ang University[2],
College of Software, Chung-Ang University [3]
Seoul, South Korea
lim0386@gmail.com, cminor_delf@naver.com, jinpark@cau.ac.kr

Abstract

Hangul is the motif of the oral form. We developed a program to make and play music using Hangul principles. The program is an upgraded version of our existing programs and we plan to use it for various future performances.

Keywords

Hangul, Korean Alphabet, Music, Sound Art

Introduction

Korean Alphabet, also known as Hangul, has been used to write Korean since King Sejong the Great invented it in the 15th century. Its founding principles and procedures are written in a book called Hunminjeongeum. Hunminjeongeum was registered as a UNESCO World Heritage Site.
We refer to the content of Hunminjeongeum, which has a relation between Hangul and human vocalization, to produce a sound, and eventually to produce a performance tool that changes the music.

The book of Hangul, Humminjeongeum

Korean words consist of an initial consonant and a vowel or sometimes a consonant placed under a vowel. According to Hunminjeongeum, Hangul consonant is a form that uses the shape of the oral cavity to form a voice. Throat, tongue, mouth shape, etc. are made in the form of letters. The vowels are based on the principle of Yin and Yang.

Initial consonant	ㄱ ㄲ ㄴ ㄷ ㄸ ㄹ ㅁ ㅂ ㅃ ㅅ ㅆ ㅇ ㅈ ㅉ ㅊ ㅋ ㅌ ㅍ ㅎ
Vowel	ㅏ ㅐ ㅑ ㅒ ㅓ ㅔ ㅕ ㅖ ㅗ ㅘ ㅙ ㅚ ㅛ ㅜ ㅝ ㅞ ㅟ ㅠ ㅡ ㅢ ㅣ
Consonant	( ) ㄱ ㄲ ㄳ ㄴ ㄵ ㄶ ㄷ ㄹ ㄺ ㄻ ㄼ ㄽ ㄾ ㄿ ㅀ ㅁ ㅂ ㅄ ㅅ ㅆ ㅇ ㅈ ㅊ ㅋ ㅌ ㅍ ㅎ

Table 1 Composition of Hangul characters

Hangul uses a combination of two to three letters to create a single letter. The form depends on the vowel. When a vowel is, "ㅏ, ㅐ, ㅑ, ㅒ, ㅓ, ㅔ, ㅕ, ㅖ", neutrality is written on the right side of the beginning. When a vowel is, "ㅗ, ㅛ, ㅜ, ㅠ, ㅡ", write neutrality to the bottom. If there is a consonant, put it under it. If the vowel is a combination of a vowel on the bottom and a vowel on the right, such as "ㅘ, ㅙ, ㅚ, ㅝ, ㅞ, ㅟ, ㅢ", write down first and then right. A consonant likewise writes to the bottom. Table 2 shows the rules.

Vowel	Shape	Example
ㅏ, ㅐ, ㅑ, ㅒ, ㅓ, ㅔ, ㅕ, ㅖ, ㅣ		아애야얘어에여예이 악앤
ㅗ, ㅛ, ㅜ, ㅠ, ㅡ		오요우유으 옥윤
ㅘ, ㅙ, ㅚ, ㅝ, ㅞ, ㅟ, ㅢ		와왜외워웨위의 왁왠

Table 2 The form of Hangul. In shape, pink indicates initial consonant, green indicates vowel, blue indicates consonant [1].

Program Design

The program is designed to work with smartphones. The Hangul input method is known to be very difficult compared to what we write easily.
First, build a server for chat. Members will connect to the server and enter text. The input Hangul produces music and beat according to the classification and displays the text on the screen.

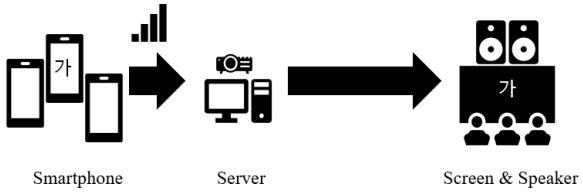


Figure 1 The text input to the smartphone are displayed on the screen with music through the server.

To improve program compatibility, we used nodeJS and P5JS based on Javascript. The initial consonant indicates

19 notes from D3 to G#4. The vowel is a measure of the length of a note. Finally, consonant represents a chord.
In case of visual source, we used customized font of Korean typewriter. The Hangul typewriter does not distinguish Korean consonants, so it cannot match the height of characters as shown in Figure 2.

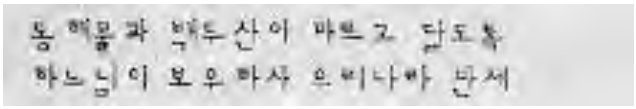


Figure 2 Hangul typewriter cannot match letter size equally [2]

We also gave it an antique feel using these features. Figure 3 is a sample of the word Hangul.

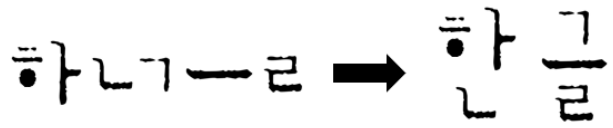


Figure 3 It is a transformation process of the font used in our work. The meaning of the letter is Hangul.

Conclusion

We have already used various programs to create music using Hangul. We have developed a new program for upgrading, and as a result, we have developed a music program that approaches the following pronunciation principles of Hangul.
In the future, with more detailed modifications, we will be able to perform text-based performances with existing music playing programs.

References

Websites
[1] Wikipedia, “Hangul”, accessed December 20, 2018, https://en.wikipedia.org/wiki/Hangul#Letter_design
[2] Namuwiki, “typewriter”, accessed December 20, 2018, https://namu.wiki/w/%ED%83%80%EC%9E%90%EA%B8%B0

Mapping_Me: a shared virtual environment of media archives controlled by a tangible interface.

Yan Breuleux, James Partaik (as equal co-authors), Rémi Lapierre
UQAC, Université du Québec à Chicoutimi
Chicoutimi-Montreal, Quebec, Canada
Contacts ybreuleux@nad.ca, jpartaik@uqac.ca

Abstract

"*Mapping_me*", the title of this artistic research project is inspired by many questions: can archives constitute a conceptual map, a personality? Is the mapping of place through a particular viewpoint a form of self-portrait, a selfie? Are we not, through self-archiving processes, mapping not only the real but also the individual? This Work in Progress (WIP) is currently at the stage of its second iteration. The project *Mapping_me* consists of a multi-User virtual reality installation allowing the Users to navigate within spatialized and geolocalized visual and sound archives using an innovative tangible interface. Specifically, the installation consists of an augmented rotating chair as a physical interface to navigate through a metaverse of digital content incorporating photographs, panoramas, texts, sounds and photos-videos in *Fulldome* format. The system structure allows one to quickly integrate new content into the virtual environment. The tools developed allows to generate media footprints of places and spaces diffused within a shared space in a virtual reality context. The installation makes it possible to represent not only the spaces and places but also to transpose the urban and human atmospheres thus making it possible to propose a new experience of a place as a form of sensory amplification.

Keywords

In-between, Altered Reality (VR/AR/MR)], Immersive soundscape, environmental storytelling, sound maps, virtual heritage, tangible media, Intangible heritage, new interfaces.

Introduction

Abraham Mole, cyberneticist, theoretician of micro-psychology and pioneer on the relation between the art, the computer and aesthetics described the artist as an "engineer of emotions" (Moles, 1971, 1972, 104). Inspired by the experiments of artists such as Victor Vasarely and Nicolas Schöffer, Moles suggests that "the artist no longer makes works, he makes ideas for making works made by computers" (Moles 1972, 142). He has also been at the root of a certain conception of the arts of space: "The arts of space are first and foremost those which construct our sensual perception of the space which is offered as a sum of experiences". According to Mole, the arts of space are spaces to be put into practice, through architectural spaces, but also to be embodied via the "total spectacle". (Mole 1972; 142).

This conception of the relationship between space and experience is contiguous with the advent of new forms and notions associated with the production of immersive experiences. This constitutes the theoretical framework of the research project *Mapping_me*.

Let us also mention the notion of soundscape as theorized by Murray Schafer (1993) in relation to the concept of environmental storytelling (Jenkins, 2004, Ryan 2016). Each new location is a “memory map” that plays an active role in the narration formatting process (Ryan, 2017; 115). Captured spaces are, in their own way, a form of "virtual heritage" (Stone and Als, 2000). When the atmosphere of a place

Figure 1: Photo integration inside the environement. ©Yan Breuleux, James Partaik.

is “re-situated” and it contains capsuled moments and specific urban noises, the recordings are also forms of intangible legacies (Champion, 2016). The project is not the reproduction of a place but the establishment of a process of sampling spaces, photographs and ambiances; a transposition which operates outside of registers of representation (Schwab, 2018). On the map, the User accesses the atmosphere through "tags" that mark virtually a real territory (McCullough, 2013).

How can one transpose the ambiance of a particular point in space? Does a virtual environment conserve the trace of a space in the form of an autonomous audio and visual object that responds to its own phenomenological reality? How does the physicality of the interface enrich the experience of an intangible world? More generally, can the depiction (mise-en-scène) of a digital archive of real space constitute a new form of knowledge?

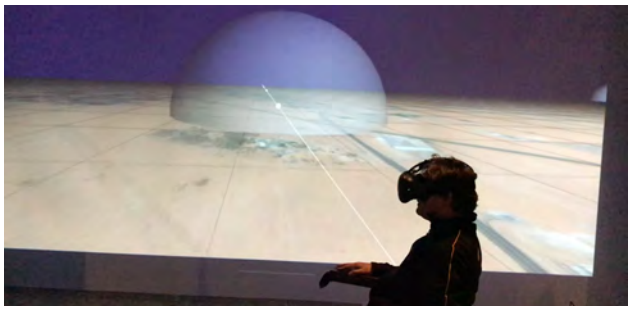


Figure 2: Navigation system inside the environment. ©Yan Breuleux, James Partaik.

The User's experience

The User's experience of the project is structured as follows: viewed through a VR headset, a map is displayed on the floor of the virtual space. A rotating chair with embedded electronics (VR controllers, trackpad, etc.) is employed as a new tangible and intuitive interface, coupled with the navigation system of the headset, offering the trajectories for the exploration of the virtual space by pivoting on itself. A video projection, placed at the height of the ground, offers a visualization to external viewers of the behavior of the User. It reproduces how the User orients the axes of navigation. While navigating the space, the User accesses a network of domes arranged on various points of the map. Inside each dome, it is possible to access a wide variety of geolocated media. The User can visualize constellations of photographs, 360 ° hemispherical images, video panoramas. In the same virtual place, a soundscape is built gradually by gradually mixing a series of samples collected at the real site itself. The User can then advance or continue to explore various capture points.

The content of the live demonstration will consist of material directly from the site of ISEA. Collected throughout our presence and/or on the same day of the event, this process constitutes a site-specific intervention that consists of ambient samplings of audio-visual sequences. The software is a staging space for audio and visual archives. We will therefore, as part of the presentation, present n collection *in situ,* of elements captured on the site of the event including hemispheric and 3D audio recordings which will therefore be available in the environment. Users will be able to revisit and explore specific points of the environment in spatialized domes. These spheres of diverse atmospheres aim to propose a renewed experience of the *familiar*, of the experiential notion of *place*. Beyond the functionality and its use, they aim to place the Users in the present time in a posture of conscious observation of spaces. The ease of integrating content into the software will create a bank of spaces inspired by the context of the festival. A new urban cartography is developed, a hybrid space in which the User generates in real time, a new sensorial experience while pivoting on a rotating chair amidst the transposed urban environment surrounding the space of ISEA.

The objective of *Mapping_me* lies not only in its inquiry into the specific language of mapping places, but also to determine how these maps serve to develop a new artistic language in the virtual realm. Thus, to map a place is to build and propose a particular vision. The realm of virtual heritage includes the use of mixed reality, augmented reality and augmented virtuality. Inscribed in the continuum of mixed reality, the field is interested in determining how the different forms of hybridization between real and virtual spaces are structured. The purpose of this poster session is to provide a methodological survey to the community about the concepts being discussed but also to establish possible future collaboration for the design of an archiving application for digital content located in the community.

References

[1] Abraham Moles, *Art et ordinateur* (Paris : Casterman, 1971), 271.

[2] Abraham Moles and Elisabeth Rohmer, *Psychologie de l'espace* (Collection « Mutations - Orientations », Paris : Casterman, 1972), 162.

[3] Murray Schafer, *The soundscape: Our sonic environment and the tuning of the world* (Simon and Schuster, 1993), 320.

[6] Henry Jenkins, "Game design as narrative," *Computer* 44, (2004) :118-130.

[7] Marie-Laure Ryan, Kenneth Foote, and Maoz Azaryahu, *Narrating space / spatializing narrative: Where narrative theory and geography meet* (Ohio State University Press, 2016), 115.

[8] Robert Stone and Takeo Ojika, "Virtual heritage: what next?," *IEEE MultiMedia* 7, no 2, (2000): 73-74.

[9] Erik Champion, *Critical Gaming: Interactive History and Virtual Heritage* (Routledge, 2016), 232.

[10] Malcolm McCullough, *Ambient commons: Attention in the age of embodied information* (MIT Press, 2013), 368.

[11] Marie-Laure Ryan, Kenneth Foote, and Maoz Azaryahu, *Narrating space / spatializing narrative: Where narrative theory and geography meet* (Ohio State University Press, 2016), 21.

Author(s) Biography(ies)

Yan Breuleux, Design (M.Sc.A), Music (Doctorate) is an associate professor at the NAD-UQAC. He's a researcher and practitioner in the field of visual-music for immersive display. For twenty years he has collaborated with musicians and composers to create multi-screen, panoramic, and fulldome pieces.

James Partaik, is an associate professor and head of the digital arts sector at UQAC. Artist, researcher, director of the research-creation group *Insertio*, contributor to the innovative open-source project *Wiring*, Partaik also is a founding member of Avatar (Quebec) regarded in Canada as pioneers for audio and electronic art.

TransMotion: A ML-based Interactive System for Aesthetic Experience of Movements

Yeorim Choi, Jihyun Park, Sey Min, Jusub Kim
Department of Art & Technology, Sogang University
Seoul, Korea
dufla812@gmail.com, jihyun14.p@gmail.com, sey.min@gmail.com, jusub@sogang.ac.kr

Abstract

This paper proposes a machine learning based interactive system, *TransMotion*, that helps one to experience the aesthetic value of body movements. *TransMotion* recognizes the body pose of the user in real time and presents the ballet movement that appears to be triggered by the user's pose in an immersive way. It aims to help users to discover the aesthetic values inherent in their body movements, but not recognized in everyday life. Furthermore, it aims to improve the user's physical self-efficacy and to increase the interests in the artistic activities based on body movements.

Keywords

Machine learning, Ballet, Aesthetics of Movements, Physical Self-Efficacy

Introduction

The perception of body and dance has changed with the times. In the traditional dance, physical beauty, technique and formality were highly valued, however with the rise of modern dance which was born in the early 20th century under the strong influence of the philosopher Nietzsche, it started to look for new values such as instincts, freedom and improvisation. Dancing has evolved into an art that pursues freedom of spirit and body. Inspired by the philosophy of Nietzsche, the founder of modern dance, Isadora Duncan, broked the boundaries between everyday movements and dances by turning everyday activities such as walking, jumping and running into dance [1]. Another contemporary dancer, Merce Cunningham, also did not define dance as a collection of pre-choreographed motions, but asserted that all human movements could become a dance and also regarded fortuitousness as an important element of dance.

However, most people live without realizing the aesthetic values inherent in their body's movements. In this paper, we propose a machine learning based interactive system, *TransMotion*, that helps one to find the aesthetic value inherent in his/her body's movements. *TransMotion* recognizes the body pose of the user in real time using machine learning and presents the ballet movement that appears to be triggered by the user's pose on a big screen comparable to a body mirror. It aims to improve the user's physical self-efficacy and to increase the interests in the artistic activities based on body movements.

Related Work

With the development of machine learning technology in recent years, several related studies that apply machine learning technology to dance have been presented. First, Jacob and Mageko developed a virtual dance agent to dance with people. They studied the expression, sociality, and entertainment of human movement by allowing people and virtual agents to dance and interact together in a dome [2]. Chan, et. el presented methods that given a source video of a person dancing, transfer that performance to a novel (amateur) target after only a few minutes of the target subject performing standard moves [3]. Friedhoff and Alvarado developed a website that recognizes users movements in real time based on a web camera and shows images of similar poses using the PoseNet developed by Google [4]. We also used the PoseNet API to recognize the pose of the user in real time.

TransMotion System

System Overview

TransMotion consists of a monitor screen of a body mirror size, a video camera installed on the monitor toward the user, and a computer with internet connection. In standby mode, which does not involve users, a video of a dancer posing for standby mode is shown on the screen. When an user stands in front of the system and makes a pose, the system recognizes the pose and displays the video clip that has the ballet motion of which starting pose most matches it. Users see the results

in the manner of overlapping images of their movements and ballet movements from the video. The immersion, created by a large screen and the interaction, makes cognitive changes in physical self efficacy.

Figure 1. An user experiencing the *TransMotion* system

Implementation

TransMotion was implemented using the Tensorflow.js development environment. Also, our system used the PoseNet API to estimate the user pose. The video database consisted of 40 different types of ballet movements recorded in our studio. The duration of each video clip was in the range of one to three seconds. Cosine similarity was used to measure the similarity between the user pose and the starting pose of each ballet movement.

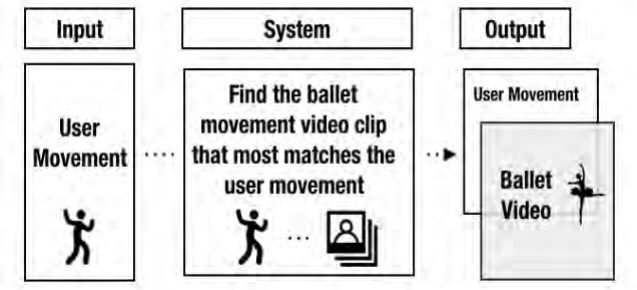


Figure 2. The system process overview of TransMotion

Experimental Results

We conducted experiments on 30 university students to validate the system. Each participant was instructed to play with the system for five minutes. The physical self efficacy was measured by asking questionnaires on 7 point Likert scale to the participants before and after using the system. The questionnaire consists of three sub-factors of physical self-efficacy: movement sensibility, aesthetic sensibility, and physical self-expression. A paired-samples t-test was conducted to compare the physical efficacy values before and after using the system. There was a significant difference in the scores for before (M=3.35, SD=.84) and after (M=5.14, SD=.57) using the system; $t(30)=-15.77$, $p<.01$. which means that our proposed system can be effective in increasing the physical self-efficacy.

Conclusion

In this paper, we proposed a machine learning based interactive system that helps an user to discover the aesthetic values that are inherent in his/her body movements, but are not recognized in our daily lives. The proposed system improves the physical self-efficacy of the user and thus increases the interest in the artistic activities using body. In the future, the video database, which is currently limited to ballet movements, will have to be expanded to include contemporary dances that have more free and diverse form of motions. We also plan to study the integration of the system into dance education and therapy program.

Acknowledgment

This research was supported by the MIST (Ministry of Science ICT), Korea, under the National Program for Excellence in SW (2015-0-00910) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation)

References

Journal article (online)

[1] Nakrim Jung, Koreanische Nietzsche Gesellschaft, “Nietzsche's body, art physiology and modern dance(XII)”,Oct 25 2014, The DancePost Korea

Proceedings Paper Published

[2] Mikhail Jacob and Brian Magerko “Interaction-based Authoring for Scalable Co-creative Agent”, Proceedings of the Sixth International Conference on Computational Creativity June 2015, 236-243

[3] Caroline Chan,Shiry Ginosar,Tinghui Zhou,Alexei A. Efros, “Everybody Dance Now”, August 2018, UC Berkeley, arXiv:1808.07371v1arXiv:1808.07371v1,Aug 22 2018 https://carolineec.github.io/everybody_dance_now

Websites

[4] Jane Friedhoff and Irene Alvarado, Google Creative Lab, “Move Mirror: An AI Experiment with Pose Estimation in the Browser using TensorFlow.js”, July 20 2018, A Medium Corporation.

MindPlay:
An EEG-based Musical Instrument for Subconscious Ensemble

Yunseon Son, Jusub Kim
Department of Art & Technology, Sogang University
Seoul, Korea
baroomy1004@naver.com, jusub@sogang.ac.kr

Abstract

This paper proposes an EEG-based musical instrument system, *MindPlay,* that provides ensemble experience in a new way. *MindPlay* is a system that produces sound by controlling a melodic percussion instrument based on an user's brainwave data monitored by a EEG device in real time. This aims to provide an user with aesthetic experience and satisfaction of ensemble with professional musicians even if they do not have the knowledge and skills of traditional instruments.

Keywords

Brain-Computer Interface, EEG-based art, New Musical Instrument, Subconscious Ensemble, Music Computing

Introduction

Playing a musical instrument is the act of realizing the musical idea into the physical sound and gives players a moment of aesthetic pleasure and satisfaction [1]. Furthermore, playing with other musicians for ensemble music gives another level of aesthetic experience and satisfaction. However, playing a musical instrument requires a lot of skills and knowledge such as accurate hand-eye coordination, score reading, knowledge about the instrument, and numerous hours of practice to convert notes into specific motor patterns correctly and subconsciously. Furthermore, for the case of ensemble, communication skill is additionally required [2]. Therefore, even though many people have desires to play a instrument, most of them, particularly those who do not major music, fail to succeed due to the above difficulties.

In this paper, we propose *MindPlay*, which is a musical instrument system that provides ensemble experience at subconscious level. *MindPlay* produces sound by controlling the melodic percussion instrument with the player's brainwaves. It aims to provide everyone with the experience of aesthetic pleasure of playing an ensemble music.

Related Work

Numerous artists have used bio data such as brainwaves in their creative works as devices such as EEG sensors become available [1]. One of the first works that utilized the brainwaves to produce music was *Music for Solo Performer* of Alvin Lucier in 1965. In the work, he connected the alpha wave to a physical instrument to produce music [3]. In *Space Between Us*, Joel Eaton presented a performance that generates sound using brainwaves from both audiences and artists as input data to a machine learning system for emotion analysis [4]. Most recently, Betty Sargeant presented an installation artwork that visualizes brainwaves from sleeping teen agers in *Dream 2.2* [5]. Our work is similar to Lucier's work in *Music for Solo Performer* in that it produces music by a physical instrument system rather than using electronic music samples.

MindPlay System

MindPlay consists of 1) an EEG device that users wear around their heads, 2) Five solenoid valves operated by five brain wave values (Delta, Theta, Alpha, Beta, and Gamma) independently, 3) a water tank with water circulating through a pump, 4) a melodic percussion instrument that can react to subtle differences in velocity and volume of the water hitting upon it, 5) a video screen, which plays the role of inducing the EEG of the user and ultimately allows users to experience the ensemble.

Figure 1. An user experiencing the MindPlay system

In the ensemble playing, an user sits and watches the video clip showing the performance by professional musicians repeatedly, and then when he or she wants to play the ensemble, they can wear the EEG device on the head and start the ensemble performance. The five different EEG data from

the player control each of the five different water valves independently controlling water ejections onto the percussion instrument and producing diverse notes of sound.

The two streams of sounds, one from the performance video and the other from the *MindPlay* system, generate one ensemble music. In making this, we note *Asynchronism* and *Naturalism* as artistic value as we find in nature [6] [7]. Even though rhythm and melody from the MindPlay may not be in harmony with those in music from the video performance, users can still feel the feeling of playing ensemble music when the overall tone of music is similar and they know that they are controlling music generation.

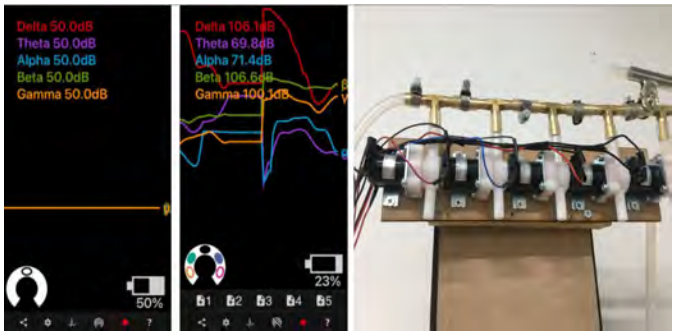


Figure 2. Left: EEG monitor, Right: Five solenoid valves of MindPlay

We implemented *MindPlay* system using Muse (EEG system), PureData, and Arduino. Brainwave data transmitted through Muse Monitor is sent to PureData in real time, and PureData operates Arduino to control the five solenoid valves' opening and closing, which determines the water ejection to the percussion. Each of the five different transmitted raw EEG data is filtered and used to trigger a valve's opening when satisfying a certain condition.

Audience Responses

We observed 20 people using this system. Before the experience, participants were told about 'what is EEG', and 'what does each data mean'. We played the video clip that shows a slow-tempo Korean traditional music ensemble performance using three instruments: the Piri, the Daepiri (low-pitched Piri), and the Bumjong (Korean buddhist bell). The majority of the participants experienced the ensemble silently, but some of them tried changing their feelings artificially to control the system. And a few users enjoyed the system enthusiastically by shaking their heads from side to side or making body movements. Sometimes they imitated the performance of musicians in the video. In the interviews after the experience, some people reported that they felt musical achievements during *MindPlay* experience although they didn't have any prior experience of playing Korean traditional musical instruments. Furthermore, some reported that they could accept the new method of subconscious ensemble as another instrument-playing activity. About a third of the participants reported that they wish they could better control the system.

Conclusion

This paper proposed an EEG-based interactive musical instrument system for subconscious ensemble experience. Through the subconscious musical playing, users experience the aesthetic satisfaction of playing ensemble music, which normally requires numerous hours of practice and learning. Furthermore, this makes users appreciate music in a more active and immersive way compared to just listening. In the future, we plan to find an user's musical thoughts or emotions from brainwaves and other bio data and use them for controlling music generation. We also plan to research the application of this for music therapy program.

Acknowledgment

This research was supported by the MIST (Ministry of Science ICT), Korea, under the National Program for Excellence in SW (2015-0-00910) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation)

References

Proceedings Paper Published

[1] Jeppe Veirum Larsen, Daniel Overholt, Thomas B. Moeslund, "The Prospects of Musical Instruments For People with Physical Disabilities", 327-331, July 2016, Proceedings of the International Conference on New Interfaces for Musical Expression(NIME'16) Australia

Journal article (online)

[2] K. Stensa eth, "'Musical co-creation'? Exploring healthpromoting potentials on the use of musical and interactive tangibles for families with children with disabilities" Int. J. Qual. Stud. Health Well-Being, vol. 8, Accepted 14 May, 2013. [3] A. Lucier, "Statement on: Music for Solo Performer(1971)", in Biofeedback and the Arts: Results of Early Experiments, Ed. D. Rosemboom, 1976, Aesthetic Research Center of Canada: Vancouver. [4] Joel Eaton, Weiwei Jin, Eduardo Miranda, "The Space Between Us: A Live Performance with Musical Score Generated via Affective Correlates Measured in EEG of One Performer and an Audience Member", June 2014, New Interfaces for Musical Expression(NIME'14) Goldsmiths

Websites

[5] Betty Sargeant, "Dream 2.2"(2018) National Taiwan Museum of Fine Arts, February-June 2018, Taiwan, PluginHUMAN website by artists Dr Betty Sargeant and Justin Dwye, https://pluginhuman.com/art/dream

Book

[6] Dewey. J, "Experience and Nature", in John Dewey The Later Works, 1925-1953, Vol. 1: 1925, ed. Jo Ann Boydston, 1981 [7] Dewey. J, "Art as Experience", New York :G. P. Putnam's Sons, 1958

A.I. Ch'angga

Sang Hyeob Lee[1], Jusub Kim[2]

Department of Art & Technology, Sogang University
Seoul, Korea
doublea@sogang.ac.kr[1], jusub@sogang.ac.kr[2]

Abstract

This paper describes the project, *A.I. Ch'angga* , that aims to simulate the music of the early 20th century's Korea using machine learning. *Ch'angga* refers to the music that was educated in the schools in Korea mostly during Japanese Colonial Era in the early 20th century. This project has been initiated from the question: "What music would have been created in Korea in the early 20th century if there had not been Japanese colonial era?". We built a music generation model using a LSTM network using music around the time from China, Russia, Japan, and Korea and had it generate music changing the degree of the influence from each country. Our preliminary results suggest that machine learning could be used to simulate the cultural products of an era based on a hypothetical history.

Keywords

artificial intelligence, algorithmic composition, ethnic music, machine learning

Introduction

In 1906, public schools in Korea started adopting music as a regular course. The music was called ' *Ch'angga'* and the education of the music was carried out as part of the Japanese colonial rule. In 1910, the first music textbook (Fig. 1) was published. Most of the songs recorded in the textbook were Japanese songs with translations of the lyrics into Korean [1][2]. Initially, Korean and Japanese lyrics were recorded together. But, in the late 1930s, all of the lyrics were changed to Japanese. '*Ch'angga'* was mandatory subject that even Korean children had to learn. After the liberation of Korea in 1945, the '*Ch'angga'* education became abolished.

This paper describes our project, *A.I. Ch'angga* , that aims to simulate the music of the early 20th century's Korea using machine learning. This project has been initiated from the question: "What music would have been created in Korea in the early 20th century if there had not been Japanese colonial era?". Our preliminary results suggest that machine learning could be used to simulate the cultural products of an era based on a hypothetical history.

Fig 1. A Collection of Ch'angga for General Education, Vol. 1, 1910 [1] ©La, Un Yung

Algorithmic Music Composition

Although algorithmic music composition has been studied since the latter half of the 20th century largely influenced by the Markov chain theory, it had developed a lot in the last few years due to the deep learning algorithms. One of the notable recent projects is Google's Magenta research project that explores the role of machine learning in the process of creating art and music [3].

In this project, we used a LSTM Recurrent Neural Network (RNN) to generate melodies. We trained the model based on a variety of music from other countries around the era. Particularly, we used Brannon Dorsey's MIDI-RNN, which is made using Keras [4].

MIDI Data

To tain our LSTM network, we collected MIDI files of traditional folk songs of four neighboring countries: Korea, Japan, China, and Russia. We collected total 80 traditional folk songs (20 from each country) from a variety of sources, all of which were created before 1910, when the first music textbook was published in Korea.

A.I. Ch'angga

In this project, we aim to find the answer to the question "How Korean music would have evolved without Japanese colonial music education?".

For a preliminary test, we built two different models: one trained with all four country's music, the other trained with all but Japan music. The latter one is for simulating the fictional history event where no colonial period existed (Figure 2).

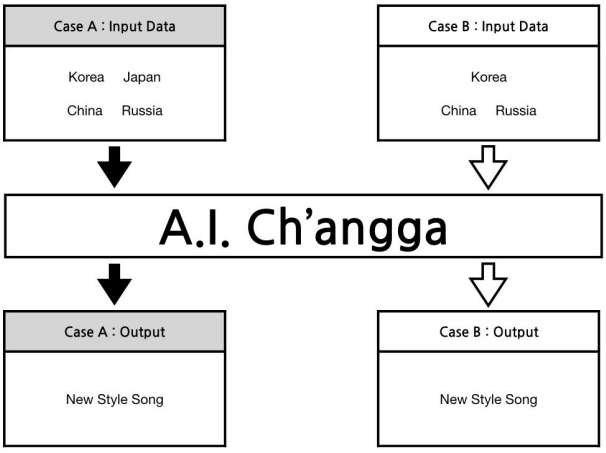


Fig 2. A.I. Ch'angga Diagram

Figure 3 shows the comparison in generated midi notes between the two simulation results. We can notice that the rhythm and tone of the music are quite different.

Conclusion

A.I. Ch'angga is a machine learning project that aims to simulate how Korean music would have evolved according to hypothetical historical events in the early 20th century. We could see that the different style of music comes out when changing the combination of which countries contribute to. Combined with the cultural influences of Russia and China without Japan, the generated Korean traditional music sounds so much different than the one that also includes Japan. Our preliminary results suggest that machine learning could be used to simulate the cultural products of an era based on a hypothetical history. We plan to expand our database for more accurate prediction and also to make a universal system that has learned all the folk songs around the world letting us explore the composition space in new ways.

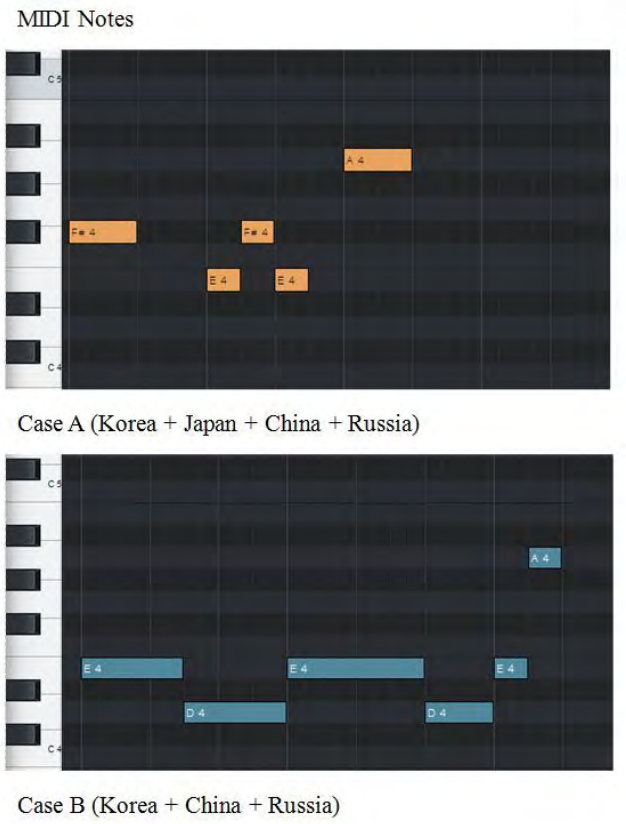


Fig 3. Simulation results

Acknowledgements

This research was supported by the MIST(Ministry of Science ICT), Korea, under the National Program for Excellence in SW)(2015-0-00910) supervised by the IITP(Institute for Information & Communications Technology Planning & Evaluation)

References

[1]La ,Un-Yung. Retrieved from http://www.launyung.co.kr/technote7/board.php?board=down02&indexorder=2&command=body&no=2\
[2] Joo Yeon Kim. (2012). Colonial education reflected in elementary school's <Ch'angga> during Japanese Colonial Era. The Japanese Language and Literature Association of Korea.
[3] Google. Magenta. Retrieved from https://magenta.tensorflow.org/research
[4] Branger_Briz. (2017). Using Machine Learning to Create New Melodies. Retrieved from https://brangerbriz.com/blog/using-machine-learning-to-create-new-melodies
[5] D. Eck & J. Schmidhuber. (2002). Finding temporal structure in music: blues improvisation with LSTM recurrent networks. IEEE.
[6] Daniel Johnson. (2015). Composing Music With Recurrent Neural Networks. Retrieved from http://www.hexahedria.com/2015/08/03/composing-music-with-recurrent-neural-networks/

MeloDraw: A System for Melodic Contour Search from Embedded Space Using Line Drawings

Jeong Choi[1], Chaelin Park[1], Halla Kim[2], Wonil Kim[1], Juhan Nam[1]
[1]Music and Audio Computing Lab., GSCT, KAIST
[2]The Cultural Complexity and Network Science Group, GSCT, KAIST
Daejeon, Korea
jeong.choi@kaist.ac.kr, lynn08@kaist.ac.kr, kimhalla@kaist.ac.kr, ianwonilkim@kaist.ac.kr, juhannam@kaist.ac.kr

Abstract

MeloDraw is an online application that automatically searches melody contours similar to user's line drawing input. The input drawing is converted into a melodic contour based on predefined rules and the melodic contour is then passed to the melody proposal model as a query to find similar melodies. The model has a bi-directional RNN autoencoder architecture trained with 15,313 melodic contours from 1,035 British folk songs to learn the melody embedding space. Most similar melodies given the query are searched on the embedding space. We implemented the system as a web-based application so that anyone can easily access to it.

Introduction

Creating an artwork is a process of configuring intangible images that creators have in their mind. For songwriters, it is thus natural that they often struggle to come up with appropriate melody which matches well what they are trying to express. Our model enables creators to explore wide scope of new melodies by using another modality of expression, line drawing. It first converts the drawing pattern into a melodic contour vector and inspects the corresponding latent space to find out similar melodic contours from the existing dataset. It can be regarded as a form of assisted creativity since it expands the possibility of musical expressions to an unexperienced process.

Related works

Input Modality for Melody Composition

There have been numerous attempts to use different yet intuitive user input modality other than directly receiving musical notes. For example, Bigo et al. developed a music composition system that utilizes user input from the interactive paper called 'PaperTonnetz' [1]. The interface has a grid system which represents the tonal characteristics of music information. Diao et al. mapped various drawn shapes into intuitive musical components [3]. Thiebaut et al. also mapped the curved line, the dashed line, and their interpolation information to sound synthesis parameters [7]. Kim and Yeo implemented a system that uses line drawing as user inputs to manipulate melodic and harmonic information to easily compose a musical piece [5].

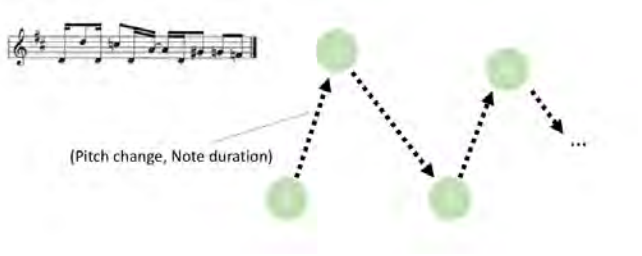


Figure 1: Conversion of musical note data into the melodic contour form

Melody Similarity on the Embedded Space

There has been many experiments on morphing high-dimensional musical information into low-dimensional space representations. Bretan et al. [2] could be mentioned as one of the standard experiments of melodic interpolation. With monophonic musical phrases, they construct a latent space using Autoencoder. By interpolating the nearest points in latent space, it gives gradual progression in both the harmonic and rhythmic elements. Works on morphing different timbre includes Jehan [4] which synthesizes timbres of various musical instruments such as a flute or choral vocals. The performer could control the timbre while making physical movements along a path. Recently, Roberts et al. implemented a hierarchical recurrent neural network that efficiently encodes a 32-bar long melody into a latent embedded vector [6]. They used a hierarchical architecture to capture the corresponding characteristics of the entire musical piece, while our work excluded the feature because we only handled short melody chunks. We, instead, used our own representation of melodic sequence as inputs for the model.

Proposed Method

The 'Melodic Contour' Data Scheme

We collected 15,313 melodic contours from 1,035 British folk songs of Nottingham Music Database.[1] As shown in Figure 2, we converted the melody data into our data representation scheme, the melody contour vector. We excluded melodies

[1] https://ifdo.ca/~seymour/nottingham/nottingham.html

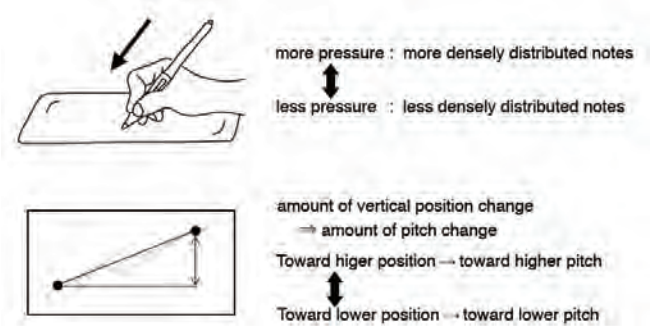


Figure 2: Conversion of drawn lines into melody contour vectors

with triplet beats and set 2-bar melody as a base unit of the data. After segmenting the tunes into 2-bar melodic sequence, we extracted a 2-dimensional vector (note duration, pitch interval) each. For example, if 8th note of C is followed by 4th note of G, the input vector becomes (0.5, 7). This way, we obtained 4313 melodic sequences. The length of a vector varies depending on the number of notes the 2-bar sequence contains. Thus, in order to make sure all sequences have the same length, we set the length as 32 encodings of (note duration, pitch interval) and applied zero-padding for short sequences. The final input is of size 2-by-32.

Converting Line Drawings into Melodic Contours

As shown in Figure 3, the system maps user's line drawing input into a sequence of melodic contour vector. The amount of detected pressure is mapped to the density of notes and the amount of vertical changes in the line is to the pitch changes.

Inspecting the Embedded space of Trained RNN Autoencoder

In the hope of capturing the inherent characteristics of melodic sequence, we tested various autoencoder architectures. We set our final model to the RNN bi-directional autoencoder which gave the most satisfactory results. Figure 4 shows that it successfully finds reasonably similar melodies from a given query. The model encodes the query melody into a latent vector and finds the closest ones by Euclidean distance in the embedded space. The original melody vectors corresponding to the closest embedded vectors are demonstrated.

Implementation

We implemented the system using a server-client architecture. The client receives the user input from the web browser and sends the melodic contour after the rule-based conversion. The server receives the melodic contour and searches similar melodies using the pre-trained melody model. Finally, the server sends the results back to the client to display and play the melody tunes.[2]

[2] https://www.youtube.com/watch?v=uABIib82Nqc

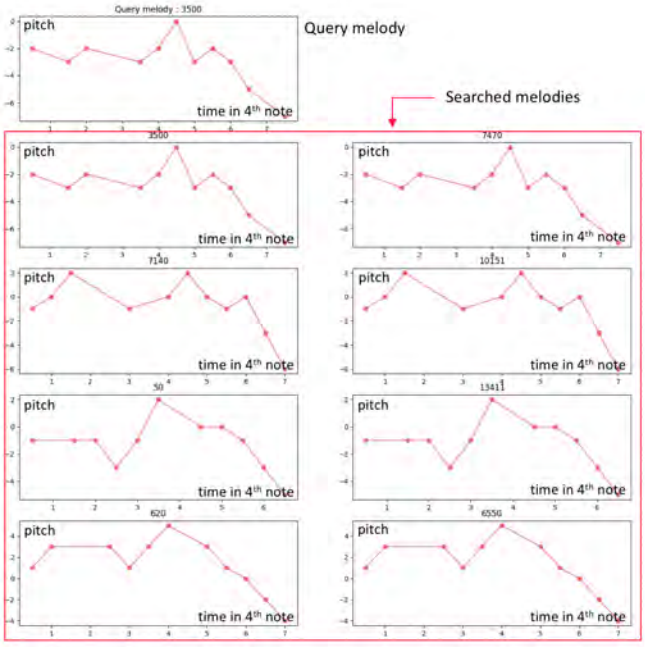


Figure 3: Similar melodies retrieved with a query melody onn the latent space of recurrent autoencoder

References

[1] Bigo; Garcia; Spicher; and Mackay. 2012. Papertonnetz: Music composition with interactive paper. In *Sound and Music Computing*.

[2] Bretan; Mason; and Weinberg. 2016. A unit selection methodology for music generation using deep neural networks. *arXiv preprint arXiv:1612.03789*.

[3] Diao; Zhou; Harte; and Bryan-Kinns. 2014. Sketch-based musical composition and performance. In *NIME*, 569–572.

[4] Jehan. 2001. Perceptual synthesis engine: An audio-driven timbre generator (master's thesis).

[5] Kim, and Yeo. 2014. Griddy: a drawing based music composition system with multi-layered structure. In *ICMC*.

[6] Roberts; Engel; Oore; and Eck. 2018. Learning latent representations of music to generate interactive musical palettes.

[7] Thiebaut; Healey; and Bryan-Kinns. 2008. Drawing electroacoustic music. In *ICMC*.

Visualization of Taekwondo Along the Path of Motion

YoungEun Kim[1,§], JiYong Lee[2,§,‡] , KyooWon Suh[3,†], JoungHuem Kwon[4,¶], SangHun Nam[5,‡]
[§]Bitwin Media Lab, [†]Hallym University, [¶]Koreatech, [‡]Seoul Media Institute of Technology
[1]naankim@gmail.com, [2]wisrage@gmail.com, [3]suh7164@hallym.ac.kr, [4]rjhkwon@koreatech.ac.kr,
[5]shnam@smit.ac.kr (Corresponding author)

Abstract

Continuous artistic efforts have been devoted to visualize the motion path of humans. If a series of motions that have occurred during a period of time is simultaneously visualized in one frame, the outcome can be interpreted from the viewpoint of motion flow over time. From the viewpoint of behavioral arts, the proposed study acquired the movements in Taekwondo and discussed a method for producing media artworks that aesthetically express the motion path shown by Taekwondo. Herein, the actual media artwork was produced according to the discussed method.

Keywords

Motion Visualization, Taekwondo, Media Art, Motion Path, Time Visualization, Motion Capture

Introduction

Various artistic efforts have been devoted to visualize the flow of time. Works with temporalities, such as painting and sculpture, have emerged owing to the influence of futurism, which considers the motion as an important formative element. The movement and speed of things were expressed on a single canvas in "Girl Running on a Balcony" by Giacomo Balla using pointillism and works by Eadweard Muybridge and Etienne Jules Marey using chronophotography (time of picture). The motion of objects in a plane has been analyzed and expressed previously, whereas the motion of objects in three-dimensional space has become recently available for measurement, analysis, and visualization through the development of technology such as virtual reality. The method using motion capture technology to track, store, and animate human movements has been widely used in the field of film and game production. Furthermore, this method has been applied to researches using posture analysis and correction, such as in the medical and sports arena and in the interactive performances and training. This study aims to investigate the visual effects of visualization of physical characteristics and motion path in human motion from an aesthetic viewpoint using the motion capture data with time continuity.

Dance conveys the message to the audience through the movements of actors, showing expressions of various movements. Various body movements in short movements can be expressed in martial art movements due to the coexistence of softness and strength. In "300 Years Hakka Fung Fu: Re-Actor motion of time analysis," the motion paths of body parts by a Kung Fu actor were arranged in a space, resulting in the visual representation. Previous studies have used motion capture data for visualizing the path for the kick of Taekwondo or traditional dance, such as Buddhist dances. Previous studies have created images using optimized rendering functions of 3D modeling software, such as Autodesk 3DS Max, Maya, and Maxon Cinema4D, to represent motion and path of actors. This study analyzed the motion path for the demonstrating Taekwondo, which is the national martial art of South Korea. This study used the Unity Game Engine by considering its expansion into media art based on interaction.

Visualization of Taekwondo

Taekwondo is a representative martial art of South Korea with the technical performance of the body and the spiritual training. The dynamism of aerial motion, as well as the splendid technique of kicking in Taekwondo, are aesthetically inspiring to the audience, leading to the worldwide popularity of Taekwondo performances such as tal, jump, and moon. This study introduces the process of producing media art works aesthetically by expressing the motion path of Taekwondo from the viewpoint of behavioral arts. The process for visualizing the motion path of Taekwondo is as follows. While a performer demonstrates the Taekwondo motion, a system obtains the motion data in the 3D space and constructs the motion data based on the human skeleton. A motion trajectory object is set at either bones or joints moving with time, which can aesthetically express the motion. Based on physical data, such as time, velocity, and distance, from continuous position data, visual effect components, such as line, mesh, texture, trail, and particles, are applied. To maximize the visual effect, a multiple of cameras were arranged for acquiring and editing images to produce media artworks.

Since Taekwondo is fast and dynamic in motion, the performer used optical motion capture equipment appropriate for moving freely without wearing heavy equipment. As shown in Figure 1, the IR markers were directly attached to the body of the performer for the attachment at the correct positions. Furthermore, the cameras acquired the positions

of the markers at a speed of 100 fps to obtain the data on fast motion, and the acquired data were reconstructed for the human skeleton structure by applying post-correction work.

Figure 1. Taekwondo Motion Capture

Autodesk motion builder was used to apply the Mocap data acquired from the motion capture device into the game engine. Based on the positions of the marker data attached during the motion capture process, the size of the actor and position and direction of the skeleton are set to match the body size, including height, arm length, leg length, waist position, of the actor with his basic posture. The animation data of the skeleton can be constructed by setting the skeleton to be used in the game engine in actor and further merging the continuous animation data of the markers. By freely applying avatars with various designs to the actor in the game engine and further applying the motion capture data with various motions through programming, an animation with infinite changes can be constructed.

To effectively visualize the overall shape of Taekwondo in this work, the human body structures were simplified into 9 body skeletons, which are head-hips, left hand-left forearm, left forearm-left arm, right hand-right forearm, right forearm-right arm, left upleg-left leg, left leg-left foot, right upleg-right leg, right leg-right foot, and trajectory objects were set on each skeleton. According to the movement analysis, the movement of the feet beautifully expresses the big and small rotations in the space, and the movement of the hands shows the fast and linear appearance. The trajectory objects were further set in 4 joints, which are left hand, right hand, left foot, and right hand, that represent important motion path in Taekwondo, and other types of visual effects were set to mix the other visual effects into the overall movement in Taekwondo as well as the motion elements of specific body parts. By modeling the background space and installing a number of static and dynamic cameras, this study recorded and edited images to produce the media artwork shown in Figure 2.

Acknowledgement

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (No. NRF-2017R1D1A1B03034041)

References

[1] Kim Young Eun and Park Jin Wan, "Stereoscopic Media-Art which Visualize the Passage of Time Using Long-term Exposure," *Journal of Digital Design*, 12.1 (2012):271-278.

[2] Xiuming Zhang, Tali Dekel, Tianfan Xue, Andrew Owens, Qiurui He, Jiajun Wu, Stefanie Mueller, and William T Freeman, "MoSculp: Interactive Visualization of Shape and Time," *The 31st Annual ACM Symposium on User Interface Software and Technology* (2018):275-285.

[3] Sarah Kenderdine, "EMBODIED MUSEOGRAPHY," *About the Culture Academy Singapore* 23. (2012):37-41.

[4] Lee Byoung Hak, "Designing visual identity of motion through visualizing the path of motion," *Design Convergence Study*, 36 (2012):1-18.

[5] Jang Daeeun and Ahn Yongkyu, "Aesthetical Exploration on Acrobatic Techniques in Taekwondo Demonstration," *The Korean Journal of Physical Education* 56.1 (2017):25-42.

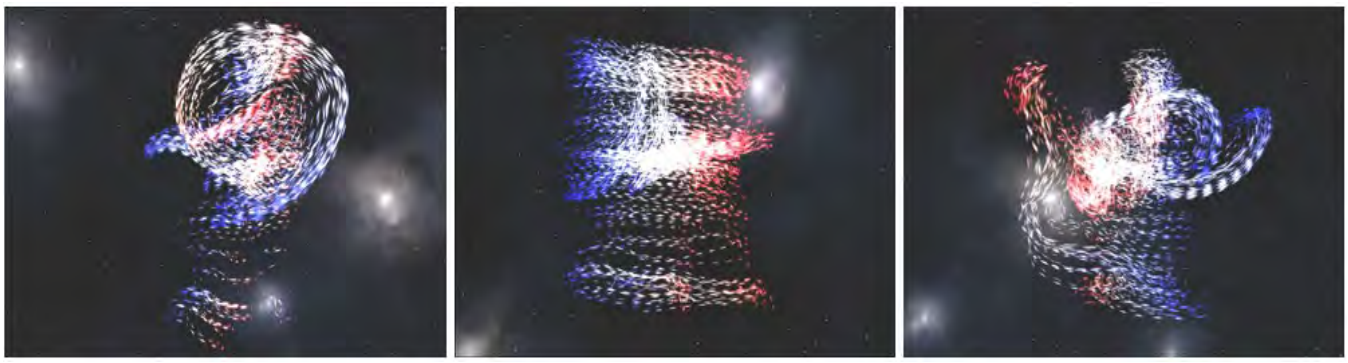


Figure 2. Taekwondo Media Art

Augmented Virtuality Storybook Using Real-Objects

Su Jin Park and Moon Ryul Jung
Sogang university graduate school of media
Seoul, Republic of korea
concept.psj@gmail.com, moon@sogang.ac.kr

Abstract

In this paper we present a newly proposed augmented virtuality called ″real-object based augmented virtuality″ in contrast to a traditional marker-based augmented reality, in order to implement an AR storybook. In this storybook, the user brings up real objects into the computer-generated virtual space to make a story go on. The objects are recognized by means of an object recognition software MobileNet implemented by machine learning.

Keywords

Augmented Reality, Augmented Virtuality, Mixed Reality, AR, VR MR, AV, Machine Learning, AR Story Books

Introduction

The Limitations of 2D marker-based on Augmented Reality storybooks

In order to experience an augmented virtuality content such as a storybook, the AR developer is supposed to prepare ″markers″ in the AR storybook content, which are 2D images specially designed in advance to facilitate the recognition by the camera. This method has disadvantage in that it is impossible to experience an augmented reality story book unless markers are prepared in advance. In order to solve this drawback, we purpose a new form of augmented virtuality storybook in which markers are replaced by real-objects the user brings up into the virtual space. These objects are recognized by machine learning based software and the 3D models corresponding to the recognized objects are inserted to the virtual space. Figures 1 and 2 show the market growth of AI technology and the educational AR contents. We hope that our new idea will help this market grow further.

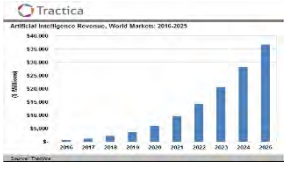


Figure 1. AI Revenue, from Tractica

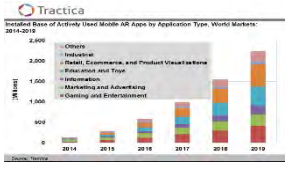


Figure 2. AR on market, from Tractica

User interactive book based on Augmented Reality

The Figure 3 shows AR coloring books. This book is an augmented reality coloring book intended for the user's education and play. When a coloring book is colorized by a user, it is applied to a virtual model in real time and then provided to a user as a model for augmented reality. This is a very interesting experience because it allows users to have their own augmented reality model for each user. However, still 2D-based image marker technology is applied, and content that is currently on the augmented reality story book market is also based on the image-based image marker method. Therefore, the users can enjoy the augmented reality contents only if there is still a marker prepared in advance.

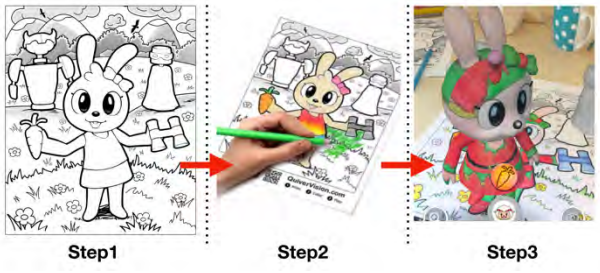


Figure 3. AR storybook App by ″Quivervision″: The figure above as shows the step-by-step progress. It has 3 steps. First, print 2D marker sketch image. Second, color the printed sketchbook. Third, the user takes a picture using the AR application. Finally, users can see the colored 3d AR models. Step 1 functions as a 2d marker. Step 2 is the process of color painting on Step1. Step 3 is an augmented 3D model based on a sketch that functions as a 2D marker.

Pre-trained Machine Learning model

The artificial intelligence model that is going to be applied to augmented virtuality storybook planning is MobileNet. It was developed by Google and provides a pre-trained machine learning model to help implement easy artificial intelligence. The MobileNet shows below figure.

Figure 4. MoblieNets, Pre-trained Machine Leaning model: a pre-trained model. object-recognition software, MobileNet, has several features. It is for mobile devices, and it can run without the Internet.

Design of AV storybook based on AI

To solve the previously analyzed problems, we used MobileNet to recognize real objects to use them in place of markers. In addition, we have developed a user environment that allows children to have a various experience. Our system is organized as shown of figures 5 and 6.

Figure 5. Software Plan: This software is intended to be developed with Unity3D engine and run on Android. The perception of things used the MobileNet model.

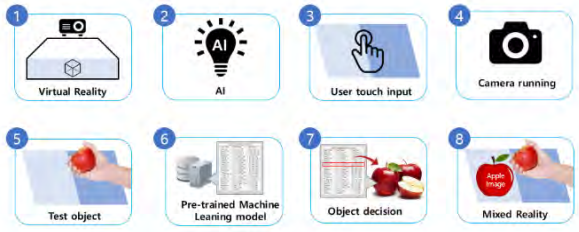


Figure 6. AV Storybook System on AI: A plan of software using the pre-trained Machine Leaning model. It shows the overall of the system concept in hardware and software. First, we created a touchable virtual space. Second, a camera is run according to the story for recognizing a real object. Third, the program reads real objects. Fourthly, projection a virtual image of the object. Finally, the virtual space contains the image of the real object.

Through this system we can ware able to produce a result on the basis of planning AV storybook based on AI. Based on the system designed the result of AV storybook is shown in Figure 7.

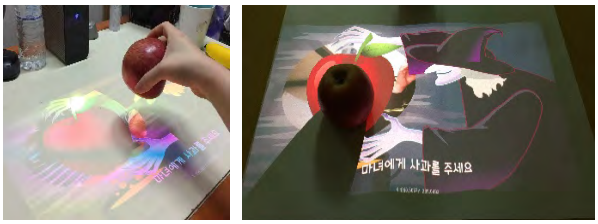


Figure 7. Real-Object Based Augmented Virtuality Storybook: The picture on the left shows the process of recognizing a real object. And the picture on the right shows that a three-dimension space image is synthesized as a result of recognizing a real object.

Conclusion

In this study, we present a machine learning based augmented virtuality storybook. It is expected that a machine learning based augmented virtuality storybook will have a positive effect by presenting immersive storybook contents for children. This augmented virtuality content has the advantage of realizing the augmented virtuality by using real objects in the real world as markers and also has the advantage of increasing the degree of freedom of the user by not requiring the use of specific markers designed in advance.

References

[1] Enrui Liu, Yutan Li, Su Cai, Xiaowen Li, *The Effect of Augmented Reality in Solid Geometry Class on Students´Learning Performance and Attitudes,* Springer International Publishing AG, part of Springer Nature 2019M. E. Auer and R. Langmann (Eds.): REV 2018, LNNS 47, pp. 549–558, 2019.

[2]http://www.quivervision.com/

[3]https://www.theverge.com/2015/10/5/9453703/disney-research-augmented-reality-coloring-books

[4]https://ai.googleblog.com/2017/06/mobilenets-open-source-models-for.html

[5]https://www.tractica.com/newsroom/press-releases/mobile-augmented-reality-app-downloads-to-reach-1-2-billion-annually-by-2019

[6]https://www.tractica.com/newsroom/press-releases/artificial-intelligence-revenue-to-reach-36-8-billion-worldwide-by-2025/

[7] Journal of the Korea contents association 16(1), 2016,01, 424-437 (14 pages)

[8] Dayang R, Dayang R A R, Wannisa M, Suziah S, *Design and Development of an Interactive Augmented Reality Edutainment Storybook for Preschool*, December 2012

[9] Andrew G. Howard, Menglong Zhu, Bo Chen, Dmitry Kalenichenko, Weijun Wang, Tobias Weyand, Marco Andreetto, Hartwig Adam, *MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications*, Apr 2017

Easy Jazz: Web-based Jazz Improvisation System

Wonil Kim, Juhan Nam,
Graduate School of Culture Technology, KAIST
Daejeon, South Korea
ianwonilkim@kaist.ac.kr, juhannam@kaist.ac.kr

Abstract

Easy Jazz is a system that helps people improvise jazz solo without musical knowledge and training. The web-based system allows users to easily access to it without any special equipment or software. The system offers two versions of backing tracks and three types of instrument options. Once the user selects an instrument, the icons of the corresponding instrument appear on the screen. There are nine icons in total, and each of them represents a single note. The user can play the desired note by hovering the cursor of mouse or other compatible input devices over the icon. The notes that the icons represent keep changing adapted to the chord of the backing track. Four notes out of them correspond to the chord tones and they are displayed as large icons.

Keywords

Improvisation, input gesture, interactive performance, web audio

Introduction

As art has been regarded as a means of self-expression in modern society, people have become more interested in expressing themselves through playing musical instruments. According to a survey [1], 87% of respondents agreed that music is a very important part of life and 69% of respondents said that they would like to learn to play musical instruments. But learning a musical instrument requires a great deal of effort and time. 66% of respondents answered that time investment is the biggest barrier to playing musical instruments.

In this context, there have been various studies and products to help people play musical instruments easily. For example, *Guitar Hero*, a video game developed by Harmonix, is designed to play all songs only with five buttons [2]. The system maps all the melodies to the five buttons and provides the timing to press buttons. *Magic Piano* developed by Smule allows users to play advanced levels of piano music just by right timings of tapping on touchscreen devices [3]. There are many other mobile applications that users can reproduce melodies and chords of popular songs by tapping the screen.

While the majority of them focus on playing notes on music scores correctly, there are some efforts that allow users to play a new melody. For example, *Piano Genie* developed under the Google Magenta project is designed to create completely new melodies and rhythms without a guide [4]. With the system, users can perform on a simple interface with eight buttons and the performance is decoded into the space of plausible piano music in real time. However, this approach has the disadvantage that users cannot predict the next note, resulting in an output that can be different from the user's intention. Our system provides scale notes corresponding to the backing track's chord instead of the notes the user has to play. In our system, users can express their intention by hovering the input cursor over a pre-composed scale. This enables users to create new melody notes as if they improvise jazz solo over a given chord progression.

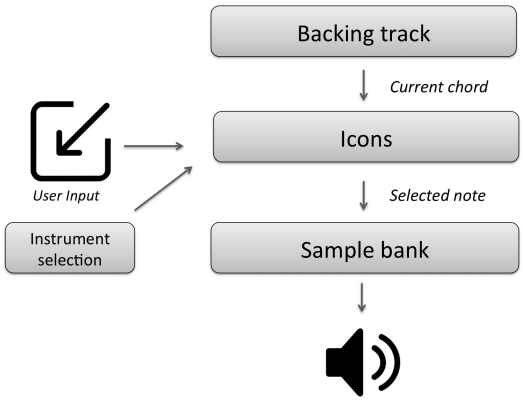


Figure 1: Overview of the system

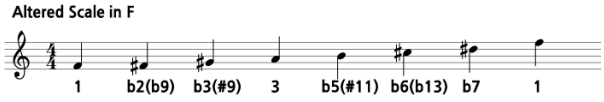


Figure 2: Altered scale is playable in the dominant 7th chord.

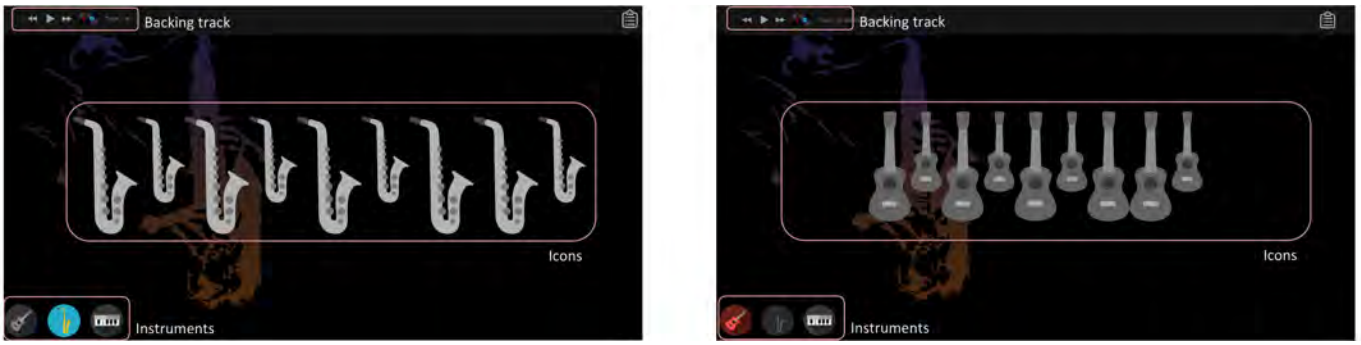


Figure 3: Screenshots of the proposed web-based music system.

System Overview

The overview of the proposed system can be found in Figure 1. The web-based application enables users to access to it without special equipment or additional software. Before starting the system, the user must select a backing track and an instrument using the vinyl button and the instruments button (Figure 3). We chose a well-known piece of standard jazz tune, *Autumn leaves*, as a backing track as an example. The system offers two versions of the piece, a funk style and a standard jazz style. The user can select one of them. Both tracks are 120 BPM in tempo and have the same chord progression.

The icons of the instrument selected are displayed as shown in Figure 3. There are nine icons in total, and each of them represents a single note that keep changing depending on the chord of the backing track. The system predicts the current chord based on the playback time of the backing track and maps the appropriate notes to icons. A total of 11 mode scales are provided, and notes provided are not more than major 2 degrees apart. For example, if the backing track has G minor key and F7 chord is played, the output becomes F altered scale as shown in Figure , which is available in dominant 7th chord. The use of chord tones can reflect the characteristics of the chord for jazz solo improvisation. By providing chord tones as large icons, the system enables the user to play more interactively.

Implementation

We implemented the system using Javascript. Instead of synthesizing the sound, we used sampled-based virtual instruments. Once the user selects an icon, the system predicts the current chord based on playback time and plays the corresponding audio sample. This sample-based approach has the disadvantage in that it slows down the initial loading especially on the web-based application but it serves high-quality audio. To overcome this slow sample loading, the system pre-loads all audio samples when initializing the system. Our web-based jazz improvisation system can be found at this link[1].

[1] `https://ianwonilkim.github.io/easyjazz/index.html`

References

[1] ”National Association of Music Merchants (NAMM)” News, last modified April 29, 2009, accessed Dec 22,2018, https://www.namm.org/news/press-releases/new-gallup-survey-namm-reflects-majority-americans

[2] Armiger, R. S., Vogelstein, R. J. (2008, November). Air-Guitar Hero: a real-time video game interface for training and evaluation of dexterous upper-extremity neuroprosthetic control algorithms. In Biomedical Circuits and Systems Conference, 2008. BioCAS 2008. IEEE (pp. 121-124). IEEE.

[3] Wang, G. Principles of Visual Design for Computer Music. International Computer Music Conference and the Sound and Music Computing Conference, 2014 (pp. 391-396)

[4] Donahue, C., Simon, I., Dieleman, S. (2018). Piano Genie. arXiv preprint arXiv:1810.05246.

Sonicanvas : An Audio Reactive Graphics Created Along Frequency Band

Taewan Kim, Juhan Nam
Music and Audio Computing Lab., GSCT, KAIST
Daejeon, Korea
wany@kaist.ac.kr, juhannam@kaist.ac.kr

Abstract

Sonicanvas is an artwork to visualize the frequency information of sound or music using motion graphic design. This work is designed to intuitively observe the entire sound data of an audio file by displaying the sound flow in real time and at the same time by expressing it as a designed image on a canvas. The frequency band of the input audio is represented by a linear graphic module according to predefined rules, and the energy size of each band is mapped to the size and opacity of the graphic module. The bar-shaped graphics module on the canvas displays only real-time information changes. The circular and square modules display cumulative visual information as well as real-time changes. We implemented this artwork using Minim and Processing. We show the result in a live demo.

Introduction

Audio visualization is an expression used to objectively interpret the expression of sound and to understand, analyze and compare music phenomena. Various attempts have been made to create artworks that extract audio features such as frequency, pitch, volume, rhythm, and velocity and then expresses them with various visual effects [6]. The purpose of this work is to visualize the frequency bands of music and sound in real time using basic graphics modules such as points, lines, and primitives, and record the flow of their changes. It allows viewers to easily identify changes of complex audio information in real time so that they can grasp a better understanding of that audio file. In general, people can detect information more quickly by eyes than by ears [5]. This work allows viewers to see real-time changes in music or sound and observe transient visual sound changes by accumulated visual information.

Related Works

Visualization Based On Sound

There have been many attempts to visualize sounds for a long time. Matanski et al. has presented a system for generative sound visualization [2]. In this paper, they used a method of mapping the color of light to frequency. For example, they changed the brightness of a color by the amplitude of the frequency band. Suranga et al. also worked to incorporate as many musical features into the visualization system as possible. They attempted to display music features such as rhythm, key, melodic contours and other qualitative aspects of the music [3].

Implementation by Processing

Many of audio visualization have been implemented using Processing. Pramerdorfer et al. introduced how audio data is processed on a computer and provided an overview of how to extract information from audio data stream [4]. They used the information to provide an approach to how Processing creates a real-time visualization of your music. In addition, Françoise suggested a guide for mapping information more precisely and effectively when sound information is represented by motion graphics [1].

Sound Visualizer

Working With Audio Data

Processing itself does not support audio, but several libraries have been developed in the relevant community that provide this functionality. One of them is Minim, which includes features for sound access, processing, and analysis. Minim supports playback of files such as mp3, wav, and provides a way to access various audio inputs such as microphone input. There is also an integrated Fast Fourier Transform that is used to process Minim audio files. It generates an FFT frame with a buffer size of 1025 and a sampleRate of 44100 Hz. In the FFT, a linear averaging is used to group adjacent frequency bands into the same number of groups. We can use this value to calculate each average value of the pixel width and height.

Visualization Approach

In this work, we tried four visualization methods. In all methods, the x-axis corresponds to the audio range. The first shows a bar graph of the audio output values that change depending on the frame output. It is intuitive to see how much the output energy is generated in each frequency band. The second graph shows the cumulative value of the energy amount in the bar graph. Opacity overlaps with several low-profile bars, creating a more prominent stroke. Depending on the depth of this stroke, it can be observed that a certain frequency band has high energy. Third, it maps the same audio data to the ellipse radius, not the height of the bar. Similarly, it shows the shape of the generated ellipse to represent the energy. Finally, the audio data is mapped to one side of the

Figure 1: The canvas appearance before sound data is accumulated.

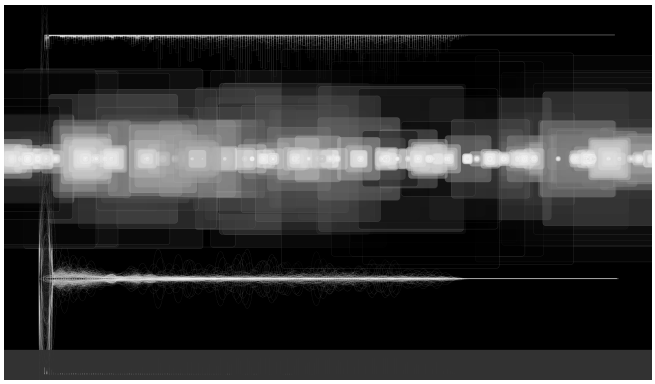


Figure 2: The canvas with sufficiently accumulated sound input in the four visualization methods.

square. This time the low-level rectangle becomes opaque and the square of the specific frequency band becomes clear. We can intuitively observe the flow of energy by viewing the number of squares and sharpness.

Installation

We implemented a wall projection to effectively show *sonicanvas* with only black / white color skimming and opacity change. We can set up sample audio and microphones with various frequency bands as audio inputs so that audiences can experience *sonicanvas* as their own sound [1].

References

[1] Françoise, J. 2015. *Motion-sound mapping by demonstration*. Ph.D. Dissertation, UPMC.

[2] Matanski, V. 2015. Generative visualization based on sound.

[3] Nanayakkara, S. C. 2007. Towards building an experiential music visualizer. *ICICS*.

[1] https://www.youtube.com/watch?v=X81v0ChpYM0t=45s

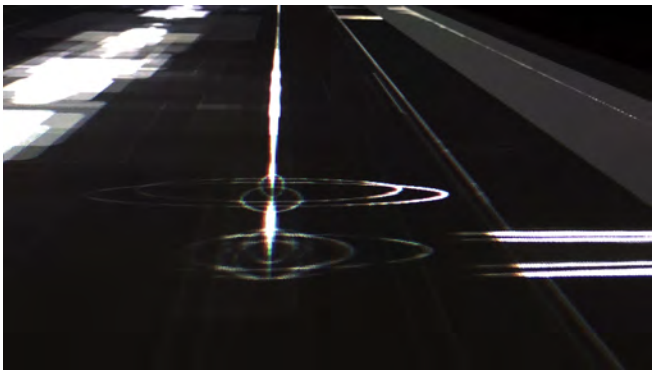


Figure 3: *sonicanvas* projected on the wall.

[4] Pramerdorfer, C. 2010. An introduction to processing and music visualization. *Vienna University of Technology*.

[5] Summerfield, Q. 1992. Lipreading and audio-visual speech perception. *Phil. Trans. R. Soc. Lond. B* 335(1273):71–78.

[6] Zhang, Y.; Pan, Y.; and Zhou, J. 2018. Study on application of audio visualization in new media art. In *Journal of Physics: Conference Series*, volume 1098, 012003. IOP Publishing.

Dance performance with a feedback loop on 3D image

Jeong-seob Lee
Independent Researcher
Danggok street, Gwanak-gu, Seoul, South Korea
jslee85@kaist.ac.kr

Abstract

In this paper, I introduce an interactive dance performance that applied a feedback loop to the 3D point cloud of a dancer's movement. Along with simple delay line buffer, feedback loop structure enables motion data accumulated and created a rhythmicality to a single dancer's movement and enabled to build up a structure of numerous movements in the space. This approach enabled flourishing and complex pattern output with a simple pipeline. Parameters were controlled by an operator in real-time, so that it gives more liveliness and dramatic flow.

Keywords

dance, performance, feedback loop, point cloud

Introduction

Dance is an art of the human body and its movement. For interactive performances, various artists/engineers explored the various relationship between body and technology. In this paper, I introduce an expressive method for amplification of dance applying feedback loop on 3D data of dancer's movement. It could bring more rhythmicality and fertility to the stage. Video clip of the performance is uploaded in https://www.youtube.com/watch?v=HmHlVg-KF1I.

Background: Artistic use of feedback loop

Ideas of my work have originated from delay-line based sound synthesis techniques in the 20th century. Before the age of computers with high performances, many engineers in the sound synthesis field struggled to achieve rich pattern with a simple analog circuit or limited processor or memory. Frequency modulation sound synthesis enabled numerous harmonics with a small number of oscillator circuits[2]. Likewise, a feedback loop with delay line enabled various expressive techniques with a short sequence of analog delay, or delay line (Figure 1). Depending on the duration of the delay line, it is recognized as different dimensions. Karplus-Strong algorithm [3] was an early method for physical modeling sound synthesis for plucking string instruments, which works in less than milliseconds. For a longer period, a simple reverb effect becomes available. In the scale of a second, it starts to show a character of rhythm.

Rhythm is an important element for dance as much as music [4]. Dance is subordinate to music to some extent. Music motivates dancers to move their bodies and audiences appreciate musicality from the movement. Rhythm plays a key role in this point. Rhythmicality is strongly bonded to repetition. By repeating the same or similar sequence, rhythmicality is born. Likewise, rhythmicality of the movement comes from synchronization of motion and musical rhythm and repetition of the same or similar movement [1]. Use of feedback loop for dance can contribute at this point.

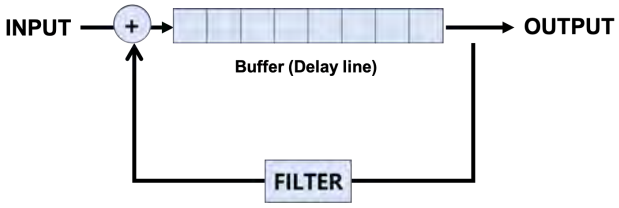


Figure 1: Signal flow diagram of the feedback loop. ©Jeong-seob Lee.

Dance with delay and feedback loop

I used Kinect for real-time acquisition of 3D point cloud. In software-wise, I used Processing IDE and OpenKinect for Processing library. I placed a square grid on the floor of the virtual space and store the highest height of points in each grid area. So, the silhouettes of a given point cloud are recorded as a buffer. We can say that it is a transformation of 3D data to a 2D dimension. I set length of the buffer as 60, which corresponds to 2 seconds as I used 30 frames per second setup. With this basic setup before the feedback loop is applied, duet performance of real-time movement of data and the delayed silhouette is available (Figure 2).

Feedback loop

For feedback loop, for each grid, the oldest height value multiplied by some decay ratio and the height of the latest point cloud are compared and the bigger one is stored as data for the given grid in the new buffer. The decay ratio is to prevent the overflow of the system, which is generally crucial for feedback systems. Feedback loop creates a repetition of motion, which is a key factor for rhythmicality. I chose 2 seconds for the period of the loop because it is the familiar duration for repetition of dance phrase in case of 500 BPM beat. For more

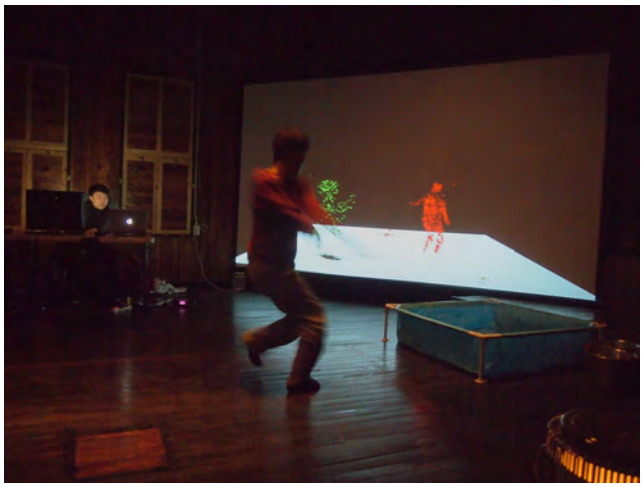


Figure 2: Duet of real-time data (red) and delayed silhouette (green). ©Seungbae Bang.

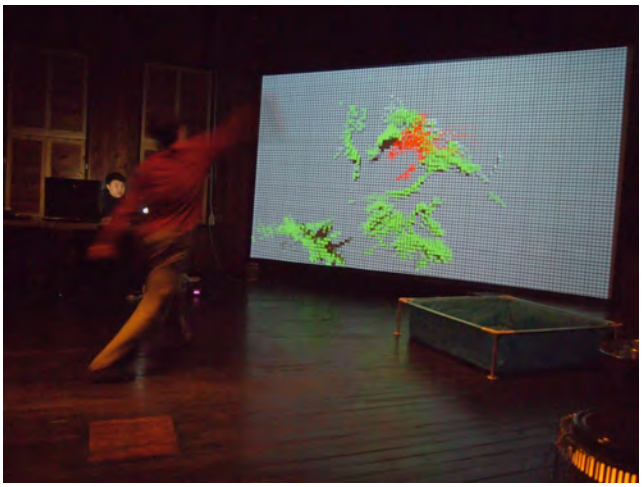


Figure 3: Accumulated motion traces on top view (green). ©Seungbae Bang.

fine structure, the period can be reduced to a half or a third, which still keep harmonics with the original 2 seconds.

Interactive control

Most of the aforementioned parameters were controlled manually by an operator (mostly myself) during the performance so that I could manage the tone or dramatic arc of a scene. The feedback loop can be switched on and off. Period of the loop can be changed. Or I can choose I will show the delayed silhouette or show its shadow only. Additionally, taking advantage of 3D data, I could freely rotate the camera angle and show the scenery from various angle including the bottom, which is a rare view that audience can experience in conventional dance pieces.

Choreography

As much as the design of the technological tool is important, exploration of proper motion phrase of style for the given tool is important too. Through several times of workshop with choreographer and dancer, I searched for effective movement style. Combination of move and stop seemed to be effective for showing the relationship between the dancer's real-time motion and delayed silhouette. When the loop is activated, the dancer could fill the space with his echoing afterimages by moving around the space. Setting the virtual camera angle to top view, the dancer slid and rolled around the floor and the result looked like flowing pile of human shapes (Figure 3).

Conclusion

In this paper, I introduced an expressive method for dance applying feedback loop on the 3D point cloud. The feedback loop has been an effective tool for artistic purposes with simple structure and small resources. It could reconstruct a dancer's movement and bring more rhythmicality and fertility. The feedback system can vary boundlessly by applying different filter into the loop. With this simple experiment as a basis, with further exploration, I expect many expressive outcomes in the future.

References

[1] Humphrey, D., and Pollack, B. 1987. *The art of making dances*. Hightstown: Princeton Book.

[2] Roads, C., and Strawn, J. 1996. *The Computer Music Tutorial*. The Computer Music Tutorial. MIT Press.

[3] Smith, J. O. J. O. *Physical audio signal processing : for virtual musical instruments and audio effects*.

[4] Woo, K. H. 2004. *Movement and Rhythm of Dance*. Yesol.

Author Biography

Jeong-seob Lee received a B.S. degree in mechanical engineering from Seoul National University, Korea, in 2010. Also, he has experience as a trained dancer and choreographer. Later he received M.S. and Ph.D. degree in culture technology from KAIST, Korea, in 2012 and 2019 respectively. His research interest is an interactive performance, computational choreography, and gesture mapping.

Computational Impressionism: Aesthetic Transference Between Impressionism and Emerging Media Arts

Kyungho Lee
Illinois Informatics Institute
University of Illinois at Urbana-Champaign
klee141@illinois.edu

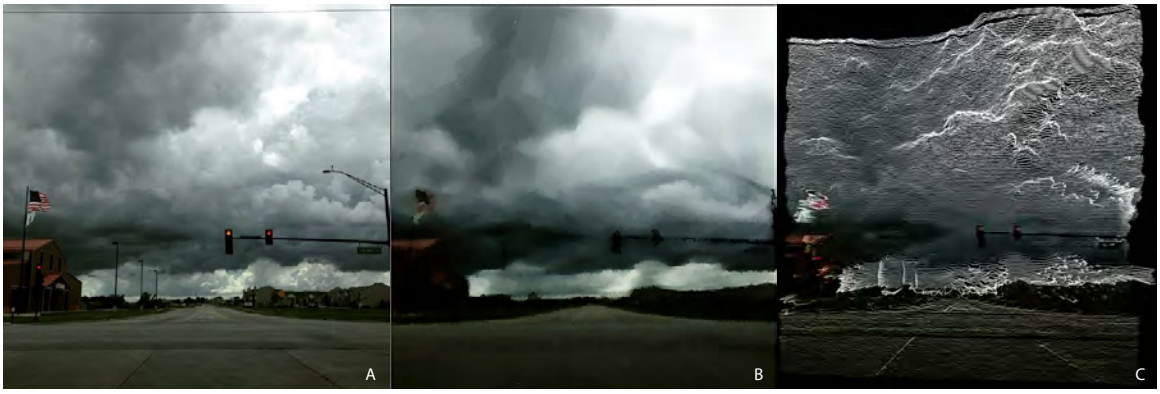


Figure 1: Visualization generated through our computational Impressionism model.

Abstract

This project aims to incite an aesthetic transference between Impressionism and emerging media art practices. How might we design a framework that is able to perceive and capture the characteristics of sceneries to portray its impression, much like Impressionists did? Inspired by the philosophy of Impressionism,this paper explores a way of depicting an impression of the world made by computers using deep neural networks (DNN). First, we built a conceptual framework adopting the insights acquired from Impressionism from a historical context. Then, we reconstruct an original image through the DNN as an approximation of human perception of the world. Our results demonstrated an opportunity for adopting a machine learning approach to generate visualizations for emerging digital media art purposes conceptually as well as practically.

Motivation

Six decades after the introduction of Rosenblatt's Perceptron, the advancement of machine learning approaches have enabled computers to learn from datasets and make more robust predictions. Nowadays, machine learning and deep learning has become a vehicle not only for solving real world problems but also for creating cultural impacts. For example, Google Research Lab released a blog post [2] that explains how computers see the world through artificial neural networks (ANN). Researchers used their large image training sets and adjusted the parameters to recognize parts of arbitrary object. The image becomes psychedelic remixes of the objects in them, show a potential use of machine learning for creating computational artworks. We believe such an emerging technology and approach, computational methods for expression, and a desire for creating innovative aesthetic experiences require us to have a paradigm shift. This change will surpass any other adopted methods of generating visualizations as a form of art, bringing forward new challenges and opportunities. From this point of view, we explored an opportunity to adopt a machine learning approach to an emerging media art practice. It was our hope that to build a holistic model that represents the Impressionist's worldview, to some degree, rather than focus on a rendering method. We designed a conceptual framework based on the insights from Impressionism as shown in Figure 2. To realize the framework, we built a computational model using DNNs to make computers interpret an original image, perceive information, and reconstruct the input image based on the structures and parameters we set up as shown in in Figure 1.

Computational Impressionism

The 19th-century was the era of serious discussion when philosophers, politicians, and artists put their efforts on moving the world forward to modernism. Impressionists was born in this context. Impressionists' significant contributions were

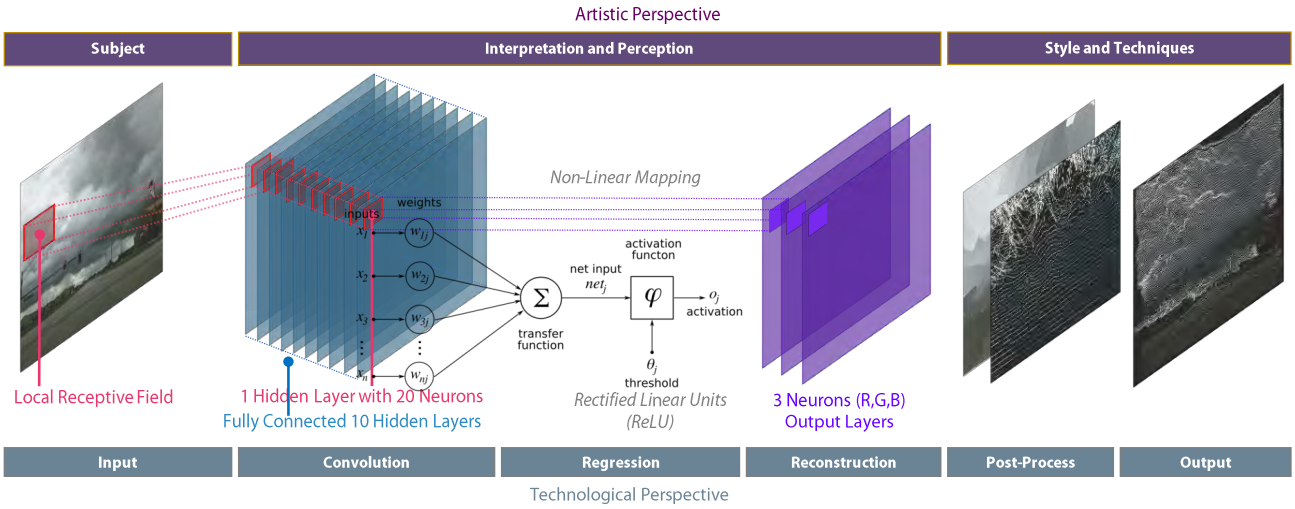


Figure 2: A conceptual framework for computational impressionism with two perspectives .

not limited to their changes to the concept of painting, to portray what our naked eyes can see, or the ways of using brush strokes and colors. It was rather an attempt to model a way of perceiving sceneries, objects, and human societies with prompt brush strokes. Our design rationale is here – we would like to unfold the legacy of Impressionism and link them to a conceptual framework which allows us to build a computational model of Impressionism rather than focusing on designing rendering methods. In this regard, our model consists of different perspectives: the artistic perspective and technical perspective.

The term, 'artistic perspective,' represents a process for identifying intentions of artists by choosing subjects and finding the best parameters to capture the impression of the subjects. Through iterative explorations, digital media artists can narrow a conceptual gap, "between the completed work and the intentions that initiated and guided its making" [1], similar to artists working in a previous generation. This perspective is particularly important because it is almost impossible to make computers initiate its own work, even though we aimed to build a model of computational Impressionism. There are three components to consider: choosing a subject, designing an interpretation and perception process, and applying a style.

The first step in this layer was choosing a subject. In our project, the goal was to capture an impression of an intersection, outside of a downtown area, on a gloomy and windy day. The second step is the interpretation and perception process. This is an exploratory analysis phase in which we adjust parameters in DNNs to see how algorithms and parameters can reconstruct images to estimate results. In this process, we can define a way of reconstructing the original image through structures which are loosely modeled after human brain activity. For this reason, artists should not expect to create accidental effects, unlike other generative visualization methods, since the DNN model that represents an impression of the world needs to be clearly defined in a way that translates results. Other than the unexpected, artists should explore a parameter space iteratively by changing values. The third step is to define a method for stylization. As Impressionists used short or broken brush strokes of pure and unmixed colors that represent a reflection of the light from the surface of an object, digital media artists should seek and choose what might represent the overall impression that we reconstructed through the previous steps.

Unlike the artistic perspective, many of steps in this layer, 'technological perspective', will be carried out autonomously without artists' intervention. However, we believe it is still important to understand a big picture of how each component functions to perceive and reconstruct an original image in each step of DNNs computationally. Lets consider a single image as an input X. We denote the impression of the original image as output Y.Then, our goal is to reconstruct an image Y from the original image X through a model F using DNNs. To generate an impression through a computational process, we wish to have the best model, F that represents our artistic intention. We briefly touch the technical requirements required in each step in Figure 2.

Acknowledgments

This research was supported by the Fiddler Innovation Research Fellowship. We wish to thank Jerry Fiddler and Melissa Alden for their generous support. The authors also gratefully acknowledge the use of the services and facilities of the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign.

References

[1] Gendin, S. The artist's intentions. 23(2):193–196.

[2] Mordvintsev, A. Research blog: Inceptionism: Going deeper into neural networks.

Navigating the Penumbra of Virtual Reality: Perception, Cinematography, Psychology and Ethics

Eugenia Kim, Sojung Bahng, Lukasz Mirocha and Carloalberto Treccani
City University of Hong Kong; Monash University
Kowloon Tong, Hong Kong; Caulfield, Australia
eugenia.kim@my.cityu.edu.hk, sojung.bahng@monash.edu, Lukasz.mirocha@my.cityu.edu.hk, ctreccani3-c@my.cityu.edu.hk

Abstract

Since the coining of the term "virtual reality" (VR) by Jaron Lanier [1] and development of head-mounted displays by pioneers such as Ivan Sutherland [2], VR has undergone several rounds of evolution, re-inventing itself slightly each time. It is only after over half a century, however, that this technology has now become accessible to the general consumer and therefore the mainstream. Not only that, anyone with access to this technology can now create content for VR - including artists. This raises questions about a creator's responsibility for a user's experience regardless of whether it relates to perception, aesthetics, psychology, ethics or multiple other factors. This panel examines several of these factors with an ultimate questioning of the impact VR artistic creations have on their audience and how these concerns factor into the design of an VR experience.

Keywords

Virtual reality, behaviors, cinematography, empathy, ethics, gaming, immersion, perception, narrative, real-time, reflexivity

Introduction

As virtual reality (VR) technology surpasses over 50 years of existence, the components are ripe for re-examination not only in terms of hardware but also from the perspective of content. No longer solely the realm of military experiments, medical simulations and niche video games, VR as well as other forms of mixed reality are increasingly used by the average consumer. The topics covered by VR experiences range from the hyper-realistic to the fantastically supernatural. VR's immersive nature, however, results in a somewhat different interpretation by the brain than traditional 2D or textual content. Although developments are being made in terms of hardware to combat some of the physical side effects, that does not necessarily resolve content and visual design choices.

This panel examines several factors related to content that affect a VR viewing experience. Starting with biological factors that then lead to issues of aesthetics, psychology and ethics, the panelists speak on aspects of VR that may be neglected or not even taken into consideration when creating an artistic VR piece.

"How We Create Reality: Perceptions and Behaviors in VR"

A recent theory in the field of neuroscience explains vision in probabilistic terms using Bayesian decision theory [3]. According to this theory, vision is the most probabilistic interpretation of the physical world. The perceptual value of what we see is in fact determined by past experiences and behaviors, assumptions and expectations. In other words, what we see is not the physical manifestation of the world as it is, but instead the most useful construction of reality as we perceive it. Given this preposition, one might propose that it is possible to think of VR (or a future totally simulated world) as a new environment that challenges our visual system (more generally our entire perceptive apparatus) shaped during millions of years of evolution, creating a new space that calls into play and re-codes our ability to sense the world. In that sense, could VR give us a new opportunity to better understand ourselves as humans beings as well as to make sense of the world in which we live?

By taking advantage of an initially non-existent or limited knowledge with a particular VR experience and the non-existent or limited physical interaction (a fundamental characteristic of human perception), the said experience, if properly used, may potentially be taken as a sort of "moment zero" for generating pro-social attitude and behavioral

change. For the general population, VR experiences are still generally limited at the time of writing and often confined to highly specialized uses (e.g., gaming, medical laboratories). However the collective lack of experience and the possibility of creating situations that would otherwise be impossible in the physical world may open up to new scenarios in the future which would require further attention and investigation.

This presentation, will highlight the correlation between perception (assumptions and expectations) and contexts (environments) and demonstrate how a change in perception, facilitated by a VR environment, may lead to a change in individual's abilities to "sense" the world.

"Aesthetics and Creation in the Age of Real-time Media: Remediations and Convergences"

Game engines create a new type of a real-time software media [4] genre by making use of remediations [5] such as: cinematography techniques, video game interaction; and media convergence [6]. At the aesthetic and interaction level, this genre can be designed and experienced in several ways. Furthermore, due to the modular and real-time nature of game engines, a clear line between the phase of designing and experiencing or viewing game engine produced content, is hard to define. All these factors lead to a new techno-cultural milieu and creative practices that are transforming both entertainment industries and media arts.

3D content creation software for designing 3D and immersive media content and experiences allow artists to produce sophisticated real-time virtual environments that respond to user input and can be dynamically represented (visualised) in a number of ways for various media genres. This presentation will address the cultural consequences of creative affordances offered by today's game engines, particularly Unity 3D, to design several ways of representing and explore the same virtual, spatial environment. Technical capabilities of the software allow artists to design a real-time linear cinematic content, a completely non-linear, game-like, immersive or non-immersive exploratory experience or even a hybrid experience that lies at the intersection of these two genres. Blurring the line between media genres - movie, video game, interactive narrative - results in new techno-cultural phenomena and creative practices.

"Beyond Empathy: Cinematic VR, Reflexivity and Intersubjectivity"

Cinematic and other categories of VR have been increasingly utilized to induce the feelings of embodiment and empathy. What has been less explored is how these experiences induce self-awareness or reflexivity. By going through the process of reflexivity, a viewer can then come to the realization that they are connected to others in an intersubjective context. These concepts can be incorporated into the storytelling design and inform the aesthetic methods used to essentially go beyond empathy. This presentation explores the relationship between these concepts as well as the duality of immersion given that a viewer exists simultaneously in physical and virtual spaces. Examples of works that induce reflexivity and intersubjectivity while relying on a sense of disembodiment will be used to illustrate these points.

"The Role of Ethics in VR for the Creative Arts"

The increasing use of VR in the creative arts raises a questions of ethics that was perhaps previously only addressed in very specific scenarios such as arts therapy and community arts. The reality is that whether creating a VR artwork for commercial, educational or purely artistic purposes, creators must now take into consideration the impact that VR technology has on both psyche and physiology when presenting content to viewers. Prior relevant research in this area includes the impact of virtual embodiment through an experiment using a rubber hand [7], the physiological impact of VR experiences [8] and generating empathy by replicating how dementia patients view the world [9].

This ending presentation of the panel begins by examining the code of ethics proposed by Madary [10], then reviewing how the prior presentations in the panel all contribute to or are impacted by such a code of ethics. Finally, the presentation looks at how crossover between the creative arts and fields such as medicine further affects how artists must develop their VR works in an ethical manner.

Acknowledgements

The panelists would like to all acknowledge their respective advisors, mentors, and supervisors.

References

[1] Jonathan Steuer, “Defining Virtual Reality: Dimensions Determining Telepresence,” *Journal of Communication*, Vol. 42, No. 4, (1992): 73.

[2] Ivan Sutherland, "The Ultimate Display," (paper presented at the meeting of the Proceedings of the Congress of the International Federation of Information Processing (IFIP), 1965).

[3] Dale Purves, Yaniv Morgenstern, and William T. Wojtach, "Perception and Reality: Why a Wholly Empirical Paradigm Is Needed to Understand Vision," *Frontiers in Systems Neuroscience* 9, (2015): 4.

[4] Lev Manovich, *Software Takes Command* (London: Bloomsbury, 2013), 26, 124.

[5] Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, Massachusetts: MIT Press, 2003), ??.

[6] Henry Jenkins, *Convergence Culture (*New York, New York: New York University Press, 2006), 48, 55-56, 59.

[7] H. Henrik Ehrsson, Nicholas P. Holmes, and Richard E. Passingham, “Touching a Rubber Hand: Feeling of Body Ownership is Associated With Activity in Multisensory Brain Areas,” *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, Vol. 25, No. 45 (2005): 10564-10573.

[8] Sue V.G. Cobb, Sarah Nichols, Amanda Ramsey, and John R. Wilson, “Virtual Reality-Induced Symptoms and Effects (VRISE),” *Presence*, Vol. 8, No. 2 (1999): 169-186.

[9] Dementia Australia.,“Virtual Dementia Experience (2018)”, Dementia Australia website, accessed November 29, 2018, https://www.dementia.org.au/learning/centre-for-dementia-learning/virtual-dementia-experience

[10] Michael Madary and Thomas K. Metzinger. "Real Virtuality: A Code of Ethical Conduct. Recommendations for Good Scientific Practice and the Consumers of VR-Technology," *Frontiers in Robotics and AI,* Vol. 3, No. 3 (2016): 45.

Bibliography

Michael Baxandall, *Painting and Experience in 15th century Italy*, (Oxford: Oxford University Press, 1988): ??

David M. Berry, *Critical Theory and the Digital*, (New York, New York: Bloomsbury, 2014), ??

Matthew Fullers, *Media Ecologies: Materialist Energies in Art and Technoculture*, (Cambridge, Massachusetts: MIT Press, 2007), ??

Jason Gregory, *Game Engine Architecture*, (Boca Raton, Florida: A K Peters/CRC Press, 2018), ??

Beau Lotto, *Deviate: The Science of Seeing Differently,* (London: W&N, 2017), ??

Austin Van Loon, Jeremy Bailenson, Jamil Zaki, Joshua Bostick, and Robb Willer,"Virtual Reality Perspective-taking Increases Cognitive Empathy for Specific Others," *Plos One* Vol. 13, No. 8 (2018): 1-19.

Out of sight, out of mind

Charlotte Gould, Paul Sermon, Jeremiah Ambrose
School of Art, University of Brighton – School of Art, University of Brighton – University for the Creative Arts
Brighton, United Kingdom – Farnham, United Kingdom
P.Sermon@brighton.ac.uk, C.Gould@brighton.ac.uk, Jeremiah.Ambrose@uca.ac.uk

Abstract

This panel will present the outcomes of a two-week residency by a research team from the University of Brighton, School of Art and the University for the Creative Arts in September 2018 on the Mar Menor, a 170 km² saltwater lagoon on the south east coast of Spain. The team were invited to undertake practice-based research on the changing ecosystem of this unique natural landscape, resulting from damages caused by intensive agriculture, increased tourism and rising sea levels. The project and panel has been developed by a team of three artists, each bringing specific experience and knowledge of 360° video to undertake the research and create a unique understanding and manifestation of the changing ecosystem of the Mar Menor. This includes Paul Sermon who is currently working on collocated telematic experiences in 360° live video environments, Charlotte Gould's work on developing immersive 360° animated augmented reality and Jeremiah Ambrose who is working on gaze controlled navigation through 360° video narratives. The overarching aim of this project is to create a unique interactive 360° video experience of the Mar Menor that manifests the anthropocene effects on this natural landscape as augmented surreal and metaphysical interpretations of the artist's experiences during the residency. Through environmental, social, economic and cultural observations and encounters the team are creating an immersive 360° installation environment that incorporates both video and audio recordings with augmented imaginary and predicted realities transformed from scientific data in obscure and profound guises.

Keywords

Augmented, reality, telematic, 360°, video, anthropocene, narratology, experience, installation, telepresent.

Out of sight, out of mind

Project Description

This collaborative project and panel discussion is born out of a 10 day residency on the Mar Menor, a 170 km² saltwater lagoon on the south east coast of Spain in September 2018, where the majority of the primary research took place by gathering 360º video material from observations, experiences and interviews. The project has been developed by a team of three artists from Brighton, UK, each bringing specific experience and knowledge of 360° video to undertake the research and create a unique understanding and manifestation of the changing ecosystem of the Mar Menor. This includes Paul Sermon who is currently working on collocated telematic experiences in 360° live video environments, Charlotte Gould's work on developing immersive 360° animated augmented reality and Jeremiah Ambrose who is working on gaze controlled navigation through 360° video narratives. This practice-based team of artists are currently undertaking research using a range of video and gaming software and advanced hardware devices, including Insta360 Pro 8K video cameras and Oculus Rift head-mounted-displays in conjunction with live video switchers. This has produced a range of ultra HD 360° outputs involving stereo 8K and real-time 4K environments with augmented live 360° video and animation sequences through live chroma-keying effects.

The overarching aim of this project is to create a unique interactive 360° video experience of the Mar Menor that manifests the anthropocene effects on this natural landscape as augmented surreal and metaphysical interpretations of the artist's experiences during the residency and available scientific data of the Mar Menor ecosystem. Through environmental, social, economic and cultural observations and encounters the team are currently creating an immersive 360° environment that incorporates both video and audio recordings with augmented imaginary and predicted realities transformed from scientific data in obscure and profound guises. This 360° telematic installation incorporating live audience interaction within the original 360° video experience will be presented in Murcia in March 2019.

The material has been generated through an intensive stage of data gathering using the aforementioned 360° video techniques, as well as spatial audio recordings, generated through both interviews/conversations and observation/refective methods of research. The aim is to build a unique picture of Mar Menor's memories, histories, tragedies, myths, aspirations, regrets and possible futures. Available data on the lagoon's water quality has also contributed to how the team manifest and communicate a unique experience of the Mar Menor as a bizarre uncanny encounter of a landscape proliferated by familiar animated objects representing this data. For example, a mountain made of bags of salt indicating the salinity level in the lagoon, green clouds in the sky representing its chlorophyll

level and a tower of suitcases signifying the increase of tourism. This technique of augmenting animated elements in 360° video has been developed by Charlotte Gould and is illustrated in Figure 1 below, exemplifying augmented data that causes the user to question the very environment they inhabit by aiming to offer alternative experiences to our pervasive anthropocentric perspectives.

Figure 1. Mock-up of equirectangular 360° environment with augmented animation elements. © Charlotte Gould

The scientific analysis and interviews/conversations are explored through the team's own observations and experiences of the Mar Menor, captured through a range of unique approaches to 360° video recording. This has included underwater filming in the lagoon and drone controlled aerial recordings. Using a technique of gaze-controlled interaction the 360° video shots are linked together to explore a non-linear narrative of the entire Mar Menor area to create movement between and interaction with the 360° film content and embedded overlays. In a 360° recorded conversation a participant on the shoreline of the lagoon points across the water, at which point it is possible to look in the same direction and enter another 360° video sequence that travels over the lagoon to the location they are pointing at. This 360° navigation technique, developed by Jeremiah Ambrose has been successfully used in previous projects and is further explained in Figure 2 below.

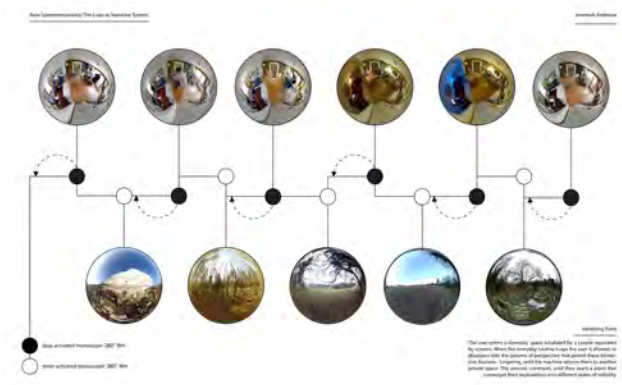


Figure 2. Virtual gaze interaction to create movement and interaction with 360° film content. © Jeremiah Ambrose

Following the residency on the Mar Menor the team have been reviewing the gathered data and editing the material to construct the non-linear interactive 360° video experience, complete with augmented animated elements. This will also incorporate the development of the immersive 360° telematic environment allowing public participants the opportunity to observe their own presence within the interactive 360° video experience of Mar Menor. Using a system of live 360° chroma-keying between two separate locations in Murcia and the Mar Menor, the participants will be able to encounter each other in this obscured landscape of recorded and imagined realities by standing within a constructed 4 x 4 metre blue box space installation. This 360° telematic technique is currently being developed by Paul Sermon and is further explained in the installation workflow diagram Figure 3. The intension is to provide the participant with a greater sense of presence and objective responsibility for the environment they exist within and are connected to. The final installation will seek to present the consequence of the anthropocene as a direct result of our own interventions, rather than being an 'out of sight, out of mind' experience of the Mar Menor.

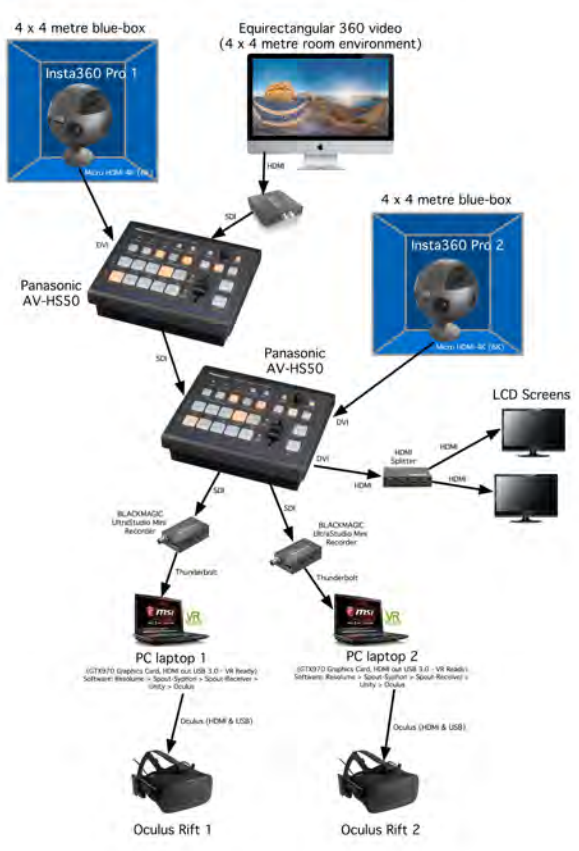


Figure 3. Installation workflow diagram for exhibition in Murcia. © Paul Sermon

Panel Presentations

Each member of this project team and panel bring a unique practice-based research method and theoretical direction on the subject of immersive 360º video to the fore of this project. The aims and objectives of the panel are to both present a concise and detailed account of the project, whilst identifying a distinctive approach to the anthropocene questions it raises by bringing their particular ideas into dialogue with the other panellists and the aims of the overarching Mar Menor project.

Paul Sermon: Since the early nineteen-nineties my work in the field of telematic arts explores the emergence of user-determined narratives between remote participants who are brought together within shared telepresent environments. Through the use of live chroma-keying, video projection and videoconference technology these geographically divided audience participants are composited live in intimate social spaces. This is essentially how all my installation projects function, where the public participant plays an integral part within these telematic experiments, whose engagement within them makes the 'Work' and their shared experiences of them creates the 'Art'. As an artist I am both designer of the environment and instigator of the narrative, which I determine through the social and political context that I choose to play out these telematic encounters. My recent research looks to identify a juncture between empathy and presence amongst remote participants in a converged 360º telepresent video installation. The research charts the kinaesthetic and proprioceptive capabilities of these shared telepresent encounters and identifies the empathetic nature of the participant's interactions and experiences - attained through observations, conversations and encounters during the realisation of installations and performances throughout the project. This reflective practice draws on a phenomenological framework, from Maurice Merleau-Ponty's extension of the bodily synthesis (Merleau-Ponty 2012 [1945] p.154) to Jean-Paul Sartre's awareness of self when confronted with the gaze of the other (Sartre 2003 [1943] pp.245-326); where the objectification of gaze is confronted on equal empathetic terms through a process of sharing our presence in a 360º third-space environment from a single viewpoint.

Charlotte Gould: Through my practice I explore the potential for intervention through open interactive installations in digitally mediated public spaces. I have developed a number of mixed reality systems to prompt play and interaction across social and cultural boundaries. I examine the notion of audience agency, testing the possibilities of open interactive systems, to offer opportunity for diverse participants to co-create artworks through the development of unique narratives, promoting public engagement, looking at how this can impact on culture, changing the way we engage in the urban environment and contributing to a collective memory and sense of place. I develop 360º mixed reality environments for immersive non-linear storytelling. Roland Barthes identified the "Death of the Author" (Barthes, 1967), where writer and reader co-produce and in this way, through public interventions, participants are invited to take a dynamic role in storytelling, working with the artists to develop narrative, creating content that forms a contemporary folklore as identified by Henry Jenkins (Jenkins, 2008). Through "Out of sight, out of mind" I aim to capture public memory merged with future imaginings to engage participants with issues of sustainability and the changing eco-system of the Mar Menor. The playful interface uses "phantasmagoric" elements (Sutton Smith 2009) to create a playful and surprising immersive environment to trigger interest and surprise in the audience. This work explores the potential for non-linear narrative and formats to inspire curiosity. Jeremy Bailenson advocates immersive 360° environments as a format which leaves a lasting impression on users due to its immersive properties (Bailenson 2018). Through this site-specific research I explore the potential for immersive 360º story telling as a public intervention to raise public awareness and effect change.

Jeremiah Ambrose: Over the last few years my practice has evolved from initial experiments looking at non-haptic interactions with moving images to becoming a more focused research framework that looks at interactive 360° film practice. Throughout my research I refer to the term *Cynematics*, which is a portmanteau of cybernetics and cinematics. I have developed this term to explicate an approach to cinematic practice/theory that is conducive to new artistic potentials for interactive film. To this end, Cynematics can be interpreted as a node of Katherine Hayles' (Hayles 1999 pp.2-5) understanding of the posthuman discourse, meaning that it stands as a practice-based exploration into how interactive immersive media discourses propagate new kinds of human experience. As we continue to develop and expand the languages of moving image it becomes increasingly more important to locate and contextualise discourses that allow us to explore the impact of our synthesis with filmic forms. Although the state of being posthuman is a difficult subject to quantify if we are to align with Gene Youngblood's ideation that media networks operate as "the nervous system of mankind" (Youngblood 1970 p.41) then is it fair to consider interactive immersive media networks as the nervous system of the posthuman? Embedded in such a query is the need to develop approaches that allow us to understand the perceptual networks that we are now embroiled with. Such systems promote new degrees of anthropocentrism at the same time as offering a way to dissolve human-centric perspectives and create new environmental relationships.

References

Bailenson, Jeremy. 2018. Experience on Demand: What Virtual Reality is, how it works and what it can do. New York: W. W. Norton & Company Ltd.

Barthes, Roland. 1977 [1967]. Death of the Author, in Image-Music-Text: essays selected and Translated by Stephen Heath, New York: Hill and Wang

Hayles, Katherine. 1999. How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics. Chicago: University of Chicago Press.

Jenkins, Henry. 2008. Convergence Culture. New York: New York University Press.
Merleau-Ponty, Maurice. 2012 [1945]. Phenomenology of perception. Translated by Donald A. Landes. London: Routledge.
Sartre, Jean-Paul. 2003 [1943]. Being and Nothingness: an essay in phenomenological ontology. Translated by Hazel E. Barnes. London: Routledge.
Sutton Smith, Brian. 2009. Ambiguity of Play. Cambridge, MA: Harvard University Press
Youngblood, Gene. 1970. Expanded Cinema. Dutton Press.

Author(s) Biography(ies)

Paul Sermon was awarded the Prix Ars Electronica Golden Nica, in the category of interactive art, for the hyper media installation 'Think about the People now' in Linz, Austria, 1991. Produced the ISDN videoconference installation 'Telematic Vision' as an Artist in Residence at the ZKM Center for Art and Media in Karlsruhe, Germany in 1993. Received the Sparky Award from the Interactive Media Festival in Los Angeles for the telepresent installation 'Telematic Dreaming', June 1994. From 1993 to 1999 worked as Dozent for Media Art at the HGB Academy of Fine Arts Leipzig, Germany. From 2000 to 2013 Professor of Creative Technology at the University of Salford, School of Arts & Media. From 1997 to 2001 Guest Professor for Performance and Environment at The University of Art and Design in Linz, Austria. Since September 2013 Professor of Visual Communication in the School of Art at the University of Brighton, United Kingdom.

Charlotte Gould has exhibited her work internationally including in China, Australia with "Urban Picnic" and "Peoples Screen" and in Europe at MACBA (Museum of Contemporary Art Barcelona) with "All the World's a Screen" (2011). Charlotte is Deputy Head of School in the School of Art at the University of Brighton responsible for learning and teaching. She teaches in Visual Communication and has taught across all levels from undergraduate to PhD supervision. She received her PhD in Interactive Works for Urban Screens: A practice based study into building new ways of engaging communities in urban space through interactive artworks for urban screens from the School of Arts & Media, University of Salford in 2015. She graduated with a BA Honours Degree in Graphic Design from Chelsea School of Art in 1990 and was awarded an MA in Creative Technology from the University of Salford (2003).

Jeremiah Ambrose works in the areas of digital art, media futures and experimental practice – his current research explores the creation of interactive 360° environments. He undertook a practice-based PhD at the University of Brighton, looking at emergent narratives and interaction aesthetics in VR and interactive 360° film. He graduated with a BA (Hons) in English, Media and Cultural Studies from Dún Laoghaire Institute of Art, Design and Technology in 2009. After this he was awarded an M.Phil in Film Theory and History and an M.Sc in Interactive Digital Media from Trinity College Dublin in 2011 and 2014. Jeremiah Ambrose was recently appointed as a Lecturer in Film and Digital Art in the School of Fine Art and Photography at the University for the Creative Arts Farnham. He is also a tutor in Immersive Factual Storytelling on the MA Ethnographic and Documentary Film at University College London and was previously a lecturer on the University of Brighton's MA in Digital Media Arts course.

Penumbra in faint light: contemporary art and technology in Latin America

Reynaldo Thompson & Tirtha Mukhopadhyay, Priscila Arantes & Gilbertto Prado, Daniel Argente, Daniel Cruz & Bernardo Piñero, Malu Fragoso, Jorge La Ferla, Nara Cristina Santos

Affiliation (s) Universidad de Guanajuato (Mexico), Universidade Anhembi Morumbi (Brazil), URU (Uruguay), UCh (Chile) UNTREF (Argentina), UFRJ (Brazil), ABA (Argentina), UFSM (Brazil)

thompson@ugto.mx, tirtha@ugto.mx, priscila.a.c.arantes@gmail.com, gttoprado@gmail.com, danielargente@gmail.com, dcruz@uchile.cl, bernardopinero@gmail.com, malufragoso@gmail.com, jorgelaferla@gmail.com, naracris.sma@gmail.com

Abstract

The aim of this panel is to showcase achievements in digital installation art in Latin America, especially as such art involves a transformation of media. Presenters, who are also experts and recognized artists, from various countries in Latin America, discuss recent innovations in-between genres and media technologies. Themes assume special importance at a time of transitions and political change, immigration and globalization. The panel which symbolizes the art of PENUMBRAL frontiers of the world may be considered from three perspectives: (a) networking (b) collective art and (c) search of alternative circuitry.

Keywords

New media, hybrid art, environment, humanization of technology.

Introduction

Some panelist will focus on their own artistic production, while some others will address the art produced by other artists that had exhibited in international festivals, biennials, museums and events all over the world, yet in a manner that highlights a common language of technology and science for the southern continent. Subjects range from native to rural cultures in Latin America, though problems faced in metropolitan areas, universal issues and problems such as those related to environment, racial segregation, politics and purely aesthetic concerns. However, all art projects are framed through the half-illuminated, grey areas of the cultural *penumbra*, the presence and absence of light, or shadow in a world in-between creativity and reason. We could discuss each of these three components in an introductory manner here, for reference and for highlighting on the content of panel discussions in ISEA 2019.

Networking and Systematization of media art history.

Currently what Ibero-America lacks, unlike the Anglophone countries, is an over-arching systematization of the history of media art in the region. So far there have been fragmented accounts with non-centralized information, and sparse and scattered bibliography. This panel is interested in approaching the different efforts that have been made in the region, by means of an electronic transfer of information through a network of signals, in order to build a common story and history, integrating its origins and mapping out its main exponents and current trends. Building a non-hegemonic and decentralized view of the currently prevailing arts in the light of the new media – that is a basic drive within these vanishing and emerging cultures of the Latino world. We will focus on the different efforts that both Latin America and also Spain and Latin countries of Europe, are making through academic and non-academic projects and initiatives, such as the creation of the "Red y Observatorio Iberoamericano de Arte Digital y Electronico" (Ibero-American Digital and Electronic Art Network and Observatory). The light of the internet integrates various countries and institutions in the region, with the aim of building a network that articulates efforts towards generating a narrative, and systematize media art collections, strengthening regional links. This is an electronics version of a heritage in the contemporary world which banks on the production of illumined scapes, objects, vistas of artists such as Diana Dominguez, Daniel Cruz and Daniel Argente. Gilberto Esparza and so many other artists.

Conclusion: New Media as a state of affairs

Considering the place and the environment of ISEA 2019 we refer to the emblematic figure of Nam June Paik, especially to one of his last works, the installation *Un monstruo de Miradas* (1996), that resulted from a commission from the Euro-American Film Exhibitions. It was a video and digital installation that consisted of a reading of Latin America. It was exhibited at the time on various formats in Bogotá, Buenos Aires, Montevideo, San Pablo, Santiago.

This emblematic installation preceded the last single-channel work by Paik, *Tiger Lives* (1999), a piece between technological images where Paik confirms the use of footage as a self-portrait in the transition from analog to digital video.

It is in the practice of the installation, where old and new technologies come together, that we verify a form of eloquent artistic expression in the field of contemporary art. The audiovisual, definitively converted into numerical information processed by brand software – something which has been instrumental in migration towards a new type of experimental work and one which went out in search of another viewer. We will refer to works and artists, among which are Andrés Denegri, José Alejandro Restrepo and Gerardo Suter, with whom we have been developing various curatorial proposals in relation to staging of political issues of the Latin American context throughout its history, but with a constant focus on the art of installation.

References

Arantes, Priscila. Re/escrituras da arte contemporânea: história, arquivo e mídia. Editora Sulina, 2015.

Beiguelman, Giselle, and Jorge La Ferla, eds. Nomadismos tecnológicos. Editora SENAC São Paulo, 2011.

Prado, Gilberto, Arlindo Machado, and Julio Plaza. Arte telemática dos intercâmbios pontuais aos ambientes virtuais multiusuário. Itaú Cultural, 2003.

Sánchez Guillén, Ariel Eduardo. "Persistencias e innovaciones en la enseñanza del arte en el Instituto Escuela Nacional de Bellas Artes." (2015).

Authors Biographies

Reynaldo Thompson studied architecture at the University of Guanajuato and postgraduate studies at the Polytechnic University of Catalonia in Barcelona as well as at the University of Texas at Dallas, where he received his doctorate in the area of aesthetic studies focused on Contemporary Art.

He has participated in different solo and group exhibitions and curated shows in Mexico and abroad. He served as director of the Department of Art and Business of the University of Guanajuato and is currently focused on research on art, science and technology in Latin America. The results of their research have been published in international journals.

Expanded Circuits and Poetic re-writings: Circuito Alameda

Priscila Arantes, Gilbertto Prado
Universidade Anhembi Morumbi, Universidade de São Paulo,
Brasil
priscila.a.c.arantes@gmail.com, gttoprado@gmail.com

Abstract

Transiting in the interdisciplinary domains between art, science and technology, Gilbertto Prado has been building a trajectory within the context of contemporary Brazilian art. His works have no hierarchy and are not restricted to a specific language or domain, being able to dialogue with issues that relate to network art as well as to explore the poetic potentialities offered by virtual environments. Many of recent Prado's works are co-authored with the Poéticas Digitais Group, formed by artists and young researchers, creating collaborative networks and knowledge circuits. In this context, the purpose of this article is to analyze the work of the artist and the group as well as the *Circuito Alameda* exhibition presented at the Laboratorio Arte Alameda in Mexico City in 2018, based on the concept of rewriting, developed by the researcher Priscila Arantes.

Keywords

Circuito Alameda, Poeticas Digitais Group, interactive installation, art and technology, rewriting

Introduction

Transiting in the interdisciplinary fields between art, science and technology, Gilbertto Prado from the early days of his production in the 80's has developed a range of projects in postal art, fax art, webcam and video, breaking with the objectual character of the artistic practices of the time and anticipating many of the issues that would mark contemporary artistic practices after the 2000's. [1]

Welcomet Mr. Halley, an international postal art exhibition, *Videoscópio*, a series of video interviews with artists, as well as *Connect*, a fax art project that allowed people in different parts of the planet to simultaneously perform an artistic project in common: these are some of the projects developed in the late 80's and early 90's. Many of them foreshadowed some characteristics that would mark Prado's future works: the idea of networking, dialoguing and creating circuits; whether those produced by people, or those typical of works incorporating electronic-digital flows. [2]

Many of Prado's works are developed in co-authorship with his *Poéticas Digitais Group*[1], comprising students and young researchers. This reveals yet another of Prado's characteristics: that of being an artist-professor who creates collaborative networks and knowledge circuits.

For Priscila Arantes, Gilbertto Prado has a substantial production, having participated in both national and international exhibitions, and being, no doubt, a key artist not only for understanding the different facets that make up contemporary Brazilian art, but also for comprehending a production connected with the issues of his time and cultural context.

Arantes has been following Prado's career for some years as a critic, colleague and curator. In addition to being one of the artists included in her book *Arte e Mídia: perspectivas da estética digital*. [3] The researcher has carried out several curatorships that included Prado's participation, such as the project *Caixa dos Horizontes Possíveis* - a *site - specific* development exhibited in the former location of the Paço das Artes - and *Desertesejo*, which was part of the exhibition *Paradoxo(s) da Arte Contemporânea: diálogos entre os acervos do MAC/USP e do Paço das Artes*. [4] Additionally, they have engaged in several partnerships, whether in developing joint events and in organizing publications.

The concept of rewriting[2] developed by Arantes in her book *Re/escrituras da arte contemporânea: história , arquivo e mídia* incorporates the principle of *different repetition*.[5] To repeat differently means precisely to understand the notion of a writing that points beyond the notion of identity. Accordingly, both the works presented at the *Circuito Alameda* exhibition, within the specific context of the *Laboratorio Arte Alameda*, gain new meanings, as well as the context of local history itself gains new perspectives based on the works of Gilbertto Prado and the Poéticas Digitais Group.

[1] The *Poéticas Digitais* Group was created in 2002 in the Department of Visual Arts of ECA-USP as a follow-up to the wAwRwT project started by Gilbertto Prado in the UNICAMP Institute of Arts in 1995. This is a multidisciplinary group promoting the development of experimental projects and reflections on the impact of new technologies in the field of the arts. Participants are artists, researchers and students, with different compositions in each project. The *Circuito Alameda* exhibition had the participation of Agnus Valente, Ana Elisa Carramaschi, Andrei Thomaz, Leonardo Lima, Luciana Ohira, Maurício Trentin, Nardo Germano, and Sérgio Bonilha. www.poeticasdigitais.net

[2] The rewriting concept is part of the book *Re/escrituras da arte contemporânea: história , arquivo e mídia* (Re/writings of contemporary art: history, archive and media) result of postdoctoral program at Penn State University.

Figure 1. Overview of the Central Nave (*Jardín Alameda*) with *Circuit Diagrama*, *Necklace-Sensor*, *Biombo* and *Encontros* .In the middle line, the Orange tree; Overview of the Choir Room with *Desluz* and *Tapete Azul II. The* Lower Cloister room, with *Desertesejo, Caixas, Serigrafias, Pedralumen, Circuito Celeste*, and *Regla del Tiempo.*

The circuit of the artist's trajectory

The *Circuito Alameda* [6] exhibition crowns, in this sense, Gilbertto Prado's trajectory of more than 30 years. It was an important exhibition not only because it gave the Mexican audience the possibility of getting to know Prado's works, but for bringing together a significant portion of his production. This was only possible through the strength, coherence and power of the artist's trajectory, as can be seen in the *Circuito Alameda* exhibition, curated by Jorge La Ferla in the *Laboratorio Arte Alameda* venue, directed by Tania Aedo, which took place from June to August, 2018.

The exhibition comprised 16 works, in 5 rooms and 600m^2, many of which previously unreleased and developed specifically for this exhibition, as is the case with *Jardín Alameda, Circuito Alameda, Biombo, Celestial Circuit, Regla del tiempo, Necklace-Sensor*, among others. There were also works that were conceived in different periods of time, such as *Azul Celeste*, a rug woven by wives of prisoners in memory of those dead in the massacre in the state of Rio de Janeiro, Brazil, in 2005, and *Desertesejo*, a multiuser virtual environment built in 1999/2000 and restored in 2014.

The exhibition also includes a set of 7 serigraphs that revisit one of the artist's earliest projects: *Depois do Turismo vem o Colonialismo*. This work was initially presented in 1989 at the artist's solo exhibition at the Galeria Centro Lavoro Arte in Milan and in 1998 as part of the web-installation at the *City Canibal* exhibition at Paço das Artes, at the time of the International Biennial of São Paulo, known as the Biennial of Anthropophagy.

Like the Biennial exhibition, the *City Canibal* exhibition sought to discuss issues concerning the processes of cultural cannibalization, anthropophagy and colonization that marked the history of the peoples of Latin America and Brazil. At the time, Gilbertto Prado presented a web-installation that consisted of a portal monitored by two video cameras connected to the network. These cameras, along with several spot lights, were triggered by sensors located in the physical space of the facility when visitors walked through the portal. The local image, captured in real time, was then mixed with those of an image bank.

For the *Circuito Alameda* exhibition, Gilbertto revisits this work and presents a set of seven serigraphs printed directly on the side wall of the lower cloister of the exhibition area. These are images that document the native Amerindians from the perspective of the colonizers, giving rise to discussions on cultural cannibalism.

These seven serigraphs, along with the three boxes displayed in the lower cloister area of the exhibition area - one crossed with machetes, one with nails and one made with transparent Plexiglas with the inscription *"Quién mira quem"* - are the two oldest works in the exhibition, both of which were first exhibited in the 80's context in Brazil. However, they already bring elements that can be seen throughout the exhibition: the processes of cultural hybridism, discussions on the perspectives, as well as the violent processes that marked the colonization of the Americas, which are part of both Brazilian and Mexican history.

The temporal distance between some of the works in the exhibition, therefore, does not seem to matter, since it is possible to perceive this poetic circuit that intertwines the works, building powerful dialogues between distinct periods of the artist's creation. This is the case with the boxes with machetes and nails produced in 1987 - which raise discussions on the memory of colonization and the violent torture processes - and the connection it has with the *Caixa de Choque*, an interactive installation developed in 2018.

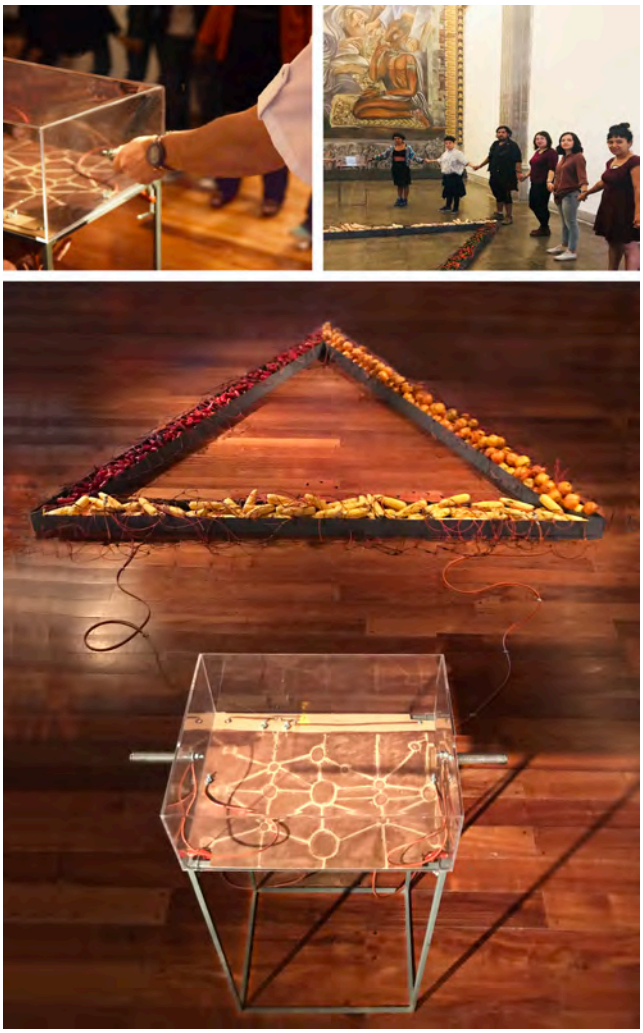


Figure 2. *Caixa de Choque* (Shock Box). Above in the Laboratorio Arte Alameda, México, 2018. Below in its preview in "Natureza Viva – Muntref, BIENALSUR, curated by Mariela Yeregui and Nara Cristina Santos, Buenos Aires, 2017.

-This last work, located in the *Capilla de Dolores* (Chapel of Dolores) of the exhibition area, boasts a large triangular metallic structure - which refers to the religious triad Father, Son and Holy Spirit - filled with peppers, corn and oranges, connected by electric cables that generate energy and electric shocks on the bodies of the visitors. The work is a direct reference to the *Toqueros* and their shock boxes - a traditional phenomenon in Mexico City, where these devices are used to give small shocks through which people self-inflict electric current to relieve stress and intoxication - and the cultural shock that marked the history of colonization in Mexico.

The circuit as a poetic rewriting

It should be remembered that the *Laboratório Arte Alameda* occupies the former San Diego Convent, which started being built in 1594, at the time of Spanish colonization in the country. The venue, as well as its architecture, could not be more revealing: a place of religious catechesis and cultural colonization.

The title of the exhibition, *Circuito Alameda*, is also quite significant. It makes direct reference not only to the name of the venue itself - *Laboratório Arte Alameda* - but also to the *Parque Alameda*, an important setting of the country's historical narratives so well represented on the mural painted by the Mexican artist Diego Rivera.

The exhibition is a major *site specific*, or rather *site specificity*, as Miwon Kwon would say. It is designed not only to formally dialogue with the architectural space of the former convent, but also to hold detailed conceptual and cultural dialogues with the memory of the place. This is the case with *Caixa de Choque*, located in the *Capilla das Dolores*. In the background of this space, and in tune with Prado's work, we find the retable "*Los informantes de Sahagún*" by Federico Cantú. The painting shows the autochthons with the catholic church priests. Circuits and Short-circuits.

The idea of circuits and creating networks, whether poetic, historical or interpersonal, permeates the entire exhibition. In the circuit fruits and seeds circuit - such as corn, pepper, and orange, which are part local food and history - in the circuit of waters - which comprise the projects *Encontros* and *Biombo*, evoking the remaining Aztec canals in Mexico City - in the circuit performed by the visitors at the exhibition, in the electronic circuit that captures the moving bodies outside the *Arte Alameda* venue and turns them into points of light, in *Desluz*, in the electric circuit of the shock machine that evokes the culture of the local Toqueros.

It is not by chance that one of the central works of the exhibition, *Jardim Alameda*, displayed in the central nave of the exhibition area, takes the form of a large circuit evokes the design of the Alameda Central Square. Viewed from above, the square is seen as a diagram in the shape of a large circuit, with its round water fountains, its trees and paths. In the vases of the *Jardim Alameda*, which take up the places of the water fountains of the Alameda Central Park, we have natural plants: peppers, corns (typical of the region) and oranges, with their fruits, smells and odors. *Jardim Alameda* not only sheds light into the dialogue between art, nature and culture, but on the history of Mexico, since the orange was brought into the country in the Age of Sail and colonization.

Among the various works displayed at the exhibition, *Desertesejo*, to the left of the *Alameda Jardim*, receives a peculiar dimension. *Desertesejo* is a work developed within the context of the 2000's in Brazil. The project is a multiuser interactive virtual environment, which has been

displayed in several exhibitions in Brazil and abroad[3]. Integrating important collections of contemporary art - such as Itaú Cultural and the Museum of Contemporary Art of São Paulo - this project is important not only for the memory and history of digital art in Brazil, but also for discussions on the preservation of digital art. [7]

The title of the work *Desertesejo*, a hybrid of the word *deserto* (desert) and *desejo* (desire), points to some interpretations. I would like to borrow the concept of desire proposed by philosopher Gilles Deleuze. From his perspective, desire is not thought of as lack of something, neediness, emptiness, helplessness; but desire is seen as production, movement, desire for potency. To want something, to desire someone, to look for something is not about being attracted to an external object with the promise of static satisfaction; is means be pushed from the inside; to move within reality.

But where to?

Through what paths?

There is no way to know!

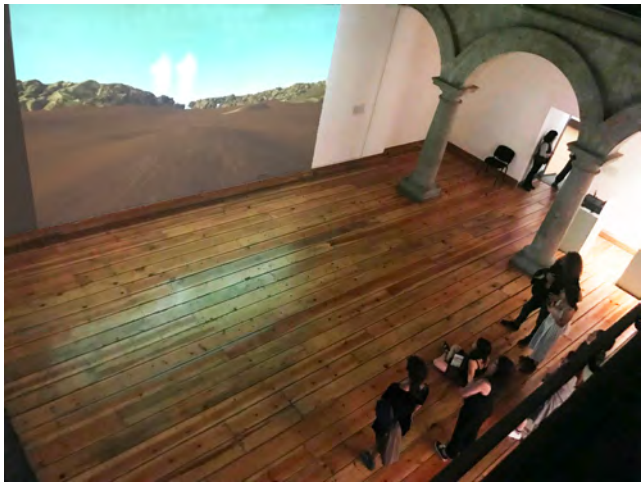


Figure 3. *Desertesejo*, Lower Cloister, *Circuito Alameda*, 2018.

To define desire is to kill it; one word and desire would be stanched. Desire does not want to be interpreted, but rather experienced! Desire is experience, movement. An erupting volcano is desire, an arrow cutting the air too - not for the target, but for the noise it makes when it goes by. And this seems to be the desire that we can experience in *Desertesejo*: the desire of sharing, of being together, the desire to constantly reinvent yourself, since in this work we can navigate in the form of a serpent, an eagle or a jaguar.

The desire to dive into, navigate, discover different territories and landscapes. The desire to move in the immensity of the desert and connect with nature, thus dialoguing, in a very particular way within this exhibition, with the context of Mexican history, strongly marked by ancestral cultures.

In this sense, *Circuito Alameda* sheds light not only on Gilbertto Prado's trajectory, but also on the *rewriting* of a portion of Mexican history, connecting visitors to its landscapes and cultural narratives. And so we can 'look up' to the art of Gilbertto Prado and the *Poéticas Digitais* Group, and create other visibility circuits so significant in these difficult times that we live in.

Acknowledgements

To *FAPESP* (Fundação de Amparo à Pesquisa do Estado de São Paulo); *CNPq* – Conselho Nacional de Desenvolvimento Científico e Tecnológico; UAM - Universidade Anhembi Morumbi; for the support they have provided.

References

[1] Gilbertto Prado. *Arte telemática:* dos intercâmbios pontuais aos ambientes virtuais multiusuário. (SP:Itaú Cultural, 2003).

[2] Gilbertto Prado. Project Amoreiras (Mulberry Trees): Autonomy and Artificial Learning in an Urban Environment. *Leonardo,* 51(1), 2018, 61-62

[3] Priscila Arantes. *@arte e Mídia:perspectivas da estética digital*. (2 ed.São Paulo:Editora Senac, 2012).

[4] Ana Magalhães & Priscila Arantes. *Paradoxo(s) da Arte Contemporânea*: Diálogos entre os acervos do MAC USP e do Paço das Artes. (São Paulo: MAC USP, 2018).

[5] Priscila Arantes. *Re/escrituras da arte contemporânea*: história, arquivo e mídia. (Porto Alegre:Sulina, 2015).

[6] Gilbertto Prado & Jorge La Ferla, (Eds.). Circuito Alameda. (Ciudad de México: Instituto Nacional de Bellas Artes | Laboratorio Arte Alameda, 2018).

[7] Marcos Cuzziol. Desertesejo 2000. In C. Freire (Ed.). *Arte Contemporânea:* Preservar o quê? (SP: MAC USP, 2015), 161-6.

Authors Biographies

Priscila Arantes is, since 2007, director and curator of Paço das Artes, an institution affiliated to the State of São Paulo's Culture department. She has a degree in philosophy from the University of São Paulo (USP) and a Master's and PhD in Communication and Semiotics from the *Pontifícia Universidade Católica* of São Paulo (PUC/SP) and postdoctoral degree from Penn State University and UNICAMP. A PQ scholar, professor of the Graduate Program in Design at the Anhembi Morumbi University, and vice-coordinator and lecturer of the undergraduate and postgraduate courses in Art: History, Criticism and Curatorship at PUC/SP.

Gilbertto Prado is an artist and coordinator of the Group Poéticas Digitais. He studied Engineering and Visual Arts at the University of Campinas, Brazil and in 1994 obtained his PhD in Arts at the University Paris I Panthéon-Sorbonne. Prado has participated in several art exhibitions in Brazil and abroad. Prizes include *9º Prix Möbius International des Multimédias* (Beijing 2001) and *6º Prêmio Sergio Motta de Arte e Tecnologia* (2006). He works with art in networks and interactive installations. Currently he is Professor at the Post-Graduate Programs of Visual Arts at the Communication and Arts School at University of São Paulo and Design at the University Anhembi Morumbi.

[3] *Desertesejo* was granted the 9th Möbius International des Multimédias Award, Beijing, China (Special Mention, 2001; participated in several exhibitions, including the São Paulo XXV Bienal - Art Net (2002).

Ibero American Observatory of Digital and Electronic Art
Observatorio Iberoamericano de Arte Digital y Electrónico

Daniel Alejandro Argente Raimondo
Instituto Escuela Nacional de Bellas Artes, Universidad de la Repùblica
Montevideo, Uruguay
danielargente@gmail.com

Abstract

Currently Ibero-America lacks, unlike the Anglo-Saxon countries, of a systematization of the history of media art in that region. There are fragmented accounts, non-centralized information, sparse and scattered bibliography. We are interested in approaching the different efforts that have occurred or are taking place in our region, to build a common story and history, that integrates and discovers its origins and map out its main exponents and current trends.
Building a non-hegemonic and decentralized view of those that currently prevail.
We will focus on the different efforts that both Latin America and Spain are making through academic and non-academic projects, and initiatives such as the creation of the "Red y Observatorio Iberoamericano de Arte Digital y Electrónico" (Ibero-American Digital and Electronic Art Network and Observatory).
Which integrates various countries and institutions in the region, with the aim of building a network that articulates efforts with the objectives of generating that narrative, systematize media art collections and strengthen regional links.

Keywords

Ibero-America, Digital and Electronic Art, Observatory

Introduction and background

Currently Ibero-America lacks, unlike the Anglo-Saxon countries, of a systematization of the history of media art in that region. There are fragmented accounts, non-centralized information, sparse and scattered bibliography. This panorama showed us the need to promote a project that centralized this information and allowed researchers, academics and artists to have a place of reference.

As a consequence of the problem expressed above, we have promoted the creation of an Ibero-American Digital and Electronic Art Network and Observatory emerges as a reflection that was developed throughout the participation and organization in different festivals, meetings and especially in our academic activity for about 20 years in this territory of the knowledge and practice

As a starting point, I would like to highlight that in 2011 was organized, together with the Groisman Chair of the University of Buenos Aires, Argentina, the International Seminar of Hypertext Narratives, NH/T [1], which was carried out during six editions, taking the headquarters between Argentina and Uruguay. This seminar had a great regional impact, especially in Chile, Argentina, Brazil and Uruguay and in the last edition, Spain joined the organization from a node in Valencia. The aim of this seminar was to reflect on the problems of digital culture and to raise awareness of academic research and artistic production in the territory of electronic and digital arts, mainly in the region.

This experience allowed us to reflect on the absence of a complete picture of what was happening in the region in terms of academic, artistic, cultural and non-formal research and education.

There is no doubt that the festivals, meetings and seminars are aimed at generating the essential and necessary meetings between peers, allowing us to update ourselves on the different artistic practices and research in our territory of knowledge, but they do not fail to present us with a fragmented reality, forcing us to make an extra effort to put together the parts that allow us to have the big picture of what is happening in the different areas previously expressed.

From these reflections comes the idea of creating an instrument that could create a map as complete as possible of contemporary reality, to progress gradually in own research and in different goals that we will later specify.

Another of the findings that emerged from the aforementioned events is the lack of a history of Latin American media art. The existing examples are few and do not present an adequate systematization in general.

The Observatory was initially submitted for consideration by the authorities of the Instituto Nacional de Bellas Artes, of the University of the Republic, Uruguay, by the Chair of Digital and Electronic Art and approved by its Council in the same year. This approval was not a minor fact insofar as it allowed us to articulate and generate agreements with different academic institutions of the Ibero-American context.

In 2016, in the latest edition of NH/T we presented this initiative having a very good reception from the artistic and academic group present at the seminar. Starting in 2017, we began to disseminate the proposal among the different academic responsible for undergraduate and postgraduate courses that focus on this subject in different Academic Institutions of Ibero-America.

In Spain we found an enthusiastic reception of the project by Dr. José Ramón Alcalá, director of The International

Museum of Electrography - Innovation Center in Art and New Technologies (MIDECIANT) of Cuenca[2], with whom it is agreed to coordinate efforts around the Observatory and add his experience directing this institution and in particular his research on the Media Art collections in Spain. Alcalá is currently one of the most active partners in this initiative and has done a great job of connecting those Spanish centers and artists, allowing us to expand our operational base.

I can not stop mentioning one of the most important contacts that Alcalá contributed by connecting us with Dr. Reynaldo Thompson[3], from Mexico, who is doing a thorough research on Media Art artists in Latin America and who was creating his own network of artists and researchers. As a result of these contacts, the Network and the Observatory were reinforced from various places and experiences.

Partners

IENBA-UdelaR, **Uruguay**; Maestría en Diseño Interactivo, UBA, FADU, **Argentina**; Maestría en Tecnología y Estética de las Artes Electrónicas, Universidad Tres de Febrero, **Argentina,** Departamento de Artes Media Lab UFG - Goiás, **Brasil**; Departamento de Arte y Empresa, Universidad de Guanajuato, México**;** Facultad de Arte, UAEM, **México**, MIDECIANT. Universidad de Castilla-La Mancha. Cuenca. **España**; Facultad Barcelona, **España**. Facultad de Arte, U de **Chile**; FFHA - UNSJ, Maestría en Comunicación Digital Interactiva, UNR, Rosario, **Argentin**a; Facultad de Artes, San Juan, **Argentina**; Universidad de Caldas, **Colombia**; Facultad de Arte, Universidad Central de Ecuador, **Ecuador.**

Objectives of the Observatory

The tasks initially proposal of the Observatory[10]:
"Aims to become a tool that makes visible the Ibero-American fabric dedicated to training, artistic and cultural production, linked to digital and electronic media. In turn, it will form a network of institutions and regional actors, which will allow the articulation of different actions together, which may have the character of dissemination, meetings, research and teaching, among others.

Create a geolocated database, hosted on a website created for this purpose and will be managed by an interdisciplinary group formed by representatives of the entire network. "

The need was considered for the creation of a regional map on the individual and institutional actors, which serves to promote and favor multidisciplinary networks, and which promotes critical processes on the contemporary artistic and cultural reality.

And although this initiative arises from the Academy, it does not intend to be closed in this area, dissolving that frontier, and in this way favoring the exchange with the community through actions of training, dissemination and collective artistic production, appealing to the practice of the Extension from the university perspective.

The updating of contents will be open to the contributions of researchers, teachers, students, artists and social actors linked to the object of study. "

Actual activities

- The regional database is being completed based on the inputs made by the different local referents and the research being carried out by the Observatory.
- Presentation to national and international calls to finance the research of Media Art in Latin America from different perspectives, the collections, their history and their present.
- Interinstitutional agreements have been consolidated that are allowing the teaching and student exchange between different Faculties.
- The Creation of a non-indexed publication that updates the material researched in the Observatory.
- Support for artistic research activities, such as the HOLOSCI(U)DAD(E)[4] Project, among academics and artists from Brazil, Argentina, Colombia and Spain.
- Support for festivals and regional meetings of digital and electronic art.
- Collaborative research between departments of different Universities

Figure 1. Example of the website map showing the data represented by country [10]

Some documents and initiatives to reconstruct the history of Digital and Electronic Art in Latin America.

A thorough bibliographic search and tracking of the websites that exist and have the initiative to archive and reconstruct the history of the pioneers of the media art and to list the current artists, evidences the scarce presence of Latin American artists in particular and of Ibero-America in general. We have rescued some examples of information that is currently available on the web:

Rodrigo Alonso, Argentine theorist and curator published in the Leonardo Electronic Almanac, 13: 4, April 2005 the work entitled "Art and Technology in Argentina, the first years" from which we extract the following paragraphs by way of example.

"The relations between art and technology have an extensive history in Argentine art. The experiments with light and movement of the 1940s were the precedents of the different currents that developed during the 1960s, including kinetic art, video art and some incursions into expanded cinema. Mechanical and electronic devices, lights, machines, new materials, photographic and cinematographic projections, sound systems, video and computers appeared frequently in the works and reflections of young artists, stimulated by a favorable political climate and a fluid dialogue with the circuit international art. "[5]

The High Andean Technology Center of Peru, directed by Carlos Mariátegui, is currently developing an investigation on the current situation of technological art in Latin America.

"ATA (High Andean Technology) has been developing research in the last 6 years exploring the diversity of production in art, technology and new media in Latin America. In recent years, ATA has developed relationships on unrepresentative areas of Latin America, as well as produced research on innovative forms of production in the region.[6]

Without trying to be exhaustive in the search for similar attempts in the Latin American environment, we would like to mention the special issue of **Interartive # 89**: Special Issue: Art + New Media in Latin America [7]

The research carried out by the Universidad 3 de Febrero in Argentina is also noteworthy, creating a map of digital and electronic art.

PAM / Plataforma Arte & Medios [8]"is an online space for documentation, analysis and dissemination of artistic practices that use media and languages from science and technology (analog and digital).

Given the growing number of artists who work with non-traditional materials and experimental and hybrid languages (sound art, interactive installations, mapping, etc.), it is necessary to document their work and provide tools to contextualize these proposals theoretically and historically.

The Uruguayan artist **Brian Mackern**[9] is another international reference. In addition to his pioneering work in the Latin American net-art world, he has an outstanding performance as a curator, and mainly as a historian within media-art. His work in this field, already discontinued but continuously cited, can be seen on his page http://netart.org.uy. In this site, it presents an interactive map, paying homage in its design to Torres García, and which allows us through its navigation to have access to a base of Latin American artists distributed by countries.

Appendix

Objectives and lines of action

Iberoamerican Cartography

- Identification of the main actors and creation of Databases.
- Perform a search and permanent list of artists, festivals and events related to the theme of the observatory.
- Continually explore the options for institutional curricular teaching in the field of primary, secondary and tertiary education, as well as decentralized initiatives that address and promote these artistic and cultural practices.
- Explore the possible sources of public and private financing in the region, related to the support and promotion of research, training and production, related to the proposed theme.

Consolidation of the network of participating institutions and implementation of academic programs among the members.

- Create links of academic cooperation with other university services and national or international organizations linked to the subject of digital and electronic art.
- Empowerment of existing academic research groups and support for the creation of new ones in order to promote the production of specific knowledge on the proposed topic.
- Encourage the creation of undergraduate, graduate and permanent update courses through the institutions involved.
- Encourage the creation of exchange programs for Teachers and Students among the participating university institutions.
- Codirection of Doctoral Theses on the topics and their related lines of research.
- Encourage the creation of scholarships and exchange visits for study and specific research.
- Support for the study of new proposals for the musealization of current Electronic and Digital Ibero-American Art.

Knowledge dissemination

- Through congresses, conferences, seminars, workshops and specific courses, in order to stimulate debate and exchange.
- Creation of specific editorial lines for the creation of own publications.
- Organization of Exhibitions, Exhibitions, Festivals and Recognitions (Awards).
- Establish a ring that nucleates the networks and existing websites of the participants.

Ibero-American Heritage of Digital and Electronic Arts.

- Identify and catalog existing collections.
- Digitization of the Ibero-American heritage of Digital and Electronic Arts.
- Conservation and restoration

Spaces of creation and innovation

- Support and link to the MediaLabs, production centers, workshops and Iberoamerican graphics laboratories
- Impulse to the creation of new spaces of creation and production in Ibero-American countries
- Support for the dissemination of young Latin American creators

References

[1] https://seminarionht.org/
[2] http://blog.uclm.es/mideciant/
[3] Reynaldo Thompson has focus his research and most recent project on cataloguing and open data base on the art, science and technology production of latin american, specially during the raise of new technologies appropriated by creators in this geographical area. The mission of the database is therefore to assist in research for technological innovations and art historical research relevant to an emerging discipline. The mission for the project may be identification and preservation of some of the most innovative and universally significant digital and augmented artworks for purposes of cultural and historical research and for the visualization of the contribution of Latin American technological artists of the contemporary generation and of the future.
[4] http://www.espai214.org/holos/
[5] reference from
http://www.roalonso.net/es/arte_y_tec/primeros_anios.php
[6] http://ata.org.pe/investigacion/
[7]https://interartive.org/2016/12/interartive-89-special-issue-art-new-media-in-latin-america
[8]http://arteymedios.org/
[9] http://netart.org.uy/
[10] http://observatorio.enba.edu.uy/

Prof. Daniel Argente

Full Professor of the Chair of Computer Languages, of the National School Institute of Fine Arts, UDELAR. Coordinator of the Bachelor of Digital Art and Electronics and Coordinator of the Degree in Languages and Audiovisual Media of the National School Institute of Fine Arts of the University of the Republic, Uruguay. He was part of the R & D Advisory Committee for the Social and Artistic Area in the CSIC in 2016.
Member of the organizing team of the International Seminar on Hypertext Narratives and the Network and the Ibero-American Observatory of Digital and Electronic Art. Integrates the performative group of sound art This is not Magritte, from the Nova Express group and the MAUA sound ensemble. He has exhibited digital infographic works, interactive installations and sound performances in France, Cuba, Venezuela, Spain, Argentina, Brasil, Chile and Uruguay.
Its main lines of research are new media art, focusing on robotics, virtual and expanded reality and artificial intelligence in art, as well as its research work "Expanded Video Game".

Nucleus of Art and New Organisms, innovative research lab in Brazil in the field of hybridization, bio telematics and transculturalism

Maria Luiza (Malu) Fragoso
NANO LAB
Federal University of Rio de Janeiro , UFRJ
Rio de Janeiro, Brazil
malufragoso@ufrj.br

Abstract

Since 2010, NANO - Nucleus of Art and New Organisms, a research lab facility at the School of Fine Arts from the Federal University of Rio de Janeiro, has been developing a consistent body of works, theoretical and practical, on the intersection of art, science, technology and nature. These works, which encompass a twilight zone in-between organic and artificial life, including plants, bees, bacteria and robots, are inspired by nature and models of thought drawn from scientific to ancient knowledge, such as indigenous Amerindian traditions and eastern cultures. This paper aims to present NANO's creative production and methods, focusing on aspects of art education, transculturalism, sustainability, based on the experience of the project "Land as an Educational Principle".

Keywords

Art & Technology, Education, Transculturalism, Land, NANO

Introduction

The trans disciplinary integration between art, science and technology allows the development of new techniques and, likewise, creates new challenges for technological development. The dialogue between art, science and technology is historical. During centuries of transformation of knowledge, improvement of research methods and new discoveries, art has remained in resonance with other fields of knowledge in order to give visibility to the deepest desires and mysteries of human development. Interdisciplinary projects involving arts, science and technology are happening in several research centers in Brazil and in the world. At the Federal University of Rio de Janeiro (UFRJ), NANO Lab has it's most up forward initiative in this direction.

Great innovations and scientific transformations are filled with insights and processes that put art and science on an equal footing in the playful and creative realm of human experience. Modern and contemporary technologies reverberate ways of seeing and thinking that are appropriated and amplified by the arts and materialized in new forms, colors, sounds, behaviors. In a recursive way, the art imaginary always points to gaps, potentialities. It is at this confluence of forces that we see the reason we operate a trans disciplinary field of ideas and actions that will contribute so much to the world today towards a sustainable coherent and fair way, according to its most legitimate needs. Research structure and implementations that are put into practice reflect not only desire and needs but also that such a model can foster systemic and operational modes to be exported to other initiatives, just as necessary. We live in a connected world. Even if this is a premise of our times, a place already common in the discourse of entrepreneurs, it is worth emphasizing that the value of connections is not in technology itself, but in what is interconnected, and in the subtle dimension of such interconnections. For this reason, an effort is made to think towards new models for the use of technology and experiments in our labs for a solid construction of trans disciplinary methods and practices.

Land As An Educational Principle

> It has never been so important to proclaim, here and now, the new world, alive, active and exultant towards the light, which is raised by hope, in the face of the moments of night and darkness in power. Those who assaulted power can dominate some things, but they do not dominate the Sun, let alone the things and people who are embraced with nature. Today, and especially tomorrow, the decisive historical struggle will be a struggle of the children of civilization against the children of nature. It is from these last, the children of the land, wherever they are, from which dawn will come. [1]

The above quotation is from the introduction of a recent publication under the title of "Land as an Educational Principle". It presents a set of reflections on the characteristics and challenges of school education and particularly teacher training in social contexts marked by the struggle for access and permanence on the land. The discussions that led to the formulation of the discussion on the notion of 'land as an educational principle' are presented as a product of the articulation of the teachers of the rural, quilombo (african descendants) and indigenous schools. The work is held

in the context of programs concerning the policy of continuing teacher education at CEFAPRO, from the town of Tangará da Serra, located in the state of Mato Grosso (BR), and NEED [4] at the State University of Mato Grosso, UNEMAT, at Tangará da Serra Campus. Initially, the objective was to promote the discussion about the present situation of rural, indigenous, and quilombolas schools, regarding European colonization and current models of globalization, taking into account the training of local teachers at schools connected to social movements. This work grew into a network of collaboration that is known as *Collective of the Land (Coletivo da Terra)*. In a context marked by severe inequalities and many limitations, the activities proposed by this group supports the traditional ways of producing and socializing the knowledge of indigenous, quilombola populations as one of the affirmative strategies for political identity of social movements in the historical processes of struggle for possession and permanence on land.

Figure 1. this author at Art&Tehcnology workshop at Pareci native American resort in 2016

For the *Collective,* the demands of these movements could be grouped in three main goals:

- mastery of the academic and scientific theoretical framework as a possibility, among others, of producing and socializing knowledge;
- construction of a dialogical relationship and respect for traditional ways of producing and socializing knowledge;
- understanding that there is a social function of the school that must be subordinated to permanence on the land.

Organized as guiding principles, these goals can point to a tripod that constitutes what is fundamental in teacher training to move forward towards a formative perspective based on educational projects of social movements that appreciate and recognize traditional knowledge and on the interests of the economic and cultural survival of the people that live from the land. NANO lab has been collaborating with the *Collective* since 2010, and most recently with art projects inspired by native south American traditions.

Art And Technology - Creative And Pedagogical Practices In Universes Of Metaphors And Metonymies

From the last fifteen years I have been carry out specific studies regarding the relationships that emerge between men, intelligent machines, and the technological universe, and consequently the insertion of these investigations in my artistic and pedagogical practice. This concern is due to the ubiquity of multimedia products resulting from the ubiquity of digital technological tools and/or devices, and, by the growing number of theories and studies on new aesthetics and new forms of human/machine/public interaction. I've proposed a focus on the possibility of the emergence of a new consciousness from immersion and creative experimentation in cybernetic environments. In order to discuss these premises I have conducted several field trips, which allowed me to experience with indigenous cultures, being the latest ones under the project Land as an Educational Principle.

My involvement with the study of indigenous cultures dates back to the 1980s, when, through the Rondon Project[5] I carried out traineeships and taught courses in Nova Xavantina (MT), a region where Xavante Indians live. In 1997, I had the privilege to accompany the Brazilian artists and researchers Gilbertto Prado, Tania Fraga, Diana Domingues and the English Roy Ascott on the project *Expedition of Recognition in the Upper Xingu*, in a visit to the Kuikuro indigenous nation. It was after the Kuikuro expedition that I began my research in Art and Technology, developing parallels between indigenous cultures and artistic contemporary experiments, culminating in a doctoral thesis defended in 2003 at the Institute of Arts of the University of Campinas (Unicamp – São Paulo).

I understand that in artistic processes sensitivity is a prime factor and that historically, artists have developed and described ways and systems to apply and improve forms of expressing that sensitivity. I believe that the new tools of sensitivity that amplify and transform our perception of the world, such as cameras, sensors and assorted technical devices, seduce contemporary artists. In many cases, technological tools can fulfill prosthetic functions, and may expand our bodies, our senses, our minds, and consequently transform our personal and social relationships. However, their use in creative processes may or may not contribute to a possible reframed consciousness of the world. From my research I have observed that similar tools in use by individuals from traditional cultures, such as native Americans, seem to be addressed though different eyes, other goals, and functions. I believe that there is much to learn from cultures that have a extensive and di-

[4] https://sites.google.com/site/needtgaunemat/o-que-e-o-need

[5] Https://projetorondon.defesa.gov.br/portal/

verse perceptual domain of nature, and that this combination of traditional and ancestral knowledge with technological futuristic endeavors becomes an interesting source of enlightment where the exchange of experiences becomes the basis of knowledge.

S.H.A.S.T. - Current Project[6]

Project S.H.A.S.T. - Housing System for Homeless Bees, was first created in 2012. It consists of a hybrid system created to integrate an active beehive, through telematics, with urban, cultural and pedagogical spaces. It involves investigations in the field of biology, urbanism, design, art and technology. Through this work I seek, by means of metaphorical simulations, to symbolize emergent autonomous systems. In this case, a beehive in a biological productive situation, is monitored by different sensors that capture data, which is transmitted through Internet to unoccupied hives installed in urban centers, exhibition spaces, or stored in clouds (virtual memories). The work is based on an integrated hiperorganic system, where a living organism (beehive) is connected to a telematic system and together they produce and transmit data, which is interpreted by another living organism that again outputs the data in metaphors that express the system as a whole. This can be done in many ways: data visualization, performance, immersive installations, etc.

The project's motivation at that time was the Colony Collapse Syndrome, characterized by the disappearance of the bee workers and the solitary death of queen bees, occurring in the United States of America. Seven years later, the same disaster is happening in Brazil. It is believed that this syndrome is related to the use of agrochemicals, which makes the problem of pollination and production of food without bees very serious. This art project has therefore an important aspect of awareness and application of technologies associated with poetic creation to provoke a reaction in the public from the seizure of facts and awareness. The proposed housing system involves the capture of urban bees and their displacement to areas of biological production that can protect and preserve hives. The work is related to issues of human ecology and biological equilibrium based on scientific and traditional knowledge, passing through the problem of urban sustainability. The production is categorized as interactive art, or interactive computational installation in telematics. The art project and its concepts are shared with artists, scholars and bee keepers from different parts of the country. It is necessary to understand these various perspectives in behalf of the complexity achieved by interdisciplinary and multicultural research.

In 2015, another development of the S.H.A.S.T. project was produced - the penetrable *We Bees,* a module that enables a near-bee experience. The object is a system composed of equipment that enables the network connection with the active hive; a green ceiling with flowers covering the box of equipment; and, a structure created with origami folds. The system is to be hung like a beehive in its natural environment, but at a height that allows a person to enter it. There is a clear intention to engage more with the public in order to offer a remarkable, transforming experience may be taken with each person for his life.

Figure 2. S.H.A.S.T. system applied to the *We Bees* penetrable object exhibited on 2017

Figure 3. S.H.A.S.T. installation at Solar do Jambeiro, Niterói, Rio de Janeiro, 2017

Figure 4. S.H.A.S.T. recently captured beehive for new installation in 2019

With the support of the university, FAPERJ[7], CNPq [8] and CAPES[9], I have been conducting research on the pro-

[6] S.H.A.S.T. http://www.nano.eba.ufrj.br/s-h-a-s-t-sistema-habitacional-para-abelhas-sem-teto/wee-bees/

[7] FAPERJ agency for science, technology and innovation in the State of Rio de Janeiro. http://www.faperj.br/

cesses of integrating images and objects to interactive multimedia computing systems. Since 2010 activities have been developed at NANO and the Postgraduate Program in Visual Arts. This year was inaugurated a new laboratory consortium under the title *AI - Innovative Actions. Art, science and technology*. This initiative aims to articulate the collaborative action between the following laboratories: Laboratory of Computational Methods in Engineering (LAMCE), Laboratory of Virtual Reality (Lab3D) - both of COPPE[10] and the Nucleus of Art and New Organisms (NANO). This opportunity will foster further research with state-of-the-art technical resources and exhibit processes and procedures with results through an interdisciplinary practical experience, reinforcing inter institutional, international and transcultural partnerships.

Conclusion

The intercession between artistic practice and pedagogical practice has been a challenge in current academic systems. I like to think of the artist as a mediator of events, someone who, in his context of creation promotes actions and mediates situations. Transculturality in artistic practice is a common fact. The idea of thinking about artistic/scientific knowledge in a trans disciplinary way has been circulating in academic circles for decades. However, the practical experience of research and teaching in these environments is still embedded in its disciplinary (or disciplined) areas, inherited from the modernist pragmatic paradigm recommended by the institutionalized administrative system. In the vicious circle of discourse, there are gaps and innovative experiences that will explore other methods of production. Not a few of these initiatives inevitably dwindle into the mass of the current extremely well structured scientific model. Practical and theoretical investigations held at NANO Lab in Rio de Janeiro intend to explore in the field of art and technology applying experimental processes applied to strategic methodologies that combine sensitive experiences based on collaborative strategies.

Acknowledgements

Research is sponsored by CAPES, CNPq and FAPERJ. Developed at NANO Lab at the Federal University of Rio de Janeiro. All images are © NANOlab

References

[1] Passos, Luiz Augusto, Preface In *Terra como Prncípio Educativo, Terra como Prncípio Educativo,* Hellen C. de Souza, Eliane B. Monzilar, Marinez Cargin-Stieler, Tangará da Serra: Gráfica Editora Sanches LTDa, 2016, p. 310.

[8] National Council of Scientific and Technological Development (CNPq), agency of the Ministry of Science, Technology, Innovations and Communications http://www.cnpq.br

[9] The Coordination of Improvement of Higher Education Personnel (CAPES), Ministry of Education http://www.capes.br

[10] Alberto Luiz Coimbra Institute for Graduate Studies and Engineering Research, UFRJ largest engineering and research center in Latin America. http://www.coppe.ufrj.br/

Bibliography

Carol Gigliotti,. The metaphoric environment of art and technology. In: ASCOTT, Roy (Org.). *Reframing consciousness:* art, mind and technology.(Exeter: Intellect Books, 1999)

Guto Nóbraga e Maria Luiza Fragoso. (2015). Field, coherence and connectedness: Models, methodologies and actions for flowing moistmedia art. *Technoetic Arts, 13*(1-2), 153 - 168(116). doi: 10.1386/tear.13.1-2.3_2

Langdon, e. Jean Matteson (Org.). *Xamanismo no Brasil, novas perspectivas*. (Florianópolis: UFSC, 1996)

Maria Luiza Fragoso, *>=4d arte computacional no brasil.* (Brasília: Programa de Pós-Graduação em Arte, 2005)

Maria Luiza Fragoso "Arte, Ciência, Tecnologia e Natureza: trajetos transculturais" - In *Diálogos Transdisciplinares: Arte e Pesquisa, (*org) Gilbertto Dos Santos Prado, Monica Tavares, Priscila Arantes, (ECA/USP - SP 2016, SÃO PAULO: ECA/USP, 2016) v. 1, p. 228-246

Maria Luiza Fragoso, Shirley Fiuza; Jackson M. Vieira; Victor H. S. Valentin, "UM ATIKUM: por uma metodologia transdisciplinar e transcultural no discurso artístico-científico". In: Maria Cristina da Rosa Fonseca da Silva, Sandra Makoviecky. (Org.). *Linhas Cruzadas: Artes Visuais em Debate*. (Florianópolis: ed da UDESC, 2009) v. 01, p. 93-106.

Roy Ascott, "A Arquitetura da Ciberpercep*ção*". In *Ars telemática – telecomunicação, internet e ciberespaço.* GIANNETTI, Cláudia. (Lisboa: Relógio D'água, 1998)

Author Biography

Maria Luiza (Malu) Fragoso is an artist with a PhD in Arts and Multimedia (UNICAMP), São Paulo (2003) where she developed research on artistic experimentations in telematics. Post Doctorate at the School of Art and Communication of the University of São Paulo. Currently professor at the Visual Communication Design Department at the Federal University of Rio de Janeiro - UFRJ. Thesis supervisor since 2005. Published the title >=4D. Computer Art in Brazil (2005).Coordinator of the research group REDE-Art and Technology, trans cultural nets in multimedia and telematics, and of NANO LAB – Nucleus of Art and New Organisms. Organizer of CAC.4 Computer Art Congress in Rio de Janeiro (2014). Also a farm administrator, biologic cheese producer, beekeeper, member of the Biologic Producers Association from Rio de Janeiro.

Curatorial Challenges in Art, Science and Technology: FACTORS 4.0 at Bienalsur

Nara Cristina Santos
Universidade Federal de Santa Maria
Brasil
naracris.sma@gmail.com

Abstract

This article contributes to this panel's discussion with the case study of FACTORS (Rio Grande do Sul Science and Art Technology Festival) and its curatorial challenges in the context of Brazil and South America. The event has brought together Brazilian, Portuguese, Argentine and Mexican artists and their established and emerging research from recent years. The festival's curatorial argument is based on a transdisciplinary concept to address issues such as digital art, art and robotics, art and nature, NeuroArt, BioArt, sustainability and art. The Festival is proposing that for the edition, FACTORS 4.0, curatorship be shared by a Brazilian and an Argentine researcher, strengthening South-South socio-cultural conditions on the Latin American continent. In this fourth edition, the festival is part of the structure of Bienalsur 2017 and is thinking collaboratively about the political idea of cultural belonging in local and global terms.

Keywords

Art-Science-Technology, Transdisciplinary, Curatorship, Latin America

Introduction

In recent years, among the emerging festivals, FACTORS (Rio Grande do Sul Science and Art Technology Festival) has been collaborating to broaden the different horizons of art, science and technology in Brazil and Latin America. Among the challenges is to propose and discuss curatorial strategies in institutional spaces, from LABART (Laboratory of Contemporary Art, Technology and Digital Media - www.ufsm.br/labart). The shared curation proposed between the Brazilian researcher Nara Cristina Santos from the UFSM (Santa Maria Federal University) and the Argentine researcher Mariela Yeregui from UNTREF (Tres de Febrero National University) in Buenos Aires reinforces the South-South socio-cultural relationship on the Latin American continent. For the case study of FACTORS 4.0, as in 2017 in Bienalsur's KM 1055 (International Contemporary Art Biennial of South America - www.bienalsur.org/es), the conceptual argument is BioArt, providing dialogue between works, artists and art spaces to reveal the similarities and differences of artistic research, proximity and transdisciplinary distance to the field of culture. Another issue proposed for consideration is the political dimension implied by the festival being part of a decentralized biennale, and dealing with the local and the global.

The curatorial argument

For López del Rincón (2015), the conception of BioArt can be understood from a classification based on carbon, but which derives from three fields of knowledge: art, technology and biology. For the festival curators, the curatorial argument treats BioArt as a trend, among transdisciplinary productions, of emerging research in the field of contemporary art. As a concept, BioArt encompasses different artistic practices produced through living beings and natural resources, coming into contact with artificial methods and digital technologies to promote sensitive experiences. On the other hand, curatorship is also a sensitizing experience, both in the particular diversity of artistic production and in the plural identity of the artists, who constitute South American culture.

Artists and works in FACTORS 4.0

For this fourth edition, the Festival offers individual, shared and collaborative transdisciplinary proposals by Latin American guest artists with an established career, as well as young artists, from Brazil, Argentina and Mexico.

There are eleven works/projects dealing with BioArt including biotechnology and the dialogue with robotics. Robots Mestizos (2016), a project by the Mestiza Robotics Research Group, proposed a space to investigate certain underlying principles in robotic creation. The project questions the boundary between the technological and the telluric other, in the local South American context.

The idea of invasion by the Other can be recognized in the work of Eduardo Kac, not in the manifestation of otherness, but in what is revealed as a duality between two living beings, even of different species: a human being and a flower. This is the case of Edúnia (2003-2008), which reveals the tension between the natural and the genetically modified.

In the video installation Jardim Colaborativo de Fritz Müller (Fritz Müller's Collaborative Garden) (2017), the artist Yara Guasque and Kaue Costa demonstrate the materiality of the dialogue between the Englishman Charles Darwin and the German turned Brazilian Fritz Müller, who contributed to the Theory of Evolution from South America.

Part of the process of real-time assisted development of plant life can be seen in the work of Rebeca Stumm. Trans(form)ação assisitida (Assisted transformation)

(2017) is an installation in which plants are grown under minimal conditions.

In a direct relationship between art, biology, technology and nature, the artist Guto Nóbrega, with the support of the NANO Group, presents his work Bot-anic (2012). The work questions the proximity and distance between the organic and the artificial, and consists of a plant and a robotic system.

The action of light on plants is also under investigation in PLNT3 (2017), by Raul Dotto and Walesca Timmen, which involves a plant under the influence of light at various wavelengths, by which its biological process of growth can be artificially monitored.

With Rizosfera FM (2016), the group Eletrobiota created by Gabriela Munguia and Lupita Chávez explores diversity and the possibility of new interspecies dialogues through an installation and sound intervention, with a different set of living plants.

The installation Ausculta (2017), by Fernando Codevilla and Leonardo Arzeno, takes the audience for a walk through tree trunks on the ground, where the spaces for circulation are full of sounds emitted by speakers. The work denounces the exploitation of nature.

The possible transformation of the invisible sound waves that inhabit the sonic environment or background noise is proposed by the work Rio Callado (2017), by Paula Guersenzvaig and the designer Juan León Sarmiento. The project questions our apathy toward nature.

Ana Laura Cantera focuses on some natural processes that are not very noticeable, like the slow decomposition of a fruit in Evolução de uma partida (2015-2016). In this installation the artist directs her gaze towards those phenomena vital biosphere equilibrium, but that escape human visibility.

Organic and artificial elements are also the central issue of the work by the artist Gilberto Prado and Grupo Poéticas Digitais (Digital Poetics Group). Máquinas de Choque 1 (Shock Machines 1) (2016) discusses an element of Mexican culture, the 'toquero' (the head dress maker), revisited by technology.

The eleven works of the 2017 festival highlight that natural elements are re-signified at the moment they are modified, by technological intervention and scientific experiments, whether permeated or not by local culture, in contrast with the action of nature. This provokes an artistic and sensory experience in the public, which is both personal and diversified, and a separation from or advance towards collective commitment.

FACTORS 4.0 is Bienal

By being part of Bienalsur, the festival is included in this global cartography, as one of the 84 venues, one of the 32 cities, one group of artists among the 350 participants. Bienalsur seeks to define itself as an alternative space in the arts system, as a platform for contemporary art, based on decentralized curatorial projects, in order to promote socio-cultural connections in different places.

For Diana Wechsler "Bienalsur's distinctive purpose is to define a format and an operation in which art from distinct regions of the planet is included not merely to fulfill a diversity quota, but to achieve visibility in diversity starting with respect for idiosyncracies by redefining traditional positions, making relationships more complex, restoring traditions, establishing other ties between spaces and times, such that they are finally congruent with the new post-autonomous paradigm that allows us to rethink the contemporary arts and culture scene." (Bienalsur 2017, pg. 22)

In this sense, a local event such as FACTORS 4.0, which was born in 2014 with a title that bears the name of the state of Rio Grande do Sul, surpassed it's regional nature and was presented as a national and international festival in the following editions. First, because from the outset it has invited important national and international artists who work with transdisciplinary proposals in contemporary art, achieving visibility in the diverse field of culture. Secondly, because by becoming part of Bienalsur in 2017, the festival can no longer be understood as "local" (nor regional, national, international), but rather as the broadest political concept within contemporary thought: as being global stemming from the local.

Conclusion

Transdisciplinary issues are often complex, not necessarily difficult to solve, but always provoking new curatorial strategies. In this sense, in the shared curatorship of FACTORS 4.0, BioArt fulfilled its role as a concept for thinking about art, science and technology, its political and ethical implications, as well as those in the field of culture. Latin American artists participated as festival guests, integrated in the South-South socio-cultural condition, with works that, in their diversity of ideas and issues, materials and technologies contribute to the discussion of concepts of sustainability and sensitivity to the BioArt environment and the complexity of nature. Artists and works also contribute to thinking about the concepts of alienation and belonging in the field of contemporary art, especially when they are part of FACTORS 4.0 KM 1055 (Santa Maria) in the Bienalsur, seeking regional and international connections in global terms. It is a cultural production without political or geographical distinction. In other words it eliminates frontiers, removes distances, to become local and global.

Bibliography

Bienalsur. Catálogo Bienal Internacional de Arte Contemporáneo de América del Sur. EdUNTREF: BA, 2017.

Freire, Cristina.(org). Walter Zanini Escrituras Críticas. Anablume/MAC/SP: São Paulo, 2013.

Guasch. Anna Maria. El arte en la era de lo global 1989/2015. Alianza Forma: Madrid, 2016.

López del Rincón, Daniel. Bioarte. Arte y vida en la era de la biotecnología. Madrid: AKAL, 2015.

Santos, Nara C.; Yeregui, Mariela. (org.) Catálogo FACTORS 4.0 é Bienalsur. Ed PPGART: SM. 2019. http://coral.ufsm.br/editorappgart/index.php/noticias/19-catalogo-factors-4-0

New Media in Latin America, An State of Affairs

Jorge La Ferla
Universidad de Buenos Aires / Universidad del Cine
Buenos Aires, Argentina
jorgelaferla@gmail.com

Abstract

The proposal for this panel is to consider recent works by four artists whose work allows us to create a landscape of contemporary art - with old and new technologies and their combinations, ones that find an eloquent form of expression in installations. Analogical audio-visual and numerical information processed by brand software is exhibited in the art spaces through different devices, each impacting other types of spectators.

Keywords

LatinAmerica, New Media, video, installation, multimedia.

Introduction

This presentation is the result of various curatorial proposals that we have been developing with Andrés Denegri (Argentina), Gilbertto Prado (Brazil), José Alejandro Restrepo (Colombia) and Gerardo Suter (Mexico), from whose works we will start deciphering certain forces in the media arts of Latin America.

A brief analysis of the artworks

The Argentinian artist Andrés Denegri has been exhibiting -what we could appropriately call – an interlaced work with a film archive and the film machine. In his recent exhibitions in Buenos Aires the *Cine de Exposición. Instalaciones Filmicas* (Espacio de Arte Fundación OSDE, 2013/14), a projection called Altered Screens (Universidad Torcuato Di Tella, 2018) has movie projectors in various dimensions of 35, 16 and S8 mm, which are put into operation by inviting the viewer to step next to the celluloid that moves along the room. Gradually disappearing from the view as the viewer moves, from the movie theater, the projector in Denegri's work is set up on another place of the exhibition, in the white cube of the art halls. Consequently, the role of the film viewer varies. If he is motionless in his seat, he now needs displacement, and from this spot on another perception is proposed. There are the projectors, in the middle of the room, those that start a reading of the history of cinema and its lost materiality. We can refer to an effect of cinema outside the cinema, reformulated by the installation in the space of the gallery and the museum.

On the other hand is the work *neoTrópico*, *Caja Negra* and another the *Microrelatos* by the Mexican artist Gerardo Suter (Laboratorio Arte Alameda, Mexico City, 2017) who refers to the clandestine crossing of spatial boundaries by using representations of an ambiguous location and an imaginary time that includes the spectator as part of the scene. The visual representation of highly supervised borders in a world that presents itself as a globalized community has a symptomatic value in Mexico.

The highly mediated northern border becomes the persecutor of a harassed southern limit. This consciousness results in a design indicating the viewer's movement between three large screens. The immersive project proposes the possibility of a wandering visitor who would look at the art according to the disorientation caused by the twenty clandestine migrants seen in the projected video. The three images in the flight of the screens across the walls of the room includes the shade of the visitor. Walking, stopping, going back, doubting, resuming the journey creates the path of crossing in this installation called the *neoTrópico*. The projected images come from night vision records of clandestine hunting chambers of migrants, the file in question, although it is not from one one prestigious film but a digital moving image, was anonymously uploaded to the networks.

The renowned Colombian artist José Alejandro Restrepo brings a critical vision of his country, and of the region to a paroxysm. An extensive work composed of performance, objects, serigraphs, prints, photographs, editorial and biological pieces, videos, are combined by him in installation practice. His show in Buenos Aires, *Cathodic Religion* (2017) confronted writings and images of history, stories and journeys through the discourse of science and religion. These narratives combine indigenous myth, popular knowledge and vestiges of narrations coming from diverse parts of Colombia. Inscriptions for a critical story are made to question the discourse of state ideological apparatuses that are perpetrated in school textbooks, national songs, gospels and particularly the mass media. We can consider Restrepo as a privileged commentator who processes the Colombian reality and, by extension Latin America, through forms of representation that concentrate on the hybrid practice of the installation. The exhibition *Cathodic Religion* is an art of critical memory, of the dominant power in its various expressions. The human body and the divine figure are manifested in the manipulation of various archives that dialogue with the documentary image. These

counterpoints overflow and generate queries around the representation of the discourse of history and religion. The piece *Santo Job*, combines a video projection with objects and silk worms in tune with the legendary Musa Paradisiaca. It is a work composed of banana plants whose stems culminate in small monitors of black and white video. Restrepo politicizes bioart and includes it in the art of installation, together with video and performance.

This combination is part of the proposal of Gilberto Prado in his anthology of his personal shows thatwas exhibited in Mexico City. *Circuito Alameda* (2018) was the result of an extensive exchange process between the artist, the *Poéticas Digitais* collective (University of São Paulo) and the Alameda Art Laboratory. The exhibition consisted of a series of works that combines from bioart with interactive art, with object pieces and programmed works that also combine analog media with new technologies. Wet media was an essential part of a dialogue between nature and the pieces of technological art available in the laboratory and in its surrounding urban environment. Among them, the new version of *Desertesejo* (2000/2018) was highlighted as a multimedia art that is reformulated over time, from the design of new platforms, its navigation trees, displays and content. The validity of *Desertesejo* is testimony of the problematic of the stock of technological works for a project of reference in the history of the media arts of the continent. *Desertesejo* in its different versions forms a metadata that circumvents the syndrome of digital art as it is the rapid obsolescence that characterizes interactive work in its hardware, its operative program, interface, expographic agency and archival repository. It is noteworthy that *Desertesejo*, as well as *neoTrópico*, by Gerardo Suter coincided with the presentation in Mexico City of Carne y Arena by the film director Alejandro G. Iñarritu. It is an immersive virtual reality installation of 360 degrees, which installed all the meanings inherent of the word, at the Tlatelolco University Cultural Center, a work that refers to crossings of geographical borders. It is an installation practice and a digital image, which proposes "physically present, virtually real" as Iñarritu's work says. *Desertesejo* stages this playful labyrinth as a metaphorical instance of a media landscape that must be crossed for survival.

There are few works, and artists, who manage to articulate a coherent and profound discourse on what it means to represent a complex, conflictive and fascinating region such as Latin America. The feature film, now in its digital version, with its narrative linearity, expressive literalism and classical language, does not end up responding to a complex montage of ideas when dealing with central issues that make a profound vision of the continent. A symptomatic example can be the film Rome by Alfonso Cuarón that simulates a Latin American neorealism that stands out for its shallow vision of the political and social environment of Mexico City in the 60s and 70s. Its production and distribution via streaming highlights the disappearance of cinema from theaters, the loss of photochemical support, and the difficulty in establishing a solid discourse on history. Despite its cinematic aspect, digital support and its transmission result in labile stories difficult to remember, once consumed on mobile screens.

Conclusion

These four artists propose an imaginary far from the speeches of the spectacle and entertainment of the mass media. Andrés Denegri, Gilbertto Prado, José Alejandro Restrepo and Gerardo Suter are some relevant cases of authors who, through their exhibition manage to develop an expressive plot that involves the viewer in its perception and movement and what the documentary questions, outside the dark room, the author manages to propose a powerful discourse on Latin America.

We consider significant the place and the environment where ISEA takes place, because it refers to the emblematic figure of Nam June Paik. Born after the war and after the division of the country along with his training in classical music, Paik discovers a space of creation where the electronic image is imposed on contemporary art. We refer to two of his latest works, the installation *Un monstruo de Miradas* (1996) - in charge of the Euro-American Film, Video and Digital Exhibitions, and exhibited in Bogotá, Buenos Aires, Montevideo, San Pablo and Santiago. It is an emblematic work that arises from a work with travel archives of journals on video between Latin America and Europe. This installation precedes his last single-channel work, the *Tiger Lives* (1999), a piece that reaffirms the use of the analogue video to the digital that marks the ontology of electronic arts.

Bibliography

Cine de Exposición. Instalaciones fílmicas de Andrés Denegri, Espacio de Arte de la Fundación OSDE, Buenos Aires, 2013.

Circuito Alameda, Gilbertto Prado y Jorge La Ferla, Laboratorio Arte Alameda, INBA, Ciudad de México, 2018.

“José Alejandro Restrepo. Tres décadas de creación con el arte y la tecnología”, Jorge La Ferla. 2017, en Arteologie. Recherche sur les arts, le patrimoine, la litterature de l´Amérique Latine, N.11 | 2017. Délocalités, translocalités et activisme dans l'art électronique et biomédiale latino-américain.
https://journals.openedition.org/artelogie/1531?lang=en

Religión Catódica. José Alejandro Restrepo, Espacio de Arte de la Fundación OSDE, Buenos Aires, 2017.

neoTrópico. Caja Negra y otros Microrelatos, Gerardo Suter y Jorge La Ferla, Laboratorio Arte Alameda, Secretaría de Cultura, Instituto Nacional de Bellas Artes, Ciudad de México, 2018

"Remote Actions/Collective, Divergence & Confluence: Art in Latin America"

Bernardo Piñero, Daniel Cruz Valenzuela

Universidad Nacional de Tres de Febrero, Universidad de Chile

Buenos Aires Argentina, Santiago Chile

bernardopinero@gmail.com, dcruz@uchile.cl

Abstract

The following is a proposal for an introductory revision in understanding the notion of the Collective in Latin American art creation; regarded as a model for dislocation of programmed strategies as an alternate layout to Contemporary Art practises.

In which ways the collective and the notion of "being networked" -proposed by Surófona collective- allows us to develop a narrative of divergences and confluences over a complex identity, where Language, both spoken and written, reveal both differentiation and identification.

Three ways substantiate the practise of the collective: (I) "Regiocal" creation (regional and local relations), (II) Alongside other subjectivities, (III) in Alternative circuits.

This way, it is intended to reveal the ever present cultural multiplicity in LatinAmerica as a contrastive factor (opposed to unifying and hegemonic views sustained in globalist voices), denoting a diverging view of wide and contrasting shades, blurring the notion of an unified body. Therefore, a question arises on the existence of a possible discursive body in the regional practises of Art and technology.

Keywords

Identity, Regiolect, Art, Territory, Identity, Latin American, Media, Experimental.

Introduction

Clay Shirky[1] offers us a viewpoint on the way the social use of digital communication tools has generated great astonishment. Specially since -beyond certain possibilities instilled in said tools- the desire of users model them and surpass their possibilities, breaking the one-sided direction of passive information consumption. Nicolás Bourriaud[2] proposes a "relational art" that, as a model, it characterises. and distinguishes nineties art from those of previous decades, due to the inclusion of institutional critique, graphies; (II) Alongside other subjectivities; (III) Alternative circuits. the questioning of the opposition artist-audience, the so-called "conceptual turn" and art's tendency to surpass and overflow its limits in the search of a reunification with the realm of life.

The former puts in evidence a disruptive attitude towards models and globalist actions imposed to the contemporary artist, that begs to question about new models to approach and understand creativity, its process and constructive systems. A small sample of the latter is creative activity from remote actions (connected to the web in order to save the physical distance evident in the map), the modification of the author paradigm towards collective/associative models, the incorporation of the spectator as a fundamental actor/user within the productive dynamics that result in a relational art; and the creation of permeable works that explore social discourses that overflow the cultural field into proposing a work/in/action.

It is in this context that several questions emerge on the Collective art practise and how its inclusion in the context, according to the particular contexts in which they emerge; They generate an acknowledgment of the local as a productive matrix, and emancipatory of the global models stablished. From this position, we can recognize three factors that emerge and offer the foundations for the practise of 'the collective': (I) "Regiocal" creation (regional-local relations) among other geo

Figure 1. Intervention at Plaza Botero, Medellín, Colombia, 2016. ©surófona

(I) "Regiocal" creation: Artists seeking to create in other geographies.

The territorial dimension, the map -with its borders and frontiers- has been blurred. The reticular and the prominent absence of any contact has given way to the

Figure 2. Building process of the Mobile Transmission cart Medellín, Colombia, 2016. ©surófona

possibility of being connected in real time from remote distances in a permanent online state, developing a latency comprising with the visceral curiosity shown by artists for other locations.

This emerging field suggests a flexible scaffold for collective creation. A dimension that encourages ample contact and discussion, finding a convergence with the rise of international artistic residencies, mainly offered by "non formal" and non academic spaces, both external and autonomous.

The thinking of a cross-wise cultural condition, of a Latin American entity -uniform and equivalent- has been replaced by the emerging understanding of the differences supported by the observation of the local, of the proxemic peculiarities that artists intuit. These suspicions activate the desire to investigate, experiment and produce in other contexts, where to reconstruct the probable artistic, cultural and social genealogies.

For artists, the act of re-locating implies to be eager or even nurture the desire to spy/poke around, to witness or even pry into other local intimacies. This meddling is often made possible by a local guide. Each artist works -in their own territory- as a guide for others, being a kind of "designated driver" in a geography (space, circuit, technique, skills) that knows.

Figure 3. Open Studio. International Festival of the Image, Manizales, Colombia 2016. ©surófona

Besides, a renewed interest is cultivated for being "a frog from another pond"[11]: a zoomorphic metaphor, remarking

an unstable condition, uncomfortable, "outsider"; common to someone who is suddenly carried into an environment, circuit or surrounding that doesn't feel natural, transforming them into a foreigner of sorts, with the need to understand, not only to adapt, but to acquire at least some camouflage skills (or why not?, some skills to communicate)

Being a "frog" in an unknown geography generates a type of estrangement, that turns interesting as an environment to sensitize, recognize oneself, and to create.

A local image that makes us think in the relationship between art, technology and media, as devices in permanent mutation; a kind of uncomfort within the discourse of the establishment and every structure imposed.

Figure 4. Sound Installation, "Cruces Sonoros" Exhibition, Santiago de Chile, 2016. ©surófona

(II) Along other subjectivities

[11]Argentinism for "To be in a strange environment", without knowing a place, a single person. Feeling strange, foreign, unfamiliar, in the end, uncomfortable. Similar to "like a fish out of the water", or "to be out of one's element").

The collective entails a field extension from the perspective of subjectivities. Co-authorship becomes in an exercise that projects a disregard for the individual and a move towards the collective. A kind of world sensitivity that seeks to overflow into other subjectivities, negotiations and exercises of a "sensitive diplomacy" in regards to creation. This way, a coproduction is projected into the work, in the discourse, even in the manifesto; implying a pause in the pitfalls of personal creation, a bit less comforting and hugely less predictable.

This fosters the discovery of forms for group functioning, as aesthetic forms themselves. The group as an entity against the grain of fixed individuality; where the collective gains its strength by recognizing in others a vast identity, that looks from the perspective of the interdisciplinary, the space in transit, to the contemporary condition of spatial scarcity "We can live in a transient state between different spaces:

Figure 5. Mobile Transmission cart at Plaza Echaurren, Festival PlaceMaking, Valparaíso, Chile 2017. ©surófona

airports, cars or rest stops as the new metaphors for residence. Just as moving or airplane travel, new modes of drawing"(3)

That is to say, collective exercises, effective-affective inter relational dynamics , they are all beautiful gestures, original, aesthetic; effective/affective dynamics ("effective" in the sense of being recognized as sufficient and necessary; "affective" in so far as being liable for affect, vulnerability, and sensitivity) .

This movement of subjectivities provides a work-inprogress strategy that activates from the act of verifying, validate, contrast, check on procedures, put them to a test inside "the collective as a media lab"

(III) Alternative Circuits.

Every artist recognize themselves as a node for a variety of nets or circuits, which are sensuously different among themselves. Contemporary art, the Academia, civilian laboratories, social organizations; cultural societies; hack groups; activist groups; political associations, etc.

Cross-contamination is in this way exerted. The permeability of each net is put into test, alongside its generosity and communicative ability. The interest for other circuits can be related to a certain transgressive attraction to "de-legitimize" the better established spaces for Contemporary Art, as a strategy to question them, amplify them or even demand a bigger capacity for inclusion.

This allows to jump among different spaces of flow, among different degrees of conventionality, different ruling systems to prescribe protocols "It is not about mingling with the incoming environment, no to fuse with the other, something that would convey a new source of insincerity and hypocrisy"(4)

Being a "frog", an eavesdropper, of a foreign circuit also generates a certain intriguing estrangement for sensibility, recognition and creation.

Figure 6. Object Rescue Expeditions, PlaceMaking Festival, Valparaíso, Chile, 2017. ©surófona

Surófona, Collective and Media

Since 2016, Surófona intervenes and interprets among festivals and other cultural events in Latin America, that connects arts and new media with the community,

The online radio located in http://www.surofona.org (unconventional, exploratory, for research and invention) is thought as a device that enters in many different contexts; in order to rescue, reconsider, and broadcast the sonic (experimental, alternative and folkloric) heritage from Latin America.

The broadcasts (see Figure 3) has as its main content: Talks with artists, sound art, electroacoustic music; improv, sound poetry, work reviews; telemátic concerts, soundscapes, Latin American regional dialects: all expressions that catch the interest and foster the interchange of ideas, stories and identities.

At the same time, the collective develops installations (see Figure 4), objects, urban interventions (see Figure 1), performing actions and workshops (see Figure 2), expanding the discursive and aesthetic process of each transmission; and spreading perspectives from and about

each territory. From its beginnings, Surófona's goals are as follows: To rescue, re-value, and share the Latin American experimental and folcloric sound heritage.

To experiment towards the idea of the radio as media, its format, contents, functions and deviations; To foster new sonic creations and experimentation with merging different genres and formats. To interview bystanders, neighbours, store owners, workers and examples from each community, transmitting stories, knowledge, sensitivities and identities.

To promote emerging artists; being an agent encouraging fraternal bonds in Latin America, exposing all things we share as well our shades.

Contact emplacements

Surófona has developed diverse strategies of territorial insertion, named Contact Emplacements. Each one of them, seeks to promote a dynamic, mobile and technological platform. which connects with the socio cultural and economic dynamics of the space of action. This space being understood as a complex frame of relationships, that provides a unique identity system.

1. Mobile Transmission cart.

The mobile cart (see Figures 2 and 5) is a portable device, which contains equipment that permits the amplification of sounds obtained live in location; by means of batteries, microphones, a sound mixer and speakers. Besides, it allows the online transmission of the radio (streaming) through the website www.surofona.org

2. Object Rescue Expedition.

This is an approach model to the visual territory in each city (see Figure 6) where interventions and broadcasts will be held. Different objects are hunted (mainly out of regular use); once recycled, they are incorporated into the Mobile Transmission cart;providing a visual correlation with the place, its objects and its particular symbolic universe.

Figure 7. Sound Rescue Expedition, Interviews at Plaza Echaurren, PlaceMaking Festival, Valparaíso, Chile 2017. ©surófona

3. Sound Rescue Expedition

This is a model of approximation to the proper sonority of a territory (see Figures 7,8,10,12 and 13) where Radio Surófona will be encamped. It seeks to reveal the original narratives transmitted by its local storytellers, by means of interviewing neighbours, passerbys, salespeople, etc. These are sound hunts that contain descriptions / atemporal narrations and synchronic narratives.

a. Regional Dialects: In every language, there are linguistic varietis that are common to a specific territory, with its own cirmcustances, flora, fauna, customs, that affect the language regarding its intonation, lexis, synthax and the way to organize thought and concepts.
b. Interviews: Talks with the inhabitants of the research zone, looking for recognizable signs coming from a first person narrative.
c. Sound territory: Sound register that document micro and macro contingencies, as well as a landscape, and specific and concrete elements.

During these expeditions among streets and public squares, we don't miss their psychogeographies(5), that is to say, we are interested in the possible relations among the characteristics of these kind of spaces and the behaviour and emotions of its inhabitants.
We approach the city from a playful dynamic, disrupting its everyday situations by means of wandering(6) as its

Figure 8. Sound Rescue Expedition, Interviews at Plaza Echaurren, PlaceMaking Festival, Valparaíso, 2017. ©surófona

original goal, returning a certain attitude related with the stroller (or "flâneur" according to Walter Benjamin[(7)]), as a way to subvert consumeristic logics that are imposed in public spaces, by means of an act that could be perceived apparently as idle and recreational; an act that, in capitalistic terms, doesn't produce a thing: Walking, recording, sitting attentively; talking, asking, sharing.

4. Broadcasting

Surofona broadcast posses 3 distinct modalities:

a. "Live on Stream": A live transmission (see figures 9 and 10) with the presence of an audience, from a cultural or academic public space. In this show, the previously

recorded sounds- during the previous Sound expedition stage- are reproduced, just as talks and live improvs of those who activate them. This modality is done by means of the "Transmission Mobile cart", as the technical support for the mix and amplification of the space.. Nevertheless, an "open studio" can be eventually mounted, going without the cart, becoming a conventional technical desk..

Figure 9. Broadcasting - Intervention at Plaza Muñoz Gamero, Festival Lumen, Punta Arenas Chile, 2016. ©surófona

b. "Live Online" A mode where the public, in any location in Latin America (or the world), becomes a distance listener in real time.. The Transmission Mobile Cart is used as a web connection antenna.

c."Podcast": Sound compilation that gathers, in show format, the global experience: The broadcast registers are available online from Surófona website, for its free download. Each of these releases includes a description and contextual tex. Eventually, some can be produced as download exclusive shows..

Quotations and Extracts

[3] Nicolas Bourriaud. *Radicante.* Buenos Aires: Adriana Hidalgo, 2009, 63.

[4] Nicolas Bourriaud. *Radicante.* Buenos Aires: Adriana Hidalgo, 2009, 73.

[5] Merlin Coverley, "Psychogeography", Pocket Essentials, 2006

[6] Guy Debord "Teoría de la deriva" (1958) First Appearing in # 2 the Internationale Situationniste. Traducción extraída de Internacional situacionista, vol. I: La realización del arte, Madrid, Literatura Gris, 1999.

[7] Walter Benjamin, "Libro de los pasajes" Suhrkamp Verlag. Frankfurt am Main, 1982. Ediciones Akal S.A. 2005 para lengua española.

References

[1] Clay Shirky. *Excedente Cognitivo: Creatividad y Generosidad en la era conectada,* Penguin Group, 2011.

[2] Nicolas Bourriaud. *Estética relacional.* Buenos Aires: Adriana Hidalgo, 2006.

Author(s) Biography(ies)

Bernardo Piñero (Buenos Aires, 1982). Professor,researcher and Inter media artist. Cultural agent, producer and entrepreneur in the fields of Art, culture, new technologies and education. He has exhibited his works, conducted workshops, presentations and organized encounters in public and private spaces in countries such as Argentina, Chile, Brasil, Colombia, Perú, Ecuador, Australia y Canada.

BA in Electronic Arts from the Tres de Febrero National University. Masters Degree in Technology and Electronic Arts Aesthetic from the same university. Grant holder of "Emerging Leaders in the Americas Program" (ELAP) en Montreal, Canada. (2012-2013).

Founder in 2006 of the Argentinean art collective "IQLab" (Multimedia Interactive Art), and in 2015 "Surófona" (Experimental Radio of Electronic Arts). In 2018 is the founder of "Nave Ágora" (Lab-space for Community and Citizen Innovation). Since 2016 is a researcher professor in the AbRiGo-UNTREF programme (creation, production and research in Tecnology of textile art). Former coordinator of CEIArtE-UNTREF (2006-2016).

URLs:

www.iqlab.com.ar | www.naveagora.org | www.surofona.org

Daniel Cruz (Coronel, Chile, 1975). Artist, Researcher and Professor. MFA (UCH), Certificate of Harvestworks, Digital Media Art Center, New York, USA. He is the coordinator of the MAM | Master in Media Arts and Vice Principal of the Visual Arts Department of the Faculty of Arts in Universidad de Chile. He is the co-author of the Digital Arts Contest in honour of Matilde Pérez. He is also is the director of the SAM | Media Arts Seminary.

Since 2000, he has participated in individual and collective exhibitions in galleries, museums, cultural institutions and public spaces in Chile and Foreign Countries .He is part of the collaborative latino american sound art project "Surófona". He has published several books: Intersecta 2018; Océano 2016; Obj / Objeto Tecnológico en el Arte Contemporáneo 2015; Tecnologías de Mediación 2015 y Espacios Temporales 2014.

URLs:

www.masivo.cl | www.surofona.org

Practices and Poetics of Urban Media Art in the Shadows of the Illuminated City

Stephanie DeBoer
University of Indiana, Bloomington, USA
sdeboer@indiana.edu

Elliot Woods
Independent artist of Kimchi and Chips, South Korea
elliot@kimchiandchips.com

Kristy H.A. Kang
Nanyang Technological University, Singapore
khakang@ntu.edu.sg

Keywords

Urban media, cities, public art, screens, transnational, commons, mediated city, place-making, mapping, space

Introduction

This panel explores a range of strategies, poetics and possibilities of media art in and of urban public space practiced not in the spotlight but adjacent to and in the shadows of the spectacle. Each paper envisions a different mode of illumination, engagement and altered perception of our urban environs, calling our attention to ways of being in and sensing spaces and places that are often unnoticed, invisible or taken for granted. From media artists' interventions that ask us to reflect upon the politics of disenchantment with the media saturated everyday in urban China, to the ways in which public art can potentially challenge the conventions of art not as object but as acts or gestures inscribed in the city itself and embodied in the memories of its inhabitants, to the design of urban interfaces that make visible overlooked cultural histories of peoples and places in Singapore, these papers present an inquiry into the ways in which urban media art can contribute towards a re-imagining and nuanced perception of the city's corners, cracks and shadows and our sense of nature, place, poetics and politics in public space.

Infrastructures of Illumination: On the Material, Poetic, and Political Valences of Screens in Urban Space

Stephanie DeBoer

This presentation addresses media art practices within a geographic context of "exposure." "Exposure" is a state-commercial context of illumination, one indicating not only the material illumination – the state-commercial lighting of the city – enabled by public screens, but also the everyday to spectacular politics and poetics that accompany them. In his discussion of recent developments in late capitalism, Jonathan Crary describes a "a contemporary imaginary in which a state of permanent illumination is inseparable from the nonstop operation of global exchange and circulation." [1] For cities such as Shanghai and Hong Kong, these paradoxes of global capital further impinge on the (trans/national) state. As Anna Greenspan reminds us, the "spectacle" of "future Shanghai" is not only materialized in its most prominently visible illumination – as with Hong Kong, Shanghai's large-scale to street-level light billboards and LED screens and lights dominate central and transit urban spaces – but is also felt in the continued struggle between light and shadow that form the politics and poetics of everyday experience in urban China. [2] In this state we might enquire into the disenchantment of the city, in the further phrasing of Crary, "in its eradication of shadows and obscurity and of alternate temporalities." [3] This presentation thus addresses media artists working in Shanghai and Hong Kong as they recognize the need for shadow in the illuminated city, and from here for if not alternative, at least adjacent durations, mobilities, spaces, and experiences for its inhabitants.

Art in the Commons

Elliot Woods

In 2018, the world of commercial art has a renewed talent for making headlines. From its self-shredding canvases (Banksy) to record-high prices for works by living (Jenny Saville, David Hockney) and non-human (Obvious) artists alike. Often we accept an idea of the 'art world' as private collectors and those artworks which disappear into their off-shore storage facilities. We must aim to re-capture the term 'art world' for art which exists in the space which we call the world.

Art which takes place in the world of the public commons is without the context of the gallery and largely without the consent of the viewer. It must physically cope with unexpected weather, issues of public safety and negotiate a highly democratic reaction. These works participate in the identity and memory of the city, such as in Jeremy Deller's "Procession" which recycles tradition into something relevant and powerful for today, and create new living monuments such as with Ryoji Ikeda's "Spectra" which creates a tower of light in the city skyline, whilst extending eternally into outer space.

In Korea, Permanent public works in the city are often commissioned through the 심의 (Shim-eui) judgement process which is famously troubled with non-artistic intentions, perhaps evidenced by a set of problematic examples of public art in the city today. The confusion of 'what is public art?' in Seoul is highlighted by the 400 million KRW publicly commissioned golden Gangnam Style artwork outside the COEX complex, contrasting with the citizen-rejected Shoes Tree of 2017's Seoullo opening. This talk will aim to consolidate these issues and demonstrate new artistic acts which cannot be collected, but belong to the space of the city itself

Illuminating Invisible Histories in the City of Continual Becoming

Kristy H.A. Kang

To create a sense of place in urban life, there is a tension between the desire for familiarity and stability in our everyday environment and the drive towards growth and evolution. Singapore, like other rapidly developing cities, is in a constant state of becoming – a global city that exemplifies hyper-plasticity while concerned with cultivating its national identity through cultural renewal and development, as geographers Lily Kong and others have studied. [4] However, because of its rapid urban re-development, its landscapes of inscribed personal meaning are unevenly and rarely fixed or stable. Singapore is largely unrecognizable from what it was over five decades ago and its rapid renewal creates a certain anxiety and sense of placelessness among its citizens. A recent article in Singapore's national newspaper, The Straits Times, critiques unabated urban development and the endangerment of vernacular post-independence architectural heritage in Singapore, challenging the state to preserve a sense of place and belonging for its citizens rather than continually serve the interest of private development. [5] As a city in a state of continual becoming, Singapore provides a useful case study for asking how cities in a continual process of urban renewal are challenged to cultivate and communicate cultural heritage and a sense of place for its diverse inhabitants.

As cities develop, the invisible layers of history embedded in them are often erased or overlooked. Initiated as a collaboration with the Urban Redevelopment Authority of Singapore, this presentation will discuss a research project that uses new media to uncover overlooked cultural histories of Singapore's diverse ethnic communities. In contrast to public exhibitions on urban planning that typically serve as an interface for visitors to learn about the city's plans for the future, this project creates a way for visitors to hear and view stories and histories from Singapore's disappearing past. Here digital technologies become a tool by which narratives of place and past are illuminated within an urban landscape that is continually shifting. This interactive mapping project engages new media to create a greater awareness of the invisible histories of our built environment and the diversity of peoples who populate it. It asks what kind of urban interfaces could be designed to communicate with the city and its communities, and what overlooked stories could be uncovered in order to enrich our understanding of the urban landscapes we move through.

References

[1] Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (Verso, 2013).
[2] Anna Greenspan, *Shanghai Future: Modernity Remade* (Oxford, 2014).
[3] Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep.*
[4] Lily Kong, Chia-Ho Ching, and Tsu-Lung Chou, *Arts, Culture and The Making of Global Cities: Creating New Urban Landscapes In Asia* (Massachusetts: Edward Elgar Publishing, 2015).
[5] Amanda Lee Koe, "If This Is Home, Truly, It Should Look Like Home," The Straits Times, April 1, 2018, https://www.straitstimes.com/singapore/housing/if-this-is-home-truly-it-should-look-like-home, (Accessed April 12, 2019).

Authors Biographies

Stephanie DeBoer is Associate Professor of Cinema and Media Arts/Studies in The Media School at Indiana University. She is the author of *Coproducing Asia: Locating Japanese-Chinese Film and Media* (U of Minnesota P, 2014), and her articles on media art, urban screens, media geographies, and global media have appeared or are forthcoming in collections such as *Framing the Global: Entry Points for Research* (Indiana University P, 2014) and *The Palgrave Handbook of Asian Cinema* (Palgrave, 2018), as well as in journals such as *Screen*; *Theory, Culture & Critique*; and *Leonardo*. With Kristy H.A. Kang and Anne Balsamo, she co-organized the 2018 symposium, *Emergent Visions: Adjacency and Urban Screens,* which invited artists, curators, and scholars to address the concerns, possibilities, and problems of public urban screens. She is also co-convener of the Shanghai-based Screens Collective, which addresses fundamental questions concerning the potential of urban screens as sites of public contact.

Elliot Woods (UK) is a digital media artist from Manchester. He tests possible futures between humans and visual design technologies (e.g. cameras, projectors, computation). Towards this goal, Elliot co-founded Kimchi and Chips, an experimental art studio based in Seoul with Mimi Son. He applies his academic studies in physics to produce sense-able phenomena from abstract systems.

Kristy H.A. Kang is a practice-based researcher whose work explores narratives of place and geographies of cultural memory. She is Assistant Professor at the School of Art, Design and Media at Nanyang Technological University, Singapore. Her research interests combine urban and ethnic studies, mapping, animation and emerging media arts to visualize cultural histories of cities and communities. She is currently developing a project with the Urban Redevelopment Authority mapping the spatial narratives of Singapore's ethnic communities. Her works have been exhibited internationally and received awards including the Jury Award for New Forms at the Sundance Online Film Festival. She was co-organizer of an international symposium on mediated public space "Emergent Visions: Adjacency and Urban Screens" (http://www.emergentvisions.org) and her article "Interfaces and Intentionalities: Adjacent Practices of Urban Media Art in Singapore" will be published in a forthcoming special issue on Urban Interfaces in *Leonardo Electronic Almanac*.

Passive / Reactive / Interactive: strategies that unify experimental art, artists and audiences

Susan Kukucka, Jonathan Parsons, Lubi Thomas, and Nicky Pastore
Experimenta
Melbourne, Australia
susan@experimenta.org, jonathan@experimenta.org, lubi@experimenta.org, nicky@experimenta.org

Abstract

This panel will discuss a framework that brings together experimental artists with new audiences through a combination of curatorial strategies that revolve around passive, reactive, and interactive forms of engagement between artworks and publics. By first presenting the conceptual and theoretical underpinnings of this approach, the panel will discuss its practical applications in the context of work undertaken by Australian media arts organisation, Experimenta. Through a thirty years history developing and presenting experimental art, and fifteen years touring media art exhibitions around Australia, Experimenta has fostered artistic processes and participatory formats that blur the boundaries between artists and the audience and bring experimentation and the unexpected to traditionally fixed gallery environments. The panel will address the logistical challenges of commissioning and touring complex, technologically driven artworks, and will reflect on galleries and audiences' reception of such artworks. In particular, the panel speakers will focus on a curatorial approach of co-creation, whereby audiences are required in the realisation of an artwork, and on collaborative methodologies with galleries to expand logistical and critical capacities in presenting media art.

Keywords

Curating; touring exhibitions; experimental art; audience development; media art; art & technology; interactive art; co-creation

Introduction

In recent years there has been a significant shift in what audiences expect from cultural experiences. In the past, audiences generally anticipated a passive viewing experience from cultural institutions and galleries. Today, in contrast, audiences desire cultural experiences that are interactive, participatory, and facilitate individual contributions either in real life (in the space) or virtually (through social media or other digital/online platforms). Former Tate gallery director, Sir Nicholas Serota, summarises this broader shift when recently stating that "[t]he relationship between museums, curators and their audiences has changed – it's much less a question of instruction, much more a question of participation and debate" [1].

The response to this shift can be witnessed from the most influential of institutions such as the Tate, through to the changing methodological approaches in programming amongst grassroots arts organisations. It is the latter position that Experimenta operates within, but due to its unique operating model, is able to affect changes in programming, exhibition presentation, and audience development in galleries across Australia.

First, some background and context. Experimenta is an Australian contemporary arts organisation dedicated to commissioning, exhibiting and promoting art driven by technology. Since its inception in 1986, Experimenta has developed a reputation for fostering creativity that extends the aesthetic, conceptual and experiential potential of new art forms. Founded as the Modern Image Makers Association by a collective of film and video artists in Melbourne, Experimenta quickly expanded to include installation, performance and sound art. As an organisation that continues to support new forms of contemporary practice, Experimenta is recognised for its ongoing contribution to the support of experimental art in Australia.

Experimenta's emphasis on artistic experimentation and practices at the transdisciplinary nexus of art, digital media, science & technology, and design, positions it well to meet the aforementioned increasing expectation of depth and diversity in engagement. Additionally, Experimenta maintains a unique position in that although it operates within the gallery sector, it does not and has never managed its own physical, presenting venue. This has necessitated the organisation's reliance on collaboration and partnership development in order to present its artists and programming, and which in turn has lead to a degree of agility in responding to the varying needs of the individual galleries it works with.

Experimenta's touring model has operated since 2003, and has seen seven editions of the Experimenta International Biennial of Media Art (which since 2017 has become a Triennial) tour extensively to almost forty galleries and museums in metropolitan and regional Australian centres, and is the only international biennial/triennial of its type to do so in the country. Whilst knowledge of Australian media artists practice is increasing, due to the complexities of display, or the experimental and often-unrecognisable (unestablished) forms of practice, these

artists remain under-represented within the national galleries program. Experimenta has an important lighthouse role in identifying and introducing these practices, as well as playing a pivotal role in supporting these artists through presentation.

Although the organisation's artistic vision is built on the premise that our world is driven by technology and our human experience is shaped by it, it equally acknowledges that "[t]echnology starts, develops, persists, mutates, stagnates and declines – just like living organisms' [2]. Rather than pursue the presentation of artworks that demonstrate technological developments in their newest and most state-of-the-art form, Experimenta is primarily interested in when newly invented technologies become accessible as tools for art making, and the creative role that artists play in re-purposing old and new technologies. This focus on the conceptual engagement with technological innovation, and critical perspectives on these developments, extends to both Experimenta's artists and audiences, and is best exemplified by the integration of co-creative artworks in all of Experimenta's exhibitions.

By expanding on the Passive / Reactive / Interactive curatorial methodology, this panel's speakers will elaborate further on the Experimenta methodology that juggles audience experience with artistic discourse and the logistics of touring, with an emphasis on capacity building opportunities that come with the presentation of a broad range of technologically driven artforms.

Panel Speaker Biographies

Jonathan Parsons has over twenty-five years of experience working as an Artistic Director, curator and creative producer in Australia and internationally. He is currently Artistic Director of media arts organisation Experimenta, and the Creative Director of Robotronica, a biennial festival of robotics and interactive design at Queensland University of Technology (QUT). He has artistically led and collaborated on a broad range of cultural programs and events across all art forms including for ISEA2016, Byron Bay Writers Festival, Powerhouse Museum, State Library of Queensland, Riverfestival, London International Festival of Theatre, Queensland Art Gallery, Queensland Performing Arts Centre, Adelaide Festival of the Arts, Sydney Gay & Lesbian Mardi Gras and Pacific Wave Festival.

Lubi Thomas is an experienced curator working in the field of digital/new media arts and associate practice areas. Currently, Lubi is an independent curator and artist; co-director of Ars Electronica Australia; Experimenta's Curator @ Large; and curatorial advisor to the Digital Placemaking Institute. In the past decade, she has developed and delivered an extensive range of exhibitions, projects, festivals, events, residencies and mentoring programs, as well as, public and education focused programming. Site-responsiveness is a key element in her practice, working closely with artists, creative technologist, and their collaborators to produce works and cultural experiences for a variety of audiences. Lubi's master's *Curating in Uncharted Territories* proposes a methodology for cultural programming development and sustainability for sites engaged in the display of, and engagement with, experimental creative practice.

Susan Kukucka is an arts manager with a background in producing public programs, and in research and policy development. Before becoming Experimenta's General Manager, she produced State Library of Queensland's public engagement programs for many years, developing hundreds of events, performances, festivals, exhibitions and numerous collections-based exhibitions and programs. Throughout Susan's career there has been a strong thread of digital media and technology-driven arts practice, from producing video games exhibitions to increasing audience access through online and digital technologies. Susan has served on committees and boards with Youth Arts Queensland, Arc Biennial: Visual Art, Craft & Design, and 2High Festival, and has held arts research and sessional teaching positions at Griffith University & Queensland University of Technology; worked in cultural and creative industries policy at Brisbane City Council; and was the recipient of an Asialink residency in China.

Nicky Pastore is a creative producer, and has worked with numerous Melbourne-based organisations including Experimenta, Footscray Community Arts Centre, 100 Story Building, Arts Access Victoria, and film studio Oh Yeah Wow as well as event-based projects at local councils such as Brimbank Council, City of Port Phillip Council and Yarra City Council. Across all aspects of her work, Nicky fosters a strong connection for artist-engaged practice and strives to create inclusive pathways for artistic development. Through her role as Festival Director of the Gertrude Street Projection Festival (2014-2018), she has been responsible for managing the delivery and programming of a highly successful public art event and implementing key strategies to ensure the growth of the video-arts industry.

References

[1] Van Leeuwen, Hans (2018). "Tate's Nicholas Seroata on using social media to bring people into art galleries", *Australian Financial Review*, 19 October 2018. Retrieved from https://www.afr.com/lifestyle/arts-and-entertainment/art/tates-nicholas-serota-on-using-social-media-to-bring-people-into-art-galleries-20181019-h16u1j

[2] Gassman, Oliver (2006). "Opening up the innovation process: towards an agenda." *R&D Management*. Vol 36(3): 223-228.

The Rise of Minority and Creativity in AI: What, Why, and How

Eunsu Kang, Haru Hyunkyung Ji, Sey Min, Jean Oh

Carnegie Mellon University, OCAD University, Sogang University, Carnegie Mellon University

USA, Canada, Korea, USA

eunsuk@andrew.cmu.edu, hji@faculty.ocadu.ca, sey.min@randomwalks.org, jeanoh@nrec.ri.cmu.edu

Abstract

This panel explores what is currently happening at the intersection of Art and Artificial Intelligence (AI) technologies, why it is important to acknowledge the power of creativity, lack of diversity, and visibility of minority groups in the field, and how we share our knowledge to raise awareness of these issues and discuss what we can do for the better future. Four panel members bring their expertise and firsthand experiences as media artists, creative coders, machine learning researchers, educators, exhibition curators, and art and technology community members.

Keywords

Artificial Intelligence, Machine Learning, Creative AI, AI Art, Artificial Life, Biased Dataset, Diversity and fairness, Visibility of minority, Implicit Bias

Introduction

In the age of AI, datasets and algorithms can predict our future (e.g., how you will look when you are older), our value (e.g., whether you are eligible for a loan or not), and our lifestyle (e.g., which items you would likely buy in the next few months). Unbalanced datasets, however, do not properly represent our world and algorithms tend to ignore minorities, also known as outliers in Machine Learning (ML). In this world where "facial recognition is accurate if you are a white guy," what do we need to know and what can we do? [1]

Figure 1. Terrance AB Johnson's Twitter post on April 2017. [2]

This panel explores **what** is currently happening at the intersection of Art and Artificial Intelligence (AI) technologies, **why** it is important to acknowledge the power of creativity, lack of diversity, and visibility of minority groups in the field, and **how** we share our knowledge and raise awareness of these issues as a stepping stone to overcome them in the future. Four panel members bring in their expertise and firsthand experiences as media artists, creative coders, machine learning researchers, educators, exhibition curators, and art and technology community members.

The panel will start with presentations by the members on four topics; machine learning art and creative AI, the merge of top-down AI and bottom-up artificial life (AL) to explore creativity in unsupervised environments for more open-ended art, the ethical issues around AI and the visibility of minorities, and the implicit bias of data-driven approaches in AI research. That will be followed by a group discussion that focuses on diverse approaches for bringing more awareness to these issues and enhancing the visibility of minority groups in the field, as well as how art can contribute to the rise of minority and creativity in AI.

Creative AI

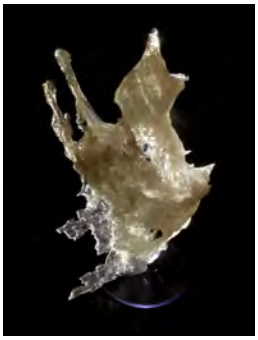


Figure 2. The Hallucinated Body of Ganymedes, the first authentic sculpture generated by Point Cloud GAN and PDD algorithms developed by a team of artists and researchers. [6]

The Global Phenomenon

Many artworks generated with assistance of Machine Learning algorithms have appeared in the last three years. Aesthetically impressive results came out as images that belong to the traditional art area of painting, and they have received global recognition. Generated art images from the Creative Adversarial Networks were favored by human viewers over images of paintings at the prestigious Miami Art Basel. [7] The top prize winner of the International Robot Art Competition in 2018, a painting by CloudPainter, proved that a machine can achieve the aesthetic level of a professional painter. [8] An image that was generated by Machine Learning algorithms and processed further by a human artist received the Gold Award of the famous Lumen Prize digital art competition in 2018. Also a painting that was generated by Generative Adversarial Networks (GANs) was sold for close to half million dollars at the Christie's art auction. The artist's signature on this painting was the mathematical objective function of GANs rather than any human artist name. [9, 10] In this age of AI, will creative Artificial Intelligence replace artists? Or will it help us to discover new areas of creativity? This section introduces state-of-the-art examples of artworks created with the assistance of machine learning algorithms to draw an overview of this phenomenon.

Behind the Scenes

Examples of ethical issues in and around this intersection of art and machine learning will be also discussed in this section. That includes biased datasets (the Faceapp case), security breaks (adversarial attacks), bad users (the DeepFake case), female/minority representation in the field of AI, and the issues around the ownership and evaluation of artwork that has resurfaced by the recent Christie's auction case.

AI & AL: Top-down & Bottom-up

For a long time, artists have made machines (whether physical or conceptual) that make art. Using machines expressed as simple or complex rules and processes, generative art can produce infinite variations of expression. However, compared to the creativity found in nature, such as speciation in evolution, often what appears with generative art are mere variations at the same level. The question is how to make machines that produce beyond parametric variation, to something close to emergence, as creativity toward the unknown.

Can artificial intelligence help to solve this problem? We think that generative art, particularly artificial ecosystemic art, is a great venue to experiment with this approach, because it can explore how learning can evolve in a context of open-endedness; an unsupervised environment that may reveal important clues to let us to understand creativity and emergence in nature.

For example, the "Infranet: Gwangju" project shows the approach of interweaving machine learning and evolutionary algorithms. In this project each agent has a neural network, subject to evolutionary change using NEAT techniques [3], while also allowing horizontal (lateral) gene transfer of neural networks, as a form of social network communication between agents. Each agent has a goal to draw out geospatial features such as commercial or residential buildings, water or electricity tracks, as well as various roads and pathways of Gwangju city. Then through sync (entrainment) pulses, what has been learned is shared by the most *differentiated* neighbors.

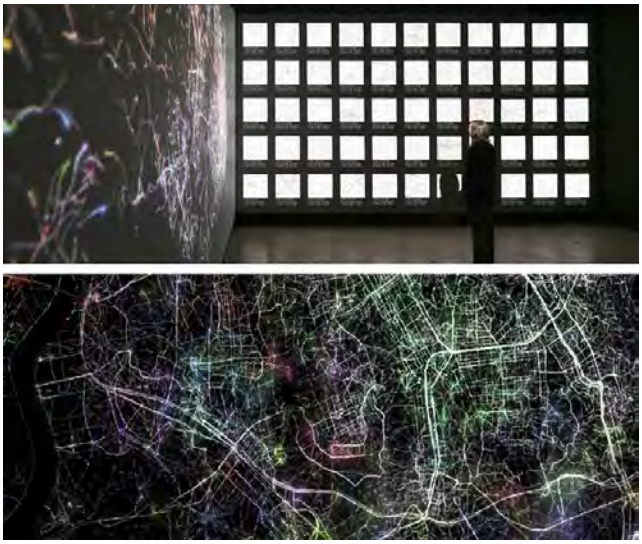


Figure 4. Infranet: Gwangju is a generative artwork realized through a population of artificial life agents with neuro-evolution, communicating to form a liquid neural network, thriving upon open geospatial data of the infrastructure of Gwangju as its sustenance and canvas. There are also observing eyes continuously surveil agents, however they appear to produce ever-changing patterns without need for extra regulation. Above: Exhibited at the Gwangju Media Festival 2018, ACC, Gwangju, Korea. Below: a detail sub-set of the work (screen capture).

The application of neuro-evolutionary liquid neural networks [4] in a multi-agent system certainly yielded interesting results due to its merger of *top-down and bottom-up* approaches, where artificial intelligence meets artificial life art. In this section, this approach and its further research and examination will be discussed. [5]

The Visibility of Minority

As artificial Intelligence technologies are rapidly developing in recent years, they are also increasingly influencing creative fields, bringing new artistic tools and

inspirational sources. However, as more artists use machine learning techniques for their creative works, important issues such as diversity and fairness are being revealed as central problems. The lack of diverse data, the imbalance in accessibility to main technology resources, and creative communities and individuals' efforts to pursue lower the barrier will be reviewed in this section from a data visualization artist perspective.

Two specific projects will be introduced as examples: "A.I, *entirely on us*" throws a question about who will be in the group taking advantage of ML, and what considerations should be taken on by tech-centric communities to raise the accessibility of minority groups.

Figure 3. Interactive visualization generated from a model trained with leading AI artists and creative researchers' opinions on three major subjects in creative machine learning: "AI driven society", "diversity and fairness", and "augmented Intelligence".

"Overfitted Society" reveals how narrow classification happens when we train a model with imbalanced data. This section focuses on what we should consider as an individual, a community, and a society in the era of AI, especially from creative perspectives.

Figure 4. Web-based interactive project that shows what happens when a model is trained with a shallow dataset.

Overall, this section will focus on imbalance, the data dependency at the heart of ML, and its influence on human creativity from an artistic perspective.

Implicit Bias of Data-Driven Approaches

The motivation for this topic has been formed from our recent experiences with image captioning. Microsoft Common Objects in COntext (MS COCO) [11] is a popular dataset used for image captioning that consists of more than 200,000 labeled images containing 80 objects and 91 "stuff" categories. When we trained an image captioning system using MSCOCO, we observed common data bias. For example, given an input image with a large, green field in the background, the system tends to generate sentences related to a baseball game even when it is completely irrelevant to the actual image. Additionally, although it will require a thorough analysis to make a conclusive remark, we noticed subtle stereotyping based on gender and race as well.

As humans, our decision making can be affected by various types of unconscious biases or stereotypes, known as *implicit bias* or *implicit social cognition*. Just as humans gradually build such biases through direct and indirect experiences, an AI system trained with arbitrary datasets can also develop undesirable implicit bias. More specifically, when data-driven approaches are used for generating media art from unquestioned datasets, the resulting products may exhibit such subtle biases. In this section, we discuss the following question: how can we tell if an AI system develops unhealthy bias and how can we prevent that from happening?

Conclusion

The prevalent use of AI and machine learning technologies in art enables exciting new creations. At the same time negative sides of these technologies, such as bias, can also be unintentionally exacerbated to influence the public through the power of art. This panel introduces state-of-the-art examples of art that have been created with the assistance of machine learning algorithms, then explores such potential issues that might have been overlooked by the art and AI communities. Through discussion, we aim to understand the presence of biases, the visibility issues of minority groups in the field, and the role of diversity in creativity. We bring together researchers from diverse disciplines to raise awareness of problems and discuss possible approaches for the better future.

References

[1] Lohr, Steve. "Facial Recognition Is Accurate, If You're a White Guy." *The New York Times*. The New York Times, 09 Feb. 2018. Web.

[2] Johnson, Terrance AB. "#faceapp Isn't' Just Bad It's Also Racist... Filter=bleach My Skin and Make My Nose Your Opinion of European. No Thanks #uninstalled Pic.twitter.com/DM6fMgUhr5." *Twitter*. Twitter, 19 Apr. 2017. Web.

[3] Stanley, Kenneth O.; Risto Miikkulainen. "Evolving neural networks through augmenting topologies." Evolutionary computation 10.2. 2002.

[4] Pinero, Jordi.; Sole, Ricard. "Statistical physics of liquid brains" bioRxiv doi: https://doi.org/10.1101/478412 Nov. 2018.

[5] Ji, Haru Hyunkyung.; Wakefield, Graham. "Biotopes Computationnels (Computational Biotopes)" In Stream 04: Les Paradoxes du vivant (The Paradoxes of the Living), pp. 304-316 Philippe Chiambaretta Architecte, Paris, Nov. 2017.

[6] Elgammal, A.; Liu, B.; Elhoseiny, M.; and Mazzone, M. "Can: Creative adversarial networks, generating art by learning about styles and deviating from style norms." arXiv preprint arXiv:1706.07068. 2017.

[7] Kang, Eunsu; Li, Chun-Liang; Ge, Songwei; Dill, Austin; Zhang, Lingyao; Zaheer, Manzil; Poczos, Barnabas. "The Hallucinated Body of Ganymedes." AI Art Gallery. N.p., n.d. Web. 17 Dec. 2018.

[8] "2018 Winners." *Robotart*. N.p., n.d. Web. https://robotart.org/2018-winners 17 Dec. 2018.

[9] Goodfellow, I.; Pouget-Abadie, J.; Mirza, M.; Xu, B.; Warde-Farley, D.; Ozair, S.; Courville, A.; and Bengio, Y. "Generative adversarial nets." NIPS. 2014.

[10] Person. "Is Artificial Intelligence Set to Become Art's next Medium? | Christie's." *Albrecht Dürer: 10 Things to Know | Christie's*. Christies, 12 Dec. 2018. Web. 17 Dec. 2018.

[11] Lin, Tsung-Yi; Maire, Michael; Belongie, Serge J.; Bourdev, Lubomir D.; Girshick, Ross B.; Hays, James; Perona, Pietro; Ramanan, Deva; Dollár, Piotr; Zitnick, and C. Lawrence. "Microsoft COCO: Common Objects in Context." CoRR. 2014.

Authors Biographies

Eunsu Kang is a Korean media artist who creates interactive audiovisual installations and AI artworks. Her current research is focused on creative AI and artistic expressions generated by Machine Learning algorithms. Creating interdisciplinary projects, her signature has been seamless integration of art disciplines and innovative techniques. Her work has been invited to numerous places around the world including Korea, Japan, China, Switzerland, Sweden, France, Germany, and the US. All ten of her solo shows, consisting of individual or collaborative projects, were invited or awarded. She has won the Korean National Grant for Arts three times. Her researches have been presented at prestigious conferences including ACM, ICMC, ISEA, and NeurIPS. Kang earned her Ph.D. in Digital Arts and Experimental Media from DXARTS at the University of Washington. She received an MA in Media Arts and Technology from UCSB and an MFA from the Ewha Womans University. She had been a tenured art professor at the University of Akron for nine years and is currently a Visiting Professor of Art and Machine Learning at the School of Computer Science, Carnegie Mellon University.

Haru Ji is a media artist and co-creator of the research project "Artificial Nature", exploring the subject of life in art through artificial life worldmaking: a form of computational generative art creating and evolving virtual ecosystems as immersive environments. She holds a Ph.D. in Media Arts and Technology from UCSB and is an assistant professor in DPXA & the Digital Futures programs at OCAD University in Toronto, Canada. Her work has been shown in art festivals, conferences, and venues including SIGGRAPH, ISEA, EvoWorkshops, La Gaite Lyrique, ZKM, CAFA, MOXI, the AlloSphere, and Seoul City Hall, and recognized in the 2015 VIDA Art & Artificial Life competition and the 2017 Kaleidoscope Virtual Reality showcase. http://www.artificialnature.net

Sey Min is a data visualization artist and designer, who is interested in dealing with live data sets in various media formats. She makes projects that reimagine how humans relate to technologies, to societies and cities, and to environments. Combining elements of environmental studies, visual art, programming, and data storytelling, her projects range from building a real-time interactive information graphics system for a music club (Gender Ratio, 2007) to visualizing Seoul City expenditure data (City DATA: Seoul Daily Expenditure, 2014).Her work has been shown at NIPS 2018, National Museum of Modern and Contemporary Art, Korea; TED 2011; TEDGlobal 2012; Art Center Nabi in Seoul, and Lift Conference, and featured on CNN Asia, Lift09 etc. After serving as an urban information design researcher at MIT SENSEable City Lab, She was selected as a 2011 TED Fellow and Senior Fellow from 2012 to 2013. Her work is also available at ttoky.com.

Jean Oh is a faculty member at the Robotics Institute at Carnegie Mellon University. Jean is passionate about creating persistent robots that can co-exist with humans in shared environments, learning to improve themselves over time through continuous training, exploration, and interactions. Her current research is focused on the intersection between vision, language, and planning in robotics. Jean has been leading several robot intelligence tasks in government, defense, and commercial projects in various problem domains including soldier-robot teaming, self-driving cars, disaster response, eldercare, and healthcare. Jean heads an interdisciplinary research group, Bot Intelligence Group (BIG), that currently includes 10 graduate and 2 undergraduate students from the Robotics Institute, Language Technologies Institute, Computer Science Department, Machine Learning Department, School of Information Science, and Mechanical Engineering Department. Jean's team has won two Best Paper Awards in Cognitive Robotics at IEEE International Conference on Robotics and Automation (ICRA) in 2015 and 2018 for the works on natural language understanding in robot navigation and socially-compliant robot navigation in human crowds, in 2015 and 2018, respectively. Jean received her Ph.D. in Language and Information Technologies at Carnegie Mellon University, M.S. in Computer Science at Columbia University, and B.S. in Biotechnology at Yonsei University in South Korea.

Media Archaeology: Linking Asia and Latin America

Erkki Huhtamo, Machiko Kusahara, Andrés Burbano

University of California Los Angeles, USA; Independent Scholar, Tokyo, Japan; Universidad de los Andes, Bogota, Colombia
erhuhta@ucla.edu, kusahara@ka2.so-net.ne.jp, aburbano@uniandes.edu.co

Abstract

Media studies is facing many challenges. One of them is finding out how to account for the presence of technical media in an increasingly global - *mondial* - environment. This cannot be achieved by concentrating only on the present, or by studying contemporary media platforms based on computing on a planetary scale. It is also necessary to work at the historical level, and to deconstruct standard historical narratives of media history written from a pervasive Western perspective. At the same time, it is necessary to tell alternative stories of devices and artifacts by linking them to their cultural-historical contexts and giving an account of their resonances and migrations between different cultures. Media archaeology provides potential to contribute to this process, but its tools must be critically investigated and modified to fit the task. Some scholars practicing media archaeology have purported to expand their field of operations by questioning accounts West-centered historiography and looking for more diverse and complex approaches. However, that is only the beginning. Many issues remain to be solved.

The three presentations in this panel will explore ways of applying media archaeology to issues of cross-cultural and international media and technology transfers. The first presentation by Erkki Huhtamo will discuss the possibilities and pitfalls of extending media archaeology to cross-cultural issues from a theoretical perspective. It is followed by two presentations shedding light on the vicissitudes of the magic lantern in different cultural contexts. Machiko Kusahara will discuss the uses of magic lanterns in nineteenth-century Japan adding little known aspects to the understanding of visual media in Far Asian cultures. The second presentation by Andres Burbano will explore the magic lantern as a literary object in the Mexican poetry of the seventeenth century, exposing some of the roots of optical media and literary culture in Latin America.

Keywords

Media archaeology, Global media archaeology, media history, Asia, Latin America, Magic Lantern.

Toward "Glocal" Media Archaeology

Like media studies, media archaeology was originally developed from the perspective of Western technological, mediatic and ideological hegemony [1]. Whether intentionally or not, it represented the Western world as the initiator and supreme master of the media forms it excavated, tracing their technological and discursive trajectories to the Early Modern Europe or at best to the classical antiquiry. The rest of the world remained in supporting roles, if even there. A "Theft of History," to borrow the harsh words of the anthropologist Jack Goody, occurred [2]. Such a perspective is inappropriate and misleading in a dynamic multipolar world where countless traditions intermingle and ideas travel along multi-directional paths that often have little to do with "the West." To remain relevant, media archaeology needs to reformulate its goals and tools to account for the radically changing realities of our times. It must learn to investigate genealogies and deep histories from perspectives that refuse to submit themselves to Eurocentric biases. Not only do we need media archaeologies of Japanese, Chinese, Indian, Russian, Uruguayan, Polynesian etc. cultures (any number of traditions and locations could be added to the list). We also need accounts that relate the separate yet-to-be-written media archaeologies with each other, accounting for cross-cultural exchanges of traditions and ideas [3]. To achieve this, a "glocal" (global+local) media archaeology needs to be created. The challenges are enormous and will require scholarly collaboration across linguistic boundaries and cultural traditions. We can get tips from cultural anthropology and historical ethnography, among other sources. Scholars like Edward Said, Jack Goody, Victor H. Mair, Timon Screech and Eric Michaels, whose works have been rarely if ever associated with media archaeology, provide models worth considering [4]. This lecture will provide an initial cartography for such an expanded media archaeology, discussing the promises and pitfalls of such an endeavor which is barely beginning.

19th Century Magic Lantern Practices in Japan

The history of the magic lantern in Japan is a case where a multicultural and multi-disciplinary approach is required. The magic lantern was first introduced to Japan from Europe in the late 18th century. At first it was interpreted as a tool for a new kind of shadow theater. By the beginning of the 19th century the magic lantern gave rise to a unique form of screen practice called utsushi-e, which incorporated traditional formats of music-accompanied storytelling with a special techniques of animating characters on the screen. Utsushi-e developed in an interplay with traditional theatrical forms like kabuki and bunraku. It became related with and was influenced by practices like spectacular transformations of scenes or actors/puppets reflecting the popularity of magic and automata (which were originally brought to Japan from Europe as well). Utsushi-e continued to be extremely popular, but in less than a century the magic lantern was again introduced from the West in a

technologically improved form. It was received as a medium of modern culture. The parallel lives of the Japanese and the Western style projection practices continued for a while, then started to merge [5]. Eventually the newly introduced magic lantern presentation became the mainstream form, but then the cinema arrived.

Sor Juana Ines de la Cruz and the Magic Lantern. Mexico, 17th Century

Juana Ines de Asbaje (1648 – 1695) better known as Sor Juana Ines de la Cruz is the primordial literary reference of the New Spain, which was the name of the Spanish colony of what is now Mexico, but at that time also included other many territories in the world from the Caribbean to the Philippine Islands. One of the most inspirational themes for media archaeology has been the influence of the books of Athanasius Kircher in Rome, like the *Ars Magna Lucis et Umbrae* published in 1646, that traveled throughout the world arriving among other places to the New Spain where several literary and religious people not only read it, and even some of them initiated epistolary exchanges with the professor of the *Collegio Romano*. The influence of Kircher's books on the work and life of Sor Juana is famous, not only because in one of the portraits made to Sor Juana, Kircher's publications appear in her library but mainly because she included the figure of the Magic Lantern in his most significant poetic work entitled *Primer Sueño*, First Dream [6]. Thus the Magic Lantern, in this case, is understood as a mystical referent and as a poetic artifact [7]. Sor Juana is a worthy representative of the so-called New World, its tensions and contradictions in the context of a profound global transformation of colonial character where technical devices begin to play an essential role in the conversion processes.

References

[1] *Media Archaeology: Approaches, Applications, and Implications*. Eds. Erkki Huhtamo and Jussi Parikka. Berkeley: University of California Press, 2011.

[2] Jack Goody, *The Theft of History*. Cambridge, UK: Cambridge University Press, 2006.

[3] Parikka, Jussi. *What Is Media Archaeology?* Cambridge, UK: Polity, 2012; *Variantology 2: On Deep Time Relations of Arts, Sciences and Technologies*. Eds Siegfried Zielinski and David Link. Köln: Walther König, 2007.

[4] Said, Edward W. *Orientalism*. New York: Random House, 1979; Mair, Victor H. *Painting and Performance: Chinese Picture Recitation and its Indian Genesis*. Honolulu: University of Hawai'i Press, 1988; Screech, Timon. *The Lens Within the Heart: The Western Scientific Gaze and Popular Imagery in Later Edo Japan*. Honolulu: University of Hawai'i Press, 2002 (orig.1996); Michaels, Eric. *Bad Aboriginal Art. Tradition, Media, and Technological Horizons*. Minneapolis: University of Minnesota Press, 1994.

[5] Kusahara, Machiko, "Magic Lantern and Its Travels," in: Endo, Miyuki; Kusahara, Machiko; Huhtamo, Erkki. *The Magic Lantern: A Short History of Light and Shadow*. Ed. Michio Yano and Tokyo Metropolitan Museum of Photography, Tokyo: Seikyusha, 2018.

[6] Cruz, Sor Juana Ines De la. *Poemas y Sonetos*. CreateSpace Independent Publishing Platform, 2016.

[7] Paz, Octavio. *Sor Juana Inés de la Cruz o las trampas de la fe*. Mexico: Fondo de Cultura Económica, 1995. Paz, Octavio. *Sor Juana: Or, the Traps of Faith*. Trans. Margaret Sayers Peden. Cambridge, Mass: Belknap Press, 1990.

Bibliography

Ars Electronica 2003: Code: The Language of Our Time. Eds Christine Schöpf and Gerfried Stocker. Ostfildern-Ruit: Hatje Cantz Publishers, 2003.

Athanasius Kircher: The Last Man Who Knew Everything. Ed. Paula Findlen. New York: Routledge, 2004.

Barros, Fabiana de. *Geraldo de Barros: Isso*. São Paulo, SP: Sesc, 2013.

Cruz, Sor Juana Ines De la. *Poemas y Sonetos*. CreateSpace Independent Publishing Platform, 2016.

Endo, Miyuki; Kusahara, Machiko; Huhtamo, Erkki. *The Magic Lantern: A Short History of Light and Shadow*. Ed. Michio Yano and Tokyo Metropolitan Museum of Photography, Tokyo: Seikyusha, 2018.

Ernst, Wolfgang. *Digital Memory and the Archive*. Ed. Jussi Parikka. University Of Minnesota Press, 2012.

Godwin, Joscelyn. *Athanasius Kircher's Theatre of the World: The Life and Work of the Last Man to Search for Universal Knowledge*. Rochester, Vermont: Inner Traditions, 2009.

Goody, Jack. *The Theft of History*. Cambridge, UK: Cambridge University Press, 2006

Huhtamo, Erkki. *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles*. Cambridge Mass: The MIT Press, 2013.

Kittler, Friedrich. *Optical Media*. Trans. Anthony Enns. Cambridge, UK ; Malden, MA: Polity, 2009.

Media Archaeology: Approaches, Applications, and Implications. Eds. Erkki Huhtamo and Jussi Parikka. Berkeley: University of California Press, 2011.

Michaels, Eric. *Bad Aboriginal Art. Tradition, Media, and Technological Horizons*. Minneapolis: University of Minnesota Press, 1994.

Parikka, Jussi. *What Is Media Archaeology?* Cambridge, UK: Polity, 2012.

Paz, Octavio. *Sor Juana Inés de la Cruz o las trampas de la fe*. Mexico: Fondo de Cultura Económica, 1995.Paz, Octavio. *Sor Juana: Or, the Traps of Faith*. Translated by Margaret Sayers Peden. Cambridge, Mass.: Belknap Press, 1990.

MediaArtHistories. Ed. Oliver Grau. Cambridge, Mass.: The MIT Press, 2010.

Relive: Media Art Histories. Eds Sean Cubitt, Paul Thomas, and Roger F. Malina. Cambridge, MA: The MIT Press, 2013.

Said, Edward W. *Orientalism*. New York: Random House, 1979.
Screech, Timon. *The Lens Within the Heart: The Western Scientific Gaze and Popular Imagery in Later Edo Japan*. Honolulu: University of Hawai'i Press, 2002 (orig.1996).
Thurman, Judith, and Jonathan David. *The Magic Lantern: How Movies Got to Move*. New York: Atheneum, 1978.
Variantology 2: On Deep Time Relations of Arts, Sciences and Technologies. Eds. Siegfried Zielinski and David Link. Köln: Walther König, 2007.
Zielinski, Siegfried. *Deep Time of the Media: Toward an Archaeology of Hearing and Seeing by Technical Means*. Trans. Gloria Custance. Cambridge, Mass: The MIT Press, 2006.

Authors' Biographies

Erkki Huhtamo is a professor at the University of California Los Angeles (UCLA), Departments of Design Media Arts, and Film, Television, and Digital Media. He received his Ph.D. in cultural history from the University of Turku, Finland. Huhtamo is an internationally renowned media historian and theorist, and a specialist in the history and aesthetics of media arts. He is one of the founders of media archaeology. Huhtamo has published extensively, curated exhibitions, directed television programs, performed on stage, and lectured worldwide. His major work to date is *Illusions in Motion: Media Archaeology of the Moving Panorama and Related Spectacles* (2013). *How to Dismantle a Fairy Engine: Media Archaeology as Topos Study* is forthcoming.

Machiko Kusahara is a scholar specializing in media art and media archaeology. She began curating in the fields of computer graphics and media art in early 1980s. Kusahara has participated in launching venues like the Metropolitan Museum of Photography (now TOP Museum, Tokyo) and NTT/ICC (Tokyo). She has worked in juries for many international competitions including Ars Electronica, ISEA, Hiroshima International Animation Festival and Japan Media Arts Festival. Kusahara's research focuses on the interrelations between media technology, art, culture and society, both in contemporary and in early visual media. She lectures worldwide, and has published widely on media art, Device Art, magic lantern history, panoramas, etc. Kusahara is professor emerita of Waseda University, Tokyo. She holds a Ph.D in engineering from the University of Tokyo, and is based in Tokyo.

Andrés Burbano is Associate Professor in the Department of Design at Universidad de los Andes. Burbano holds a Ph.D. in Media Arts and Technology from the University of California Santa Barbara. Burbano has been a keynote speaker at Potential Spaces at the ZKM (Karlsruhe, Germany) in 2017, the Academic Chair of ISEA2017 (Bogota. Colombia), and Siggraph 2018 Art Gallery Chair (Vancouver, Canada). He is the Siggraph 2020 Art Papers Chair (Washington, USA). "Burbano explores the interactions of science, art and technology in various capacities: as a researcher, as an individual artist and in collaborations with other artists and designers. The broad spectrum of his work illustrates the importance, even the prevalence, of interdisciplinary collaborative work in the field of digital art."

Machine Flaws in Generative Art

Paul Boyé
Sessional Lecturer and PhD Candidate, University of Western Australia
Perth, Australia
paul.boye@uwa.edu.au

Dr Dejan Grba
Visiting Associate Professor, Nanyang Technological University
Singapore
dejan.grba@ntu.edu.sg

Dr Kristy H.A. Kang
Assistant Professor, Nanyang Technological University
Singapore
khakang@ntu.edu.sg

Dr Melentie Pandilovski
Riddoch Art Gallery Director
Manager Arts & Culture Development
Mount Gambier, Australia
mpandilovski@mountgambier.sa.gov.au

Dr Vladimir Todorović
Senior Lecturer, University of Western Australia
Perth, Australia
vladimir.todorovic@uwa.edu.au

Abstract

This panel focuses on opening up a discussion on the role of art in the times when AI systems are becoming ubiquitous. It embraces the machine flaws, irregularities and errors that artists explore to push the boundaries of their art practice and find new thematic, technological and conceptual grounds for experimentation. The panel explores and compares multiple views, case studies and projects produced in various disciplines including data driven city portraits, generative media facades, urban media art, spatio-temporal visualizations, machine learning narrative experiments in VR, neural networks and art; and discrepancies or interrelatedness between human creativity and the future of Artificial general intelligence (AGI).

Keywords

Generative art, virtual reality, machine learning, AI, cognitive mapping, error, generative visualization, inaccuracy, urban media art, media city, software city, hardware city.

Media Ruins: Aesthetics of Neglected Media in the Software City

Kristy H.A. Kang

In *Soft City*, a personalized account of London life in the early 1970s writer Jonathan Raban stated that "the city as we imagine it, the soft city of illusion, myth, aspiration, nightmare, is as real, maybe more real, than the hard city one can locate on maps, in statistics…and architecture." [1] As global cities aspire to become "smart", merging technology with urban infrastructure in the interest of increased efficiency and usability, Raban's vision of the hard city has transformed into the hardware city, and the soft city has become software city — the local, intimate human dimension of urban life now increasingly mediated using digital technologies. These comprise the spatial narratives of the city layered over time and place. Cities embed technology into everyday life, aspiring towards a utopian vision of a computational, data-driven urban infrastructure that does not break down. But what if the hardware city glitches or stops working? What would an aesthetics of a flawed, forgotten and neglected media city look like? And what kinds of artistic expressions could be generated from this? This paper will explore how artists use digital media in and of urban space to create poetic frictions between the hardware and software city and challenge us to see what is overlooked. It offers a reading on the creative practices and expressions that emerge between hardware and software city by looking at the work of urban media artists Krzysztof Wodiczko and Refik Anadol.

Though each artist's practice differs both generationally and formally, one can say that they are both concerned with creating portraits of the city. While the urban media and projection works of Wodiczko concern themselves with giving voice to overlooked bodies in the city, Anadol's urban projection mapped performances deal with the quantified body. Anadol's portraits are "derived from data" and "augment the more instrumental monitoring and administering of the city promulgated by IT infrastructures…" [2] Wodiczko's "instruments" or media "prostheses" ask the urban dweller or witness to share an experience that is deeply intimate or traumatic and is not typically shared with strangers in public. [3] His works create a relational interface or an empathy exchange that allows for the possibility of collective healing and reflection within the hardware city. Whereas Refik Anadol transforms the collective body of machine informatics collected and generated by the quantified city into a poetics of data amplification in his architectural projection performances. Each of

these artists create ways of revealing characteristics of the media city which may be imperfect, neglected or overlooked in its aspirational vision to be smart and efficient. They craft encounters with the (data)body of the city that challenge us to see the urban anew. Each creates in their work, a point of contact – a relational interface between human and machine, and between hardware and software city.

STUDY 7/0: Error-Generated Spatiotemporal Visualization

Dejan Grba

Study 7/0 project visualizes the positioning errors generated by a static GPS receiver. Motivated by the idea of cognitive mapping as an individual, non-linear and discontinuous spatiotemporal experience, the project explores error and imperfections as generators of interesting conceptual, and narrative source material for further creative processing and expression unlike typical glitch art where the error is an aestheticised frontline layer. [4] *Study 7/0* is a concise study of the effective approaches to emergence in generative art in which the simple initial settings of a system can produce complex and surprising phenomena. [5] In this context, it is spatiotemporal configurations and relations.

Placing a Garmin GPSmap 60Cx receiver on my desk, I turned it on with a *draw track* function, and kept it there powered on for 7 days, 7 hours, 16 minutes and 11 seconds (from 7 July 2010 04:46:36PM to 15 July 00:02:47AM). While the ideal GPS plot for an immovable object is a single point, this setup had recorded 8438 trackpoints on a path 34.7km long, covering an area of 2.1km^2 with average speed of 0.2km/h and maximum speed of 17.9km/h. The path is a consequence of the limited precision of a commercial GPS receiver working inside a building under changing weather conditions, combined with the general GPS inaccuracy. With time-stamps, horizontal positions, altitudes and speeds for all trackpoints, the path constitutes a large dataset.

In the initial iteration I animated the horizontal positions (lon/lat), speeding up the 630,971 seconds of real-time record into 4 minutes and 41 seconds (281.26 seconds at 30fps). The first animation isolates the current 2.25% (780m) of the whole path, revealing the complex dynamics of error-generated motion. The second animation follows the current 2.25% building up into the complete path. Each animation displays the numerical values from the dataset.

With Philippe Kocher from Zürcher Hochschule der Künste, I am working on a 3D animation with sound, in which a circle spline will be extruded along the GPS path into a NURBS tunnel. The tunnel inner surface will have a 100% (mirror) reflectivity while the material will have a degree of one-way transparency so the inside will be illuminated from a rig of external light sources. The point camera will be animated along the GPS path in a subjective point of view, [6] [7] at the speed and acceleration dynamics of the GPS-error-generated data. The animation will be sped up from its real-time record to approximately 5 minutes of running time. The combination of tunnel's self-reflectivity and transparency with subjective POV will produce complex visual dynamics referring to the idea of an environment that challenges its own material and visual reality. [8] Philippe Kocher is developing granular synthesis algorithms for the sonic layers in which the altitude will be a specific generative parameter interacting with the luminochromatic values registered by the point camera.

The Running Nude: Narrative Mistakes of a Generative VR Experience

Vladimir Todorović

The Running Nude is a generative VR experience inspired by the early chronophotographs of human body in motion. It renders a running nude figure in a 3D game engine by making use of generative storytelling, machine learning and invasive effects that the VR experience can have on users' perception. Numerous artworks and approaches that are referenced and appropriated in this work include dadaist poetry, Queneau's literature influenced by mathematics, Duchamp's *Nude Descending a Staircase, No. 2,* and Mamoru Oshii's *Ghost in the Shell*. The core narrative aspect of the project consists of stories created by tinkering with the recurrent neural network (RNN) *Neural Storyteller*. This machine learning system is trained to write a romantic story based on an image that it analyzes [9]. Multiple stories generated by this creative machine were used as voice over whispered in the style of Autonomous sensory meridian response (ASMR) recording. The generated narratives sound like fragmented memories of the running nude. This element of the project also functions as a layer of the digital VR world capable of piercing transversally the membranes of physical reality and that way making this artwork permeable. By using pseudo-random functions, the system determines and generates the music, sounds, points of view, as well as the flexibility and properties of the nude's animation rig/skeleton. Orchestrating and controlling these elements with random logic, as well as enabling the system to make creative decisions, unveil the Frankensteinesque nature of the created character and the whole project. Its overall narrative architecture enables users to observe the running nude, to become one, and to experience traversing through nudes' ghostly figures and imprints located inside the 3D digital world. These visceral encounters connect the VR experience with the early beginnings of film and experiments conducted by Étienne-Jules Marey and Eadweard Muybridge.

On Consciousness, Memory, and the Role of Art in the Era of VR & AI Maturity

Melentie Pandilovski

Henri Bergson claimed that we have to change our way of thinking when facing new objects: "The idea that, for a new object, we might have to create a new concept, per-

haps a new way of thinking, is deeply repugnant to us." [10]

Memory has resurfaced as an important concept. Although much has been achieved with Analytical, Human-inspired, and Humanized Artificial Intelligence the loss of memory in AI can be treated as catastrophic and represents a big hurdle in the development of AI. For Vilem Flusser in the first phase of manipulating information we deal with creation or production of information, and in the second phase with the deployment of memories with the aim of storing them. [11] Flusser emphasizes two significant aspects of the technical image: its capacity for memory and its mathematical logic.

For McLuhan, the nature of media determines the nature of society. He writes, "[o]nce a new technology comes into the social milieu it cannot cease to permeate that milieu until every institution is saturated." The Tetrad, or Four Laws of Media, according to the McLuhans, refers to enhancement, obsolescence, retrieval, and reversal. McLuhan notes: "[v]ideo related technologies must produce a form of psychological death for all mankind [sic] by separating it permanently from the natural order, the book of nature, through narcissus-like self-involvement" a conclusion reached by McLuhan operating on three analytical levels at once: the perceptual, the historical, and the analogic. [12]

Thomas Metzinger draws attention to the fact that we do not know what the psychological consequences of the use of VR will be and emphasizes the risks of depersonalization after extended immersion in virtual environments, as well as to the need to study its long term effects. [13]

Antti Revonsuo points out how conscious experience exactly is a virtual model of the world, a dynamic internal simulation, which in standard situations cannot be experienced as a virtual model because it is phenomenally transparent—we "look through it" as if we were in direct and immediate contact with reality. [14]

The Meaning of AI Art Following the Challenges of Artificial General Intelligence

Paul Boyé

Artificial general intelligence (AGI), or the notion of a computational system that is operational at the level of human intelligence, could be tentatively posed as the central concern for modern machine intelligence engineering. Qualities such as natural language processing, representation, teleological consciousness and the execution of judgements, if incorporated by an AGI system would not only level the system with the human, but would additionally secure an 'outside view', producing a schism between experience and its exterior. [15] The agents of this system, emerging out of a history of human-bound conceptions, now self-conceive their own practical movements, guided by intelligence-qualities and ideas semantically bound to statements of what intelligence is, and what the agents ought to do to make changes. In this sense, the 'artificial' in AGI is not merely indicating the system's status as the artifice of a human engineer, but is the apprehension by the system itself of its own artificiality; the ability to make oneself the artefact of one's own ends, intelligently crafting worlds exterior to any human-bound construction of concepts.

Although it is widely understood –by organizations such as OpenAI [16] and the Machine Intelligence Research Institute – that AGI development projects are more or less in their infancy, the constructive potential of AGI has challenged the supposed substantiality of many human-oriented semantic systems. It is as if the potential what AGI systems and their agents could do has altered the interactions of meaning-generating language in its actual performance. This paper will be considering this point by examining the semantics of contemporary art – how value is secured through stating the putative meaning of a given work – and how this has been challenged following the use and response of artists to AI computation. For instance, the Paris-based collective, *Obvious,* has used Generative Adversarial Networks (GAN) to produce images based on classical family portraiture, genre-mashing and algorithmically collapsing several epochs, styles and materials into a single material expression. Their *Portrait of Edmond de Belamy* (2018) was controversially placed and sold through a Christie's auction [17], raising questions on how the works were valued. It could be argued that the absence of author, expression and creativity – or the value of a work of art vis-à-vis the market – demands that the work needs to argue for its value in a different manner. This paper will explore this contentious ground as an analogue to the philosophical implications of AGI – between human-bound creative intelligence and the exterior-general edifice of future AGIs; how they might produce meaning and subsequent disruption, error and manipulation of the standard rules determining the value of art.

References

[1] Jonathan Raban, *Soft City* (London: Hamish-Hamilton, 1974), 2.

[2] Holly Willis, *Fast Forward: The Future(s) of the Cinematic Arts* (New York: Columbia University Press, 2016), 109.

[3] Krzysztof Wodiczko, *Critical Vehicles: Writings, Projects, Interviews* (Boston: MIT Press, 1999).

[4] Tim Barker, "Aesthetics of the Error: Media Art, the Machine, the Unforeseen, and the Errant," in Mark Nunes, ed. Error: Glitch, Noise and Jam in New Media Cultures (New York and London: Bloomsbury Academic, 2012), 42-58.

[5] Dejan Grba, "Get Lucky: Cognitive Aspects of Generative Art," (paper presented at the XIX Generative Art Conference Proceedings, 2015). XIX Generative Art Conference Proceedings (Venice: Fondazione Bevilacqua La Masa), 200-213, http://dejangrba.org/lectures/en/2015-get-lucky.pdf

[6] Peter Kogler, "Untitled (Ohne Titel) (1993)", Peter Kogler website, accessed April 15, 2019, http://kogler.net/ohne-titel-

computeranimationprojektion-zusammenarbeit-mit-ati-hagenberg-1993

[7] Gerhard Mantz, "Nirmala (2013)", Gerhard Mantz website, accessed April 15, 2019, http://www.gerhard-mantz.de/3d/nirmala-anim.html
[8] Vladimir Todorović, "Reflections (2003)", Mega.nz repository, accessed April 15, 2019, https://tinyurl.com/y9sybg3n
[9] Kiros, Ryan, Yukun Zhu, Ruslan R. Salakhutdinov, Richard Zemel, Raquel Urtasun, Antonio Torralba, and Sanja Fidler. "Skip-thought vectors." In Advances in neural information processing systems, pp. 3294-3302. 2015.
[10] Bergson, Henri. 1944. Creative Evolution. New York: Random House.
[11] Flusser. Strohl, Andreas (2004), ed. Villem Flusser: Writings. University of Minnesota Press, Minneapolis
[12] Marshall McLuhan and David Carson. 2003. The Book of Probes, editors, Eric McLuhan and William Kuhns. Corte Madera, CA: Ginko Press.
[13] Metzinger, Thomas K. 2018. "Why Is Virtual Reality Interesting For Philosophers?". Frontiers in Robotics and AI 5.
[14] Revonsuo, Antti. 1995. "Consciousness, Dreams and Virtual Realities". Philosophical Psychology 8 (1): 35-58.
[15] Reza Negarestani. *Intelligence and Spirit*. (London: Urbanomic, 2018), 95-97.
[16] OpenAI, "OpenAI Charter", OpenAI website, accessed April 12, 2019, https://openai.com/charter/
[17] Christie's, "Is Artificial Intelligence set to become art's next medium?", Christie's website, accessed April 12, 2019, https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx

Authors Biographies

Paul Boyé is a writer and artist based in Boorloo (Perth, Western Australia). His research investigates the interface between media and intelligence, functionalist accounts of semantic content, new materialist philosophy and future-oriented political constructivism. He is currently a PhD Candidate at the University of Western Australia, writing on the contemporary artistic responses to the philosophy of Quentin Meillassoux.

Kristy H.A. Kang is a practice-based researcher whose work explores narratives of place and geographies of cultural memory. She is Assistant Professor at the School of Art, Design and Media at Nanyang Technological University, Singapore. Her research interests combine urban and ethnic studies, mapping, animation and emerging media arts to visualize cultural histories of cities and communities. She is currently developing a project with the Urban Redevelopment Authority mapping the spatial narratives of Singapore's ethnic communities. Her works have been exhibited internationally and received awards including the Jury Award for New Forms at the Sundance Online Film Festival. She was co-organizer of an international symposium on mediated public space "Emergent Visions: Adjacency and Urban Screens" (http://www.emergentvisions.org) and her article "Interfaces and Intentionalities: Adjacent Practices of Urban Media Art in Singapore" will be published in a forthcoming special issue on Urban Interfaces in Leonardo Electronic Almanac.

Dejan Grba is a media artist, author and educator. He has exhibited, curated and/or lectured at venues including ISEA Manizales and Hong Kong, SIVA Shanghai, SU Syracuse, SIGGRAPH Los Angeles, ZKM Karlsruhe, IFA Berlin, GfZK Leipzig, Montevideo Amsterdam, MiP Vienna, <rotor> Graz, MoCA Novi Sad and Belgrade. He has published papers in new media art journals worldwide. He is currently a visiting associate professor at the School of Art Design and Media, Nanyang Technological University in Singapore. He is a founding chair of the international interdisciplinary MA program The Art of Digital Media at University of the Arts in Belgrade, and a founding chair of New Media department at the Faculty of Fine Arts in Belgrade where he teaches Transmedia Research. He teaches Poetics of Digital Art at Digital Art doctoral program at University of the Arts in Belgrade.

Vladimir Todorovic is a filmmaker, new media artist and educator. He works with new technologies for immersive and generative storytelling. His projects have won several awards and have been shown at various festivals, exhibitions, museums and galleries including: HANIFF, Cottbus (28th), Visions du Reel (49th, 46th, 44th) Cinema du Reel (37th), IFFR (42nd, 40th and 39th), Festival du Nouveau Cinema (42nd), BIFF, SGIFF, L'Alternativa, YIDFF, Siggraph, ISEA (2008,2006), Ars Electronica, Transmediale, Centre Pompidou, The Reina Sofia Museum(Madrid), and Japan Media Art Festival.

Dr Melentie Pandilovski is an art theorist/historian/curator. He deals with examining the links between art-culture, science-technology. He is Director of Riddoch Art Gallery. He has curated more than 200 projects in Europe, Australia, and Canada: Stelarc's *Contestable Bodies – Alternate Anatomical Architectures*; *Inaugural International Limestone Coast Video Art Festival*; *The Rise of Bio-Society*; *Age of Catastrophe*; *Toxicity, Marshall McLuhan & Vilém Flusser Communication&Aesthetics Theories Revisited*; *Biotech Art-Revisited; Skopje Electronic Art Fair (SEAFair)*. He is author of *The Rise of Bio-Society* (2019) Palgrave MacMillan; *Arts & Science – the Intersection (re)engineered* in: "A Companion to Curation", Wiley Blackwell (2019); *The Phenomenology of (Non) Habitual Spaces for the Bioarts* in: "Naturally Postnatural—Catalyst: Jennifer Willet", with Catalyst Book Series (2017). He has edited *Marshall McLuhan & Vilém Flusser Communication & Aesthetics Theories Revisited"*(2015); *Energy, Biopolitics, Resistance Strategies and Cultural Subversion* (2012), The Apparatus of Life and Death (2011), *Art in the Biotech Era* (2008).

Electronic Art Archives Platform, A Round Table Discussion

Wim van der Plas
ISEA Online Symposium Archives, ISEA International Advisory Committee
Rotterdam, The Netherlands
wim@isea-web.org

Abstract

This panel session is a continuation of an initiative taken at ISEA2018 in which a roundtable of practitioners and academics from around the globe participated in the discussion. The topics for this panel include the continued discussion of: (1) how to equitably, comprehensively, and legally capture the content of past symposia, exhibitions, and performances and (2) co-operation of existing online electronic art/new media archives for the purpose of creating a comprehensive archive. As well as these issues the meeting identified other critical topics including:

- institutional and electronic hosting
- funding, grant writing
- development of archive toolkit
- standards for archive inclusion (difference in value systems for art and science)

The aim is not to solve all these questions, but to bring co-operation (and implicitly, the work on these issues) a step further..

Keywords

Electronic Art, Media Art, Archives, Co-operation, Platform, Research.

Background

ISEA has been in existence since 1988. Due to the nomadic character of the symposium, an accessible central archive has never been maintained, until recently. The Online ISEA Symposium Archives, still in development, now contains the abstracts, artist and workshop statements, as well as the proceedings, catalogues, and programmes of all 24 symposia so far organised, as far as they were available.

The panel session aims for the co-operation of all existing online electronic art/new media archives. This is a continuation of an initiative taken at ISEA2018, where a roundtable on the same subject was organised. The participants of that meeting were the following persons: - Bonnie Mitchell (USA), Ohio State University, ISEA online Symposium Archives & ACM SIGGRAPH Digital Art Archive - Thomas Asmuth (USA), Digital & Experimental Media, University of West Florida - Shamsher Virk (USA), ZERO1 Biennial - Stahl Stenslie (NOR), Art & Technology at Aalborg University, Denmark. Represents several Norwe- gian archives - Pat Badani (CAN/USA), New Media Caucus & ISEA International Board - Diana Dominguez (BRA), Universities of Brasilia & Campinas - Mike Phillips (UK), Director of Research at i-DAT, Plymouth University & ISEA Int. board member - David Doe, (ZA) Ph.D. student robotics, Durban University of Technology - Annet Dekker (NL), Media Studies: Archival and Information Studies, Universiteit van Amsterdam - Paul Hagen (USA) environmental scientist and agronomist focusing on sustainability issues - Wim van der Plas (NL), ISEA Online Symposium Archives Unable to attend, but also involved: - Jose-Carlos Mariategui (PER), director Alta Tecnologia Andina, representst Latin-Amercan archives - Miguel Carvalhais (PT), University of Porto - Sophie-Carolin Wagner (AT), artist and researcher. - Pablo Gobira, Brasil, Full-time professor State University of Minas Gerais

The conclusions of the 2018 meeting were the following:

- We need to connect
- The discussion needs to be extended and continued
- We need to find servers
- An API needs to be written Actions (for all)
- Extend inventory of related archives,
- Find names of contact persons
- Send links to relevant articles & use cases

Since the meeting at ISEA2018, many more relevant archives have been identified. For the panel, all the before mentioned participants and interested persons will be invited, as well as representatives of the other archives we identified. These include:

- unesco.org/archives/multimedia/
- Documenta, specifically their media archive
- Leonardo
- Digital Art Museum
- ZKM
- Bremen University:
- Museum Computer Network, since 1967
- International Conference: Digital Art History − Meth ods, Practices, Epistemologies, Zagreb.
- newmedia-art.org
- ARCHIVES HUB
- archivesportaleurope.net
- AAA: Archiving As Art
- EAI. Founded in 1971, Electronic Arts Intermix
- V2, Rotterdam
- LIMA, Amsterdam

The organizers and recruiting participants to attend in Korea, but will include some participants via remote connections to create a broad spectrum of stakeholders. The meeting will be prepared, so the agenda can be actualized even at the last minute. For the time being the agenda is clear from the above-mentioned conclusions. Other topics that emerged in our first meeting were, among others:

- Difference in value systems for art and science
- Upload Your Own
- Toolkit creation
- Tagging
- Use cases
- Funding.

The aim is not to solve all these questions, but to bring cooperation (and implicitly, the work on these issues) a step further.

Bibliography

Wim van der Plas studied Social & Cultural Sciences at the Erasmus University Rotterdam. After that he was director of the Foundation for Creative Computer Applications (Rotterdam) that initiated the First International Symposium on Electronic Art. He organised the first, second and seventh ISEA symposium and co-ordinated the continued occurrence of the symposia. After leaving the board of ISEA International in 2017, he is the archivist for the Online ISEA Symposium Archives and chair of the ISEA International Advisory Committee.

Panel: Interactive Arts for Digital Natives

Stahl Stenslie, Peter Lee (Nolgong), Charlotte Blanche Myrvold, Cecilie Lundsholt
Arts for Young Audiences Norway (AYA)
Oslo, Norway
Contact Email: stahl@kulturtanken.no, hello@nolgong.com, cbm@kulturtanken.no, cecilie@teatretvart.no

Abstract

Digital technologies have not just changed the world, they are increasingly impacting children and youth all over the world. Childhood, learning and upbringing have changed dramatically over the last decades. And it is not going to stop. As UNICEF puts it, "*digital technology is an irreversible fact of our lives*". [1] Yet we experience a Digital Gap between the adult generation born before the Internet and the Smartphone - and those born after, the so called Digital Natives born after 2000. How to bridge this gap and include the younger generations into the field? What forms of electronic art speaks to Digital Natives today? How to include electronic art works in schools? The panel on *Interactive Arts for Digital Natives* discuss these and related questions. It is composed by an international expert group and will be led by Arts for Young Audiences Norway (AYA).

Keywords

Digital art in schools, Digital natives, education, digital shift in culture, interactive art

Introduction

Digital technologies have not just changed the world, they are increasingly impacting children and youth all over the world. Childhood, learning and upbringing have changed dramatically over the last decades. And it is not going to stop. As UNICEF puts it, "*digital technology is an irreversible fact of our lives*". [1] Yet we experience a Digital Gap between the adult generation born before the Internet and the Smartphone - and those born after, the so called Digital Natives born after 2000. This generational gap is problematic, posing challenges such as discommunication due to different competencies and naturalized technologies, and, worse, even silence. While the Smartphone is the digital tool Norwegian children use the most, it is also what we talk least about to our kids. [2] Where the adult generation sees only a screen, the Digital Natives experience reality. An important challenge is therefore how to

Figure 1. Children using HoloLens to immerse themselves in interactive AR models of cultural heritage sites modelled in Minecraft.

grapple with the emerging digital habits of children, understanding how these habits influence and transform how children and youth perceive, approach and interact with contemporary artistic and cultural forms. The one arena where all children and youth can be gathered and experience art is within schools. Bringing arts and culture into the framework of schools and primary education is a strong field in Scandinavia and of growing importance internationally. *Arts for Young Audiences Norway* (AYA) focus on young audiences. Given the digital shift on arts and culture, AYA current main focus is on how interactive arts are experienced and used in schools.

The panel on *Interactive Arts for Digital Natives* discusses these and related questions. It is composed by an international expert group and will be led by AYA.

Panel member #1: Cecilie Lundsholt

Cecilie Lundsholt is artistic director of the regional state funded theatre "Teateret Vårt" (Our Theatre) in Norway, responsible for the repertoire aimed at audiences from zero to eighteen years old. [3] During the years from 2016 till 2018, the theatre has been a partner in an EU-project exploring the intersections between theatre and new technology. In this period, she has produced and co-produced

seven theatre productions for children, teenagers and young adults, utilizing digital technology as a theatrical tool in a variety of ways. She has been developing new creative content and experimenting with both genre and form according to the new affordances made possible by technological innovation. Considering the social and political issues raised by technology, she asks how its application to the theatre may enable theatre to speak more directly to young people today. For example, as an educational material accompanying her latest production, an online game was developed that allows the audience to explore the theatre production thematically by a first person interactive game experience. In her panel presentation, she will present a selection of works, discussing challenges and benefits of employing digital media in theatre productions for young audiences.

Panel member # 2: Peter Lee
will present the Nolgong Theater from Korea and their two interactive theatre projects: [4]

1: <**Being Faust: Enter Mephisto**>: an interactive and electronic theater where participants become a Faust and make his or her own deal with the devil.

The project has been traveling around the world to over 10 different cities. Here are two samples.

- Being Faust at Vilnius
  https://vimeo.com/141516162

- Being Faust the full Show
  https://vimeo.com/218430100

2: <**Wallpeckers - From The DMZ to The Berlin Wall**>
Before physical walls to come down, we must tear down the wall in our heart.

The participant become a special reporter to complete the news from 70 years of German division and unification and North & South Korea.

The game gets to be played in physical locations in Berlin and Seoul.

- Final play testing session
  https://vimeo.com/302300098

Panel member #3: Charlotte B. Myrvold
will present the electronic media art project FoNT (Dissemination Models and New Technology)

The AYA's R&D department's FoNT project, is a direct response to the pressing need to develop new models of art dissemination fit to meet children and young audiences fostered in a digital reality. [5]

Its aims are threefold; responding to the needs and expectations of the digital natives, innovating art educational formats and bringing together technical, artistic and educational forms of competence.

Working with a variegated range of art forms, the project's focus point is on the individual pupil's experience. We give dedicated attention to the situation created around an artwork. What forms of interaction are made possible both socially between pupils and with the art object or performance. Which mode of experience are made accessible for the audience; co-creation, play, dialogue, or contemplative silence?

Our particular interest with new technology comes out of curiosity with regards to how it affects the situations around art and the modes of experience offered to young audiences. The philosopher Jacques Rancière offers an optic to comprehend how experience does not only rely on phenomenological and cognitive abilities. [6] In his theory on the distribution of the sensible demonstrates how the sensible is divided into time and space, as well as positions from which one sees, or is sees, and hear or is heard. He demonstrates that the sensible is experienced and accessed differently according to class, but age will also determine how one partake in the sensible.

The olden days' saying - children should be seen, but not heard - is just one among many examples of how society structures children's access to forms of sensibility. Traditionally, in relation to art, maybe visual art in particular, children have been expected to restrain from intuitive modes of experience such as play, movement, manipulating objects, and asking questions, for the benefit of patience, silence and stillness.

Figure 2. Children interacting with interactive AR models of cultural heritage sites modelled in Minecraft.

New technology changes the premises for how children can interact with art. Virtual objects and 3D prints render possible interaction and manipulation of objects. Interactive apps and game structures infuses the experience of art with playfulness and new social dimensions. The contemplative and subjective interpretive mode, the ideal in the modernist paradigm, is now challenged. However, it is not our ambition to replace one mode of experience with another, our projects are run with the intention of contributing to the unfolding of a rich diversity of possible situations around art. Nevertheless, we work with an audience-centered perspective, attempting to stay attuned to children and young people's cultural praxis and the innovative potential of new technology.

Panel member #4: Stahl Stenslie
will head the panel and is the director of R&D at *Arts for Young Audiences Norway (*AYA*)*, the Norwegian Ministry of Culture's agency owning the national responsibility for *The Cultural Schoolbag* (TCS) program. [7] Together with all county municipalities and municipalities, schools and all fields within arts and culture, *Arts for Young Audiences Norway* wishes to open doors to the arts, to culture, and to the future for all children in Norway.

To fulfill this task *The Cultural Schoolbag* (TCS) was established in the early 2000's as a nationwide program and the centerpiece of the government's policy for bringing culture to children and young people. *The Cultural Schoolbag* secures that all children growing up in Norway have access to professional art and culture – spanning literature, music, visual arts, performing arts, film and cultural heritage.

The program is ambitious and far reaching. Several times a year, 3300 schools, including 830 000 school pupils all over Norway are visited by professional musicians, writers, theatre companies, dancers, artists and other cultural producers through *The Cultural Schoolbag.* The explicit political aim is to provide all children living in Norway with a shared frame of reference and joint experiences, irrespective of their nationality, address, wealth and social background. It is held that artistic and cultural expression can transcend norms, languages and social identities, and in this way, be a force for democracy that ideally can be felt far beyond our national borders, reaching out into the world.

While *Arts for Young Audiences* is an agency of the Ministry of Culture, it also works very closely with the Ministry of Education and Research, which is responsible for the institutions where TCS is implemented, namely the schools. In addition to being responsible for TCS, *Arts for Young Audiences* will provide advice and other services to the central government authorities involved in the culture and education sectors, thus helping to establish a political framework and working to improve national initiatives.

References

[1] UNICEF. (2017). *The State of the World's Children 2017: Children in a Digital World*. https://www.unicef.org/publications/index_101992.html Downloaded 9.1.2019

[2] Children and Media 2016 (2017) Medietilsynet. http://www.medietilsynet.no/globalassets/publikasjoner/barn-og-medier-undersokelser/children-and-media-2016-english-summary.pdf

[3] https://www.teatretvart.no/

[4] http://www.nolgong.com

[5] https://www.kulturtanken.no/

[6] Rancière, Jacques (2013) The Politics of Aesthetics. A&C Black.

[7] https://www.artsforyoungaudiences.no/

Curating Games in the Asia Pacific Region

Hugh Davies
RMIT, Australia

Kyle Chung
City University of Hong Kong

Yang Jing
Universität Heidelberg, Germany

Panel Abstract

Videogames are rapidly becoming a major medium of contemporary art. As videogames move into the popular and conceptual mainstream with exhibitions occurring at major international spaces, how are the complexities of this new medium playing out among arts workers, collectors and the spaces in which games are exhibited? More specifically, how are curators, artists and institutional spaces within the Asia Pacific region responding to the opportunities and challenges posed by videogames in arts practice? Are best practices being adopted from US and European models, or, given the Asia Pacific's standing as the largest producer and consumer of videogames, and recognising its long history of videogame art from exponents such as Feng Mengbo and Cao Fei, are distinct and region-specific trends emerging? This panel considers future and present practices in the curation of contemporary videogame art.

Keywords

Videogames, Game Art, Curatorial Practice, Archiving, Media Art, Exhibition,

Introduction

Although artists have been working with videogames as medium for decades, only in recent years have we witnessed an explosion of videogame exhibitions in gallery and museum contexts. No longer simply nostalgic surveys in game arcade formats, the contemporary curation of videogame exhibitions is approached with aesthetic deliberation and conceptual rigor. This remains true even when the games exhibited are produced by non-identifying artists and for commercial contexts. With the Asia Pacific constituting the largest videogame region of in terms of production, consumption and income generated, how are videogames differently understood, curated and exhibited in this part of the world? To what extent are regional differences specific to the Asia Pacific needing to be accounted for? This panel examines the distinct features of videogame art and its curation and presentation in the Asia Pacific Region. Fields of discussion will take place under the following headings.

Defining Videogame Art

What is Videogame art? How is it different to media art? What are its boundaries of practice? In a 2005 article titled *Art Games as Genre,* digital arts writer Kristine Ploug provides a crucial definition of videogame art noting that: "art games are neither addictive nor meant to be played over and over [1]. In the introduction to *Gamescenes: Art in the Age of Videogames,* artist and academic Matteo Bittanti defines game art as works "in which digital games played a significant role in the creation, production, and/or display of the artwork" [2]. For art critic Lana Polansky, game art constitutes conceptual works that treat games not as a form, but as raw material [3]. While most agree that works of game art are produced by artists specifically to be pieces of art, some works have ulterior motives —social or political [4] — and yet others are merely a playful piece of interaction. But what makes them art and not just games? Can it all be boiled down to intention, originating either from the curator or the artist. And to what extent do the largely western definitions of videogame art hold true across Asia? Are these frameworks accurate or useful in the full context of the Asia Pacific region?

Game Exhibitions

In attempting to embrace videogames as cultural practice, many GLAM (Gallery/ Library/ Archive/ Museum) institutions have simply brought the videogame arcade into the building. Yet such exhibitions tend to lack context about the games they feature. Examples include *Power UP: The ultimate gaming experience* (2017), at the Science Museum, London, UK, and Video Arcade (2017), New York, USA. More considered exhibitions make an effort to include the social, cultural and technological background of games by combining fashion, design and media archaeology. These exhibitions tend to involve historical surveys of computer games spanning the early 1970's to the present. Examples include *Game On*, 2002 – 2016, presented at multiple locations globally, Game Masters. 2012 – 2015, multiple locations globally, and *Pong to Pokémon: The Evolution of Electronic Gaming*, 2017, Bullock Museum, USA. Yet, these

listed examples are limited to the industrial design and history of video games. Some of the best exhibitions of videogame art combine arts practice and musicological survey to provide a deeper and more tactile understanding of both games and play. In these contexts, games can be understood as powerful and enduring culture artefacts. What ways might curators present games in exhibition spaces? as playable artefacts? as objects in display cases? as design practice? Or as code?

Game Art Versus Videogame Industry

Although often highly imbricated, the relationship between commercial videogames and conceptual game art is not without problems. Games are big business and developers create games to attract audiences for purposes of entertainment and profit. While largely operating under a different set of motivations, the practices of game artists often cannibalize content, concepts, software and hardware from their industry-based counterparts. Of course, such relationships are not binary, with many game artists also producing commercial videogames and vice-versa, such that concepts and content that emerge from domain of practice may feed back into the cycles of the other. Indeed, many commercial videogames are exhibited as art and many games art works have become commercially successful. As artist and scholar Mathias Fuchs writes in 2005, the motivation of the game artists and the art domain more broadly are different to the commercial or industrial impulses. "The art world seeks to find new media and new platforms of artistic discourse, explore new ways of making art, and also includes a large number of people dedicated to education, criticism and preservation of what has been made to date. Aesthetic innovation through social discourse and examining popular issues are a major driving force in the art community" [4]. To what extent are videogame art and the videogame industry connected? Do these connections impact the reputation of game art?

Exhibiting Videogame Art in the GLAM Sector

Presenting game art, or media arts in general, within large institutional spaces in the Gallery, Libraries, Archives and Museums (GLAM) sector brings an array of stakeholders and factors that curators must juggle. Many of these challenges stem from the lack of literacy around games. As relatively new medium with a large commercial impact, awareness and acceptance of its validity as a cultural form is often in question. These manifold challenges often compromise the vision or intent of curators and the experience of visitors. For example, GLAM institutions may anticipate game exhibitions to bring high attendance because they are thought to be "audience friendly"; marketing departments may frame game art in commercial or popular media terms for general accessibility; general audiences may be expecting game art to be entertainment-driven; critics and journalists may expect to read an artwork/exhibition the same way as they would for other screen based or contemporary art forms. How can videogames be presented with attention to design histories, conceptual rigor and their standing as cultural practice? How might game art curators and practitioners increase the literacy of institutional stakeholders across the GLAM sector toward the critical positioning of game art? What is the role of the museums and galleries in framing games? Does game art require a different set of interpretation skills to previous mediums?

Videogame Art in the Contemporary Art Market

Videogame art does not enjoy the same profitability or reputation in the commercial art world as more established mediums. In turns, most gallerists in contemporary art world would rather not carry the high risk of representing game art practitioners because as commercial products. Game art is often perceived as challenging to exhibit, comprehend and, in-turn, difficult to sell. In addition, many collectors simply do not have the literacy to know how, nor the motivation to learn. From the artist's perspective, when their work doesn't sell as well, they will often keep their game art practice separate, showing only in festivals while making artworks in more traditional medium to sell within commercial galleries. Is there a commercial market to game art, or a pathway to creating one? To what extent should these motivations shape the context and trajectory of game art practices? Are there established solutions in other related domains? What, for example, can game art makers, curators and collectors learn from earlier screen practices such as video art and interactive media art?

Collecting and Archiving Game Art

Curatorial concerns such as how games are collected and archived are becoming pressing interests for screen museum collections and give rise to a multitude of questions and uncertainties. In being attentive to the material past of game objects, to what extent should archivists maintain an integrity of game platforms and equipment such as screens, consoles, and operating systems? These questions are complicated by the rapid and designed obsolescence of game technologies. With many games being platform specific, and as commercial game platforms suffer redundancy, what policies and approaches should be taken toward the archiving and preserving of videogame art? Should the physical electronics of game platforms be collected and preserved as readily as the artworks they house? Is the ephemerality of game art to be overcome or to be embraced? What efforts can archivists make when it comes to preserving the authenticity of the game artwork? What is lost and gained when a game art work is transmitted from one platform to another? Who should make these decisions; game historians; academics; curatorial staff, or game artists themselves? Given the impact that the modes of consumption and rapid obsolescence that videogames command, to what extent should these issues be taken-up by game artists and the museums that house them?

Cultures of Play in Asia Pacific Region

In terms of games as cultural practice, are there distinct pan-Asian game art tendencies and aesthetics worthy of specific attention? Certainly, cultural exchange has typically developed in the wake of trade routes and strategic alliances.

Today, as in the past, various Asian and Asia Pacific nations look to each other for economic opportunities and pathways. For example, the internationalization of Japanese contemporary art in the late 1980s, followed by Korean and then Chinese art in the mid-1990s fueled the Asian contemporary art cross-cultural dynamic [6]. Broadly speaking, the trajectories of videogame popularity and understanding have followed a similar period and pattern of growth – from Japan outwards, and while China is currently recognised as the fasted evolving videogame economy, South East Asian nations are understood to be quickly developing their own distinct videogame vernaculars [7]. Given historical, cultural and contemporary economic affinities between these countries, are there distinct cultural nuances in the geo-political space of the Asia Pacific region?

Acknowledgements

Special thanks to the anonymous reviewers and to Nhung Walsh for her feedback on versions of this document.

Author Biographies

Hugh Davies

Hugh Davies is an artist, curator and postdoctoral research fellow at RMIT exploring game cultures in the Asia Pacific region. Following recent fellowships at Tokyo Art and Space, M+, and the Hong Kong Design Trust, Hugh curated the Longitude Exhibition of Asia Pacific Games and Play in 2018. Previously he was senior lecturer within the Media: Screen + Sound program at La Trobe University and co-director of the Centre for Creative Arts. With extensive exhibitions and curation of game and play based art in Australia and abroad, Hugh has also operated as Board Chair of both the Australian Network for Art and Technology (2009 - 2011) and the Freeplay Independent Gaming Festival (2011 - 2014). Hugh remains on the Freeplay board of directors.

Kyle Chung

Kyle Chung is a Hong Kong based curator whose recent exhibitions explore the dynamics between technologies, materiality and human agency. Selected exhibitions include Ellen Pau: Time After Time Will Tell at 1961, Singapore; #YOU #ME #ourSELFIES at Hong Kong Visual Arts Centre; To Outland at SMAC, Berlin, Germany; Conjunctions and Disjunctions: Juried Exhibition of International Symposium on Electronic Art 2016, Hong Kong; Bright Shadow at The Morgue, London, UK. Chung was appointed as Co-Chair of Art Gallery at SIGGRAPH Asia 2018 in Tokyo, Japan; Jury of CynetArt International Festival in Dresden, Germany in 2016. Chung is currently Senior Research Associate in Centre for Applied Computing and Interactive Media, City University of Hong Kong; and House Curator at Videotage, Hong Kong.

Yang Jing

Yang Jing is a writer, editor and curator based in Hong Kong. Her recent exhibition *Video Game Cohabited* was held in OCAT Shenzhen and at Design Society Shenzhen, China. She is completing a PhD in Global Art History at the Transcultural Center of Heidelberg University, Germany. In addition, she manages the game channel of the online Chinese media outlet *Initium Media* as well as writing her own fiction column in Hong Kong's No.1 paparazzi newspaper outlet. Yang is interested in the social dimension of games and gaming culture within and beyond Chinese societies. Her recent adventures explore the intersection between games, DIY media in exhibition settings.

References

[1] Kristine Ploug, "Art Games as Genre**,** An introduction", *Dichtung*. 2005. Accessed on Jan 5, 2018 from: http://www.dichtung-digital.de/2005/2/Ploug/index.htm

[2] Matteo Bittanti, "Game Art. (This is not) A Manifesto. (This is) A Disclaimer," in *Gamescenes: Art in the Age of Videogames*, edited by Matteo Bittanti and Domenico Quaranta, 7-14. Monza: Johan & Levi Editore. 2009.

[3] Lana Polansky, "Towards an Art History for Videogames", *Rhizome.* 2016. Accessed on Jan 5, 2019 from: https://rhizome.org/editorial/2016/aug/03/

[4] Dean Chan, "Beyond the "Great Firewall": The Case of In-Game Protests in China", *Gaming Cultures and Place in Asia-Pacific*, London: Routledge, pp. 141–57. 2009.

[5] Mathias Fuchs, "Art Games - From an Artist's Perspective", *Artificial.dk,* December 31st 2005. Accessed on Jan 5, 2018 from: http://www.artificial.dk/articles/fromanartist.htm

[6] Deena Chalabi, "Expanding Asia: Field Notes From a Changing Cultural Landscape", *Arts Asia Pacific*. Accessed on Jan 5, 2019 from: http://www.artasiapacific.com/Magazine/81/ExpandingAsia. 2010.

[7] Cheryll R Soriano, Hugh Davies & Larissa Hjorth, "Social Surveillance and Let's Play: A regional case study of gaming in Manila slum communities", *New Media and Society*, 2019.

Bibliography

Alice Ming Wai Jim, "Mao goes pop online: Game art worlds in China", *East Asian Journal of Popular Culture,* 2: 2, pp. 247–265, 2016. doi: 10.1386/ eapc.2.2.247_1

John Maeda, "Videogames Do belong in the Museum of Modern Art", Wired Magazine, 4 December 2012. http://www.wired.com/2012/12/why-videogames-do-belong-in-the-museum-of-modern-art/. Accessed 1 December 2014.

Technologies as agents to Penumbras

Su Hyun Nam, Sanglim Han, Julieta Gil, John-Patrick Ayson

Syracuse University, Cheongju University, University of California – Los Angeles, State University of New York at Buffalo
Syracuse, NY, USA, Cheongju, Korea, Los Angeles, CA, USA, Buffalo, NY, USA
suhyunnam.s@gmail.com, dolphin@sanglimhan.com, julietagilg@gmail.com, johnpatr@buffalo.edu

Abstract

This panel undertakes a critical discussion on the altered agencies between the User, Viewer, research-based artist & praxis-led researcher. Various uses of VR, AR, A.I and other smart technologies are discussed by each panel member - particularly technologies that also act as vessels to occupy multiple hyperspaces.

As tools to maintain kinships with other-bodies, exo-spaces, exo-biomes, hyperobjects, speculative-histories, datafied atoms, the labor of using VR, AR, A.I & smart technologies should always undertake a deep meditation, in constant flux amongst a myriad microbiome, forever cemented in constant archeological reinterpretation, inhaling & becoming one with dust particles, while dancing with the data from its lunchtime, pre-snack bowl of yogurt.

Keywords

Affect Theory, Meditative Computation, Microorganisms, Hyper Objects, Datafied Artifacts, Algorithms, Altered Reality, Cognition, Computational Aesthetics, Concept & Theory, Immersive Media, Interactive Art

Introduction

How do VR, AR, Artificial Intelligence & other smart technologies alter & illuminate agencies w/our own bodies & objects around us? As users, viewers, social media personas, nation-state citizens, research-based artists, praxis-led researchers, university-level instructors, how do those technologies act as agents to penumbras b/w physical & digital spaces, meditation & consciousness, kinships w/ other-bodies, other objects, microbiomes, hyperobjects, artifacts, atoms & datafied food?

ONE: Meditative Computation

As digital technologies and Artificial Intelligences increasingly become integral staples of the cognitive ecosystems of humans, living & non-living beings, the traditional rule-driven approaches to computation limit our intricate relationship with technology. Contemporary philosophers and scholars in cultural and media studies argue the interconnectivity between "dividuals" and the compatibility of digital and biological information sharpen the focus on inarticulate intensities of tangible data. Since we can only witness the human-technology interaction on the surface first, some kind of interface second, we often disregard the fact that such interactions are much more complex & are occurring continuously, on various levels. However, I argue that the possibilities of the human's affective interactions with technology truly enable a mindful understanding of these relationships and promotes sustainable coevolution between humans and technology.

In the interconnected technological society, human intelligence and digital information together compose a huge portion of the cognitive system on the planet, and humans increasingly depend on digital memories, scientific data and artificial intelligence. As technology processes and analyzes a massive amount of data in a second and usually presents a readily readable result, nonlinguistic human experiences become relatively overlooked in our relationship with technology. However, a inclusive perspective and true understanding of both cognitive humans and nonhumans is at stake and nonlinguistic knowledge and mindful experience emerged from the interaction with technology deserves much further attention in the discussion on cognitive coevolution of human and technology. The advancement of artificial intelligence quickly adopts various models in cognitive science – including enactivism[1][2] that claims intelligent organisms engage with their surroundings. If we undervalue our own intricate and abundant experience in the relationship and interacting with technology from mechanism-oriented perspectives, we might end up falling behind in understanding our own experience. Therefore, in the inevitably intricate relationship with technical cognition, human cognition should be mindful of nonlinguistic experiences and affective forces, which resonate between different bodies of all beings – the conscious and nonconscious as well as humans and nonhumans.

A practice-based researcher in media studies is in an advantageous position to explore the complexities of the human-technology relationship in both experiential and theoretical ways. While creating a media artwork, I am a user of software, observer of human-machine interaction, and creator of digital media. Through my own art practice, I experience the intensities that flow between human and technology - and my research is initiated by my curiosity &

my own naïve questions about their relationship. With unorthodox approaches to technology and computation, I explore – both theoretically and practically – possibilities of affective relations with technology in their cognitive ecologies and address this subject in a non-verbal, non-spoken, experiential way through my art practice.

Figure 1. *Woven Milieu* (2012), Still Image from Video ©Su Hyun Nam

As a media artist, I often gain technical knowledge almost effortlessly through a creative process. My experimental video work, *Woven Milieu* (2012), recomposes hundreds of cropped videos of heterogeneous movements and relationships in urban spaces. While repeating technical tasks to create the project, I found myself absolutely immersed in the digital images and computational process, losing my sense of time, self, and reality – almost working like a machine. However, as the mechanical operations allow me to lose the central ego-self and habitual karmic pattern, the spiritual intensities and affective forces in my body are rather enhanced and the experience becomes meditative. In this way, the demarcation between technical being and myself is blurred and a huge portion of our interaction occurs nonconsciously[3].

My interactive installation, titled *Mediated Meditation* (2019), embodies the meditative digital experience to give audiences a sense of the selflessness and allows them to surmount the karmic relationship with technology. In this work, Herrigel's *Zen in the Art of Archery*[4] provides a conceptual framework because his experience of learning Zen with archery is analogous to the artist's mindful practice with technology. When drawing a bow, he attends to the flow of his breathing and waits for the highest tension with his arm and shoulder muscles remain relaxed to be mindful of the process and moment. The interaction in Mediated Meditation invites audiences to unlearn the habitual interaction with technology – rule-driven and logical approaches – and encourages them to be attentive to their mindful experiences and affective forces between the digital work and themselves.

Figure 2. *Mediated Meditation* (2019), Interaction Demonstration ©Su Hyun Nam

Such nonlinguistic and visceral forces cannot be fully analyzed and articulated only through theoretical research. However, the artists' affective experiences through the artmaking process not only diversifies research methods of investigating the human-technology relationship but also blurs the boundary between humans and nonhumans through the mindful understanding of different cognitive systems. By searching for affective possibilities in digital media, my work regards technology as a companion cognitive being rather than an intelligent machine of a merely algorithmic processor.

TWO: Endless Dining

Experiencing and Visualizing Body through Technologies

The way in which bodies are visualized in the field of science can be illuminating. Exploring our bodies through a scientific instrument, the microbes and cells are augmented and projected on a screen. It is a moment of experiencing being aware of the materiality of the human body as well as a sense of awe at the complex and delicate system we so often take for granted. All the material exchanges happening within the body are caused by constant biochemical interactions between each organism. Microbiome is an "ecological community of commensal, symbiotic and pathogenic microorganisms that literally share our body space"[5] and the microbial cells are ten times as many more than human cells[6]. Microbiome cannot be observed with bare eyes but exist very close to the body in certain presence and form, deterritorializing the strata of organism. On a microscopic level, individual identities become distinguishable not by the socially constructed categories such as skin color, sex, education level, or economic status but by the degree of intensity of microbial interactions and their effects. From this perspective, the notion of body

denotes an ecosystem of trans-species entanglement rather than a singular entity.

Microorganisms constantly enter into the body through food ingestion or contact with others. Sometimes microbes floating in the air penetrate through the skin. They are then let out again in the air or other ecosystems through excretion or contact. Looking closely at the diaspora of this microscopic world, it seems as if we are having an unending meal. At every moment, the body consumes and discharges small particles. These minuscule fragments that make up the body were once part of me, which left me and went adrift somewhere. Through this unending banquet, the body becomes transitional as a fluctuating domain where fragmented entities coexist.

The worries that are conventionally associated with eating — who do you eat with? Is it okay to double dip with someone with an illness? What generational, cultural norms do you follow on a dinner table? — is extended to the following questions: With whom can you share the surface of the body? What is this surface that we share with others? The shared bodies blur the boundaries of private realm. The constant migration of microbiome may bring us together or separate us.

As my artistic exploration, I construct these unending meals as a digital ecosystem. Microorganisms collected from myself, others, or somewhere in-between evolve into magnified images and 3D simulations. I create digital human figures and compose the virtual ecology around these bodies of representative species of human microbiome. Bacteria and fungi were reinterpreted and animated in the form of 3D polygons. The direction, speed, and collision factors of these microbiome species are determined by pre-programmed formulae. I code the motility of the virtual microbial cells against real-world physiology. They collide, bounce, and go through each other, merge with one another, and subtract from and reflect others. In this pluralistic and unpredictable disorder, innumerable variables are produced, and the structure is continually transformed. The virtual camera zooms in on the metaphysics of the 3D bodies and navigates this cybernated ecological community.

Figure 3. *contaminated* (2018), Installation View at Artspace O ©Sanglim Han

Sharing the boundary surfaces, the scattered 3D microbes constantly move according to variables, and their arrangement and relationship change. Each virtual cell have individual positions, breaking the homogeneous spatio-temporal order. The "virtual microbiome-body" is located between spaces separated by the binaries of center and periphery, territory and deterritorialization. Each particle is neither surplus that becomes "the other" in the dichotomy of the center and the periphery, nor the subject distinguished by the innate factors. Not the space itself formed by the accumulation of the virtual microorganisms, but the gap formed by the fragments—the boundary as space, and furthermore, the fluidity of the boundary caused by the movement of debris—matters. The traces through the confrontation of the differences are engraved on the screen. The virtual microbiome-body cannot be explained through analogies, but rather as an in-between existence: it becomes the intertwined structure and exists as a combination of the relational terms and as a trail of differences and changes. The virtual microbiome-body deconstructs our conventional way of perceiving the human form in represented images, suggesting a new aesthetic experience and a way of recognizing the world.

My investigation is reinterpreted in the form of 3D animations, experimental games, and installations where the audiences reenact a meal in an idiosyncratic way. Just like having dinner—constantly consuming other organisms, dismantling the bionomic environments of our bodies, transplanting body fluids, and interchanging our social and cultural experiences—the audience is invited to this microbiome luncheon to examine their bodies and those of others. Through the endless "meal" microbiome is constantly transmitted from a participant to the other and vice versa.

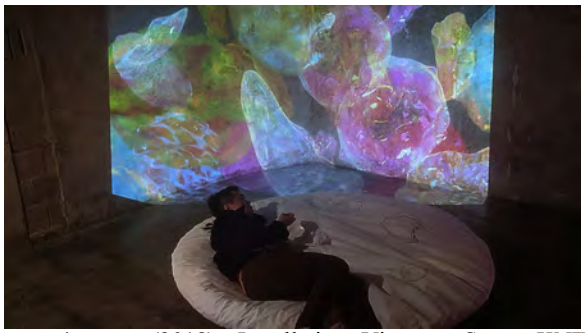


Figure 4. *xxxs* (2018), Installation View at Space KNEET ©Sanglim Han

The coded images produced by media in the current digital age give prominence to the interface between the virtual and real. The digital body without physical materiality as simulated imagery becomes an interface, a space as a mediator, and a placeless place. Microbiome—one on a participant's body, one within the body, one in the air, one on a shared surface, and a virtual one over the screen—interact each other entering into the "zone of proximity" that, according to Deleuze, "makes it impossible to say where the boundary between the human and body

lies—something shared or indiscernible:" [7] it blurs the demarcation between the virtual and real. As the new fragments are transplanted, the environment networks with the newcomers, entangling the history and the simulated present. The body that the participant identifies with continuously iterates being disembodied, fragmented, interstitial, transitional, and emergent. Body, relationship, culture, and intimacy intersect in the physiology of the virtual/real ecosystem.

THREE: Can a Souvenir be (the size of) a Building?

As digital technologies evolve and become ubiquitous - interfaces and devices such as VR headsets become naturally incorporated into art and cultural institutions such as museums. Artists who work with VR technology must question and reflect on the relationship between the museum as an architectural space, the body as the performer, the device as an extension of the body and the interface or content as an extension of the mind. We must imagine new ways in which we can experience the museum as a space where the body must negotiate between the physical and the virtual and understand it as a microcosm, where similar interactions may translate to our everyday life because of the interconnectedness between our bodies and our digital devices, as well as the physical and virtual spaces in which we operate and interact with the world.

To what extent does visual-based technology --- particularly a VR technology such as the Oculus Go headset --- shape the aesthetic experience in a space such as a museum… or the works of art inside such space?

As a case study, I will describe my solo show ¿Puede un souvenir ser del tamaño de un edificio? [Can a Souvenir Be the Size of a Building?] held at Future Gallery in Mexico City last year, from September 22 to November 4, 2018.

This was an exhibit that spanned & ranged between time and technology. The gallery became a complex and ethereal place, a multi-timeless zone in which the past, present and future recreated in a physical, virtual and ghostly fashion, fragments of the most iconic institutions in Mexico which are dedicated to the preservation, creation and promotion of culture.

Interpolaciones [Interpolations] and Fragmentos [Fragments]– were the two projects presented, which in fact I am currently still exploring using various formats. Interpolaciones, the first project that the visitor encounters, is a piece which reflects on the validity of the use of vitrines and glass displays which prevail in institutions such as anthropology museums. By comparing them with TV monitors, I raise questions about how the materiality of those devices conditions the experience regarding the objects we see in them. By digitally simulating a museum display with 3D scanned and rendered archeological objects onto a 4K led screen, I created the illusion of walking into a dark space with an illuminated glass vitrine. The closer you observe the artwork the more you realise that what you are looking at is a digital animation.

Figure 5. *Interpolations* (2018), Installation view at Future Gallery ©Julieta Gil

Fragmentos, the second project was a multimedia installation consisting of 3D printed sculptures laying on a room full of white marble dust, marble stone sculptures containing written captions, and an Oculus Go VR headset that looped a 360 video. The project reflects on the architecture, specifically on the neo-indigenist ornaments in the façade of the Palace of Fine Arts in Mexico. These ornaments where 3D scanned using photogrammetry and then recreated in virtual and physical form, but this time in the condition of ruins from an imaginary future. When walking into the room, the visitor can experience two versions of this narrative, one as a physical experience where one walks on marble powder, the same material used to 3d print the sculptures that you are looking at and the other as a virtual experience, where the body, while still present in physical form in the space, is transported into a virtual experience of the Palace of Fine Arts in ruins is located in an imaginary world, thus bringing the issue of the construction and symbolic fragmentation of this monument to the table. By placing the visitor in this building's decayed possible future, invite them to think about and experiment the consequences of this event in the collective imaginary.

This specific exhibition exemplifies the way in which my work ranges between physical and virtual spaces. Technology and computational means have become ubiquitous. Ontological reality, simulated reality and the computer-mediated reality are an array of layers which get mixed together in a complex and multidimensional manner. My artistic practice researches the possibilities that exist in this overlap of realities that coexist and interact, thereby creating objects and narratives that make us reflect about the past, present and future.

Figure 6. *Interpolations* (2018), Installation view at Future Gallery ©Julieta Gil

FOUR: (Un)Conscious Hyperbodies, Spaces, OBJECTS (as Datafied Particles)

The first part of this paper / presentation will provide an analysis of artists Maria Judova & Andrej Boleslavsky's VR artwork DUST and their use of VR technology to portray the human body in motion – a body in motion, dancing amongst, as one, with motioning, layered dust – & the physical spaces it occupies as live, motioning particles.

Featured as one of the main attractions during the Connecting the Dots media art festival in Mexico City during September 2018, Judova & Boleslavsky's DUST argues that not only does VR technology influence the human's perceptive relationship with its own body, it also places the body & the spaces it occupies in the same plane – in terms of its abilities to maneuver past spatial, cognitive & imaginative borders & relationships.

The second, concluding part of this / paper presentation will then provide an analysis of the human body as a datafied composition of microbodies (in the form of food & the nutritional data drawn from food, as independent hyperobjects in of themselves) and macroorganisms (in the form of economic, consumer-actors, operating within larger economic industry-corporate networks) – via a series of visuals from my upcoming interactive art installation "YOGURT."

By analyzing the motioning human body, the motioning human body as AND within datafied dust particles, the motioning human body that ingests food as hyperobjective means of sustenance & nutrition, the motioning human body as an actor, coexisting with food as hyperobjects – all of which simultaneously occupy physical & virtual hyper-spaces, local & global economic industry-networks, as one – my talk / paper / presentation will argue that such datafied relationships are even more possible & apparent, if & when AR, VR, A.I. & smart technologies are intermittently used & questioned.

References

[1] According to Enactivism in Varela's book, *Embodied mind*, cognition is " the enactment of a world and a mind on the basis of a history of the variety of actions that a being in the world performs," and cognition works through a network of multi levels of sensorimotor subnetworks. Therefore, a mind is not pregiven, and the worlds have no fixed, unchanging foundation or substrate.
[2] Varela, Francisco J., Evan Thompson, and Eleanor Rosch. The Embodied Mind: Cognitive Science and Human Experience. Cambridge, MA: MIT Press, 1991.
[3] Hayles, Katherine. Unthought : The Power of The Cognitive Nonconscious. Chicago and London, IL: University of Chicago Press, 2017.
[4] Herrigel, Eugen, and R. F. C. Hull. Zen in the Art of Archery. New York, NY: Pantheon Books, 1953.
[5] Joshua Lederberg, "'Ome Sweet 'Omics—A Genealogical Treasury of Words," The Scientist 2 (2001): 8.
[6] Alanna Collen, 10% Human: How Your Body's Microbes Hold the Key to Health and Happiness (New York, NY: Harper, 2016), 7.
[7] Gilles Deleuz and Félix Guattari, A thousand plateaus (Minneapolis, MN: University of Minnesota Press, 2007), 273.

Authors Biographies

Su Hyun Nam: As an interdisciplinary media artist and researcher working at the intersection of art, technology, science, and philosophy, Su Hyun Nam explores her relationship to digital media with an artistic and meditative approach to computation. Her affective experience with technology, which emerged from the process of digital art making, is represented in various forms of media art projects. Her work, including an interactive video installation, 3D game art, and media performance, has been exhibited both nationally and internationally at venues from Spain, UAE, Greece, and Singapore to South Korea. Her community-based media art projects were showcased at Burchfield Penney Art Center and Hallwalls Contemporary Art Center in Buffalo, New York, and her papers have been presented at SIGGRAPH Asia in Japan and the International Symposium on Electronic Art (ISEA) in Colombia. Su Hyun Nam earned an M.F.A in art and technology studies from the School of the Art Institute of Chicago. She is currently an Assistant Professor in the Department of Transmedia at Syracuse University and a Ph.D. candidate in media study at University at Buffalo.

Sanglim Han: Sanglim Han explores disembodied, fragmented, and interstitial bodies. Through performative media, primarily simulated 3D animations and experimental games, she creates a site for fluctuating identities where our personal and social experiences are revisited and boundaries are convoluted. Her works have been presented internationally at various venues and festivals from Austria, Bulgaria, Denmark, Ethiopia, Germany, India, Netherlands, Spain, Portugal, South Korea, Turkey to the USA. She first enrolled at the Korea Advanced Institute of Science and Technology, then began her art studies at the School of the Art Institute of Chicago. After receiving her BFA, she researched an intersection between art and science at the University of California, Los Angeles where she received her MFA.

Julieta Gil: Julieta (b. 1987), lives and works between Los Angeles and Mexico City. She holds an MFA from the Media Arts program at UCLA, and a B.Arch from Universidad Iberoamericana, Mexico City. Her creative research incorporates installation, sculpture, 3D animation and print to explore topics of simulation, and the overlappings that occur between the virtual and physical. Her work has been exhibited in places such as Laboratorio de Arte Alameda (Mexico City), Museo Nacional de Arte (Mexico City), Nevada Museum of Art (Reno, Nv), Anchorage Museum (Anchorage, Al), Future Gallery (Mexico City), Human Resources (Los Angeles), and Zuecca Projects (Venice, It).

john-patrick ayson: john-patrick ayson is a writer, artist & PhD researcher who uses mobile phone technologies, improvisational dialogic approaches, speculative app designs, remixed data & map-based visualizations, to critically engage with eco-socio-political concerns & technologically-determinist themes. currently, he is working on YOGURT an interactive, food-based installation & THE BUFFET a five-part docufiction about all-you-can-eat foods in the anthropocene.

Rational Games for Biological Spaces

Abstract

Rational Games proposes to look at the immortal logic of technological application into penumbral biological spaces. By probing mathematical structures, philosophies of rea-soning, their harmonies and practical fruits, this panel hopes to shed light on the effects of cybernetic acceleration on lived contexts. What sort of biology does instrumental-ized rationality produce, what arts diagram the shadows of its fallout and finally what kind of enlightened reasoning can engage with the noise and environments it creates? Rational Games will take these questions as a starting point to examine the value of the arts and sciences, the eternities and light of artificial structure, and their consequence amidst our biological and social reality.

Keywords

Bio Art
Enlightenment
Medical Ontology
Rational Harmony
Artificial Structure
Visceral Penumbra
Cybernetic Acceleration
Practical Noise

Bian Zheng 辩证: Negotiating Across Bodies and Medical Technologies

This aspect of the discussion begins with Ann Scott's (1998) question: if medicines other than modern allopathic medicine can be said to 'work,' then 'what are the implications for our [Western/Eurocentric] metaphysics? In what reality might these sort of [interventional practices] have an intrinsic place?' This question will be discussed from the perspective of working with the human body within the Chinese medicine clinic (which encompasses two approaches to medical practice: biomedical and 'traditional' Chinese medicine).

The lifeworld of the Chinese medicine clinic constitutes a situation of complex interactions between body-based problems[1] on the one hand, and finding solutions in the form of treatment strategies on the other. Attending to body-based problems under the 'logic' Chinese medicine is accomplished by using a specific set of interventions and performance methods.

The Chinese medical constitution of the body is as an interfacing organism that is actively shaped by its relationship to natural and sociocultural structures – structures that are themselves in continual states of transformation. Also central to the Chinese medical organisation of the body is that it is a 'holistic' organism of different interrelated substances and essences that are shaped and mediated by the alchemical processes of yinyang 阴阳 and wuxing 五行 – which is to say a cyclical and cosmological model of relations (logic) where the focus of relations is on trans-individual process, Whereas the biomedical model of the body, largely influenced by Cartesian and Augustinian traditions, views the body as a set of mechanical processes to be perfected. Moreover, within the Aristotelian tradition, technological concepts of time and space are based on progression and movement from one thing to another. The schema of progression tends to move between the thinking subject (self) and the other.

Within the trajectories of European and Chinese medical cultures, the manifestation of the technical also travelled in different directions. On the one hand, allopathic physicians relayed the concept of the body as an individual organism, separate and distinct from the exterior world and elaborated upon the processes of the body as discrete system of mechanical processes. Conversely, Chinese physicians approached the body as an ecological organism that shared a complex relationality with the environment and with the wider cosmos – as a systemic of interior and exterior interrelated and alchemical processes.

This discussion proposes to demonstrate trans-individual relations (logic) within Chinese medicine by discussing Bian Zheng. Bian Zheng 辩证 is a Chinese medicine conceptual entity that represents a body of complex patterned interactions that can exist in the continuum between the interior of the body and the exterior climate. Zhèng encompasses a detailed system of differentiation and analysis that is used to determine (prognosticate) the interior condition of the body's substances and processes in relation to exterior factors such as wind, heat, cold and dampness – or in relation to internal somatic processes such as Dampness(associated with the Stomach and Spleen), Heart Fire, fear(associated with Kidney/Bladder fluid physiology) grief (associated with Lung function) and anger (associated with Liver function).

Determination of zhèng patterns within the body is maintained via clinical observation methods such as: looking, listening, questioning and particularly pulse analysis Since providing a detailed theoretical overview of zhèng patterns is beyond the scope of this discussion, instead I describe one example of zhèng that makes my use of this concept somewhat clearer.

Whilst in biomedicine it is possible that two or more persons can be placed within the same diagnostic category, when using zhèng differential diagnosis, each person will present with unique configurations of internal/external patterns with a particular aetiology that thus requires a personalised approach to treatment. For example, a person arrives in the clinic during a heat wave and they have a medical history of what biomedicine terms as 'gastritis.' There are several zhèng diagnostic patterns in Chinese medicine for the one-size-fits-all diagnosis of gastritis, such as Damp Heat invasion (an exterior pathological entity which has invaded the Stomach directly – something that is more likely during a heat wave), Liver Qì Stagnation and Depression(an internal energy-blood dynamic created by constrained emotions), Liver Qì Invading the Stomach (this occurs when a person's emotional constraint becomes compounded), Stomach Deficiency Cold (cold in the Stomach fǔ jīng-luò), Spleen Deficiency Cold (cold in the Spleen zàng jīng-luò), and so on.

To determine which direction and shape the malady will take, the Chinese medicine physician typically conducts a pulse analysis to assess the characteristics of vibration along the Stomach/Spleen zàng-fǔ jīng-luò 脏腑经络 as they are perceived in relation to the pulse-wave characteristics of other organ-networks and also in relation to exterior climate conditions such as heat, cold, damp, wind and aridity. Following the identification of the correct pattern, a treatment response, or lùnzhì 论治 (prescription) is typically performed by applying needle techniques on specific acupuncture points or by formulating herbal strategies to initiate a set of pharmacodynamic actions within the body that correspond to the zhèng.

1

These interventions are thought to either strengthen what is deficient or interrupt and reduce the pathogenic processes within the zàng-fŭ jīng-luò. This occurs by strengthening the body's antipathogenic response (zheng qi 正气) and clearing the body of any pathogenic substances (xie qi 邪气). The overall aim is to use zhèng as an interface, as a set of strategic concepts and interventions in order to create a balanced and harmonic resonance between the interior and exterior layers of the zàng-fŭ jīng-luò and the exterior environment. Thus zhèng is a system for mediating the ecological body.

Biological Art and the Circumscription of Reason

Rationalism in its limits leads to a potential space of applications and also the diagrammatics of art. Within biology we have the rooting of the analytic and aesthetic in the moral - that is, the rationalist precept of increased precision towards the inhuman is matched by an increased focus on both its limitations and the immediacy of those limitations. It is the aesthetic that gives place to the circumscription of ethical possibility.

Rationalized biology both neuters and radicalizes subjects. It equates unthinkable horror with the invisibly mundane which marries Kant's mathematical and dynamic sublimes, Platonism's purified beauty with its inspired Ionic nemesis, or Aristotle's comic (over-rationalized life) and tragic (un-der-rationalized life). This collapsing of categorical spheres has as its goal a reinvention within moralist inter-rogation.

Biological art, that is art whose thematic is placed in im-mediacy and ephemeral tradition, constitutes both the root and simplest form of the empirical rational endeavour - as event it is the most basic art forms, the performed aspect before anything, media equating with environment. As rooting, deficiency in logic and invisibility in sublime in-stantiation, it is a constant reminder of ethos, the character with which an act is imbued.

The applied use of reason, within practical undertakings, is the key reflective value of aesthetic marriage, and how a biotic approach becomes tantamount. Simply put, biology makes rationalism and its proper description both allows and relates how aesthetic inhumanity creates the bounds for the ethics of the future. Biology is the reminder of what ethical ties both investigation and depiction owe their timely performance to.

Thoughts on rational definitions for biological aesthetics.

Inspired by the rational evolution thoughts of Darcy Thompson and Alan Turing's morphogenesis or even by the formalistic models that generate complexity via Stephen Wolfram's cellular automata, mathematical func-tions generators or "deformers" are being used as a base platform to explore changing patterns (in behavior in living things.

Is there a need for a definition that feeds the mathematical structure into biology in order let any type of aesthetics emerge?

In order to combine the two disciplines of mathematics and biology we chose a generative approach. This approach is influenced by George Spencer Brown's "Laws of form," a mathematical textbook introducing the concept of "self-reference" as a generator of a new type of logical algebra. This specific textbook that influenced the evolution of second order Cybernetics and scientists like Humberto Maturana, Francisco Varela, Heinz Von Foerster becomes the core for our inspiration to generate something out of nothing and create a context to approach biology and art via mathematics.

The following generative system [similar to linguistic generativity with premises/axiom rules and evolution] shows a mathematical approach to understand the relation from a structure of logic to a structure of complexity.

1. We start from nothing.
2. We make a distinction, a choice.
3. From nothing via a distinction we have a duality.
4. With a similar sequence of actions we can generate com-plexity.
5. Within complexity we have the "biological."
6. The "biological" reaches a cultural point where it [we] can define a Mathematical [formalistic] model that can explain how through a recursive duality we can produce modeled [mathematical] complexity.

In terms of aesthetics and art there is a need to abandon the direct correlation of mathematics in art via geometry and representation. Mathematics is being gradually redefined as a science of patterns. Patterns in many disciplines and with an initial inspiration from the generative meta-mathematical domain of Category Theory patterns via morphisms and transformations [or functions]. Under this approach the network of relations and sets through which such functions are evolving becomes the birthplace for aesthetic experiences and constructions.
In the same sense biology observed from a mathematical/ linguistic approach becomes such an aesthetic generator. To achieve we share the necessity to define and analyze these relations, these arrows that create causal or non-causal connections between elements, environments living and non-living systems. These arrows vectors of intentionality from conscious creatures towards further life generating activities and relations are the building blocks of the biological aesthetics, the proteins of the "aesthisis".

Bibliography

Aristotle. 1984. *Complete Works of Aristotle, Vol. 1*. Edited by Jonathan Barnes. Bollingen Series edition. Princeton, NJ: Princeton University Press.

Balaguer, Mark. 2016. "Platonism in Metaphysics." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta, Spring 2016. Metaphysics Research Lab, Stanford University.

Banaschewski, Bernhard, and others. 1977. "On G. Spencer Brown's Laws of Form." *Notre Dame Journal of Formal Logic* 18 (3): 507–509.

Hofstadter, Douglas R. 1996. *Metamagical Themas: Questing for the Essence of Mind and Pattern*. New York: Basic Books.

Hui, Yuk, and Robin Mackay. 2019. *The Question Concerning Technology in China: An Essay in Cosmotechnics*. Falmouth: Urbanomic.

Jiang, Miao, Chi Zhang, Guang Zheng, Hongtao Guo, Li Li, Jing Yang, Cheng Lu, Wei Jia, and Aiping Lu. 2012. "Traditional Chinese Medicine Zheng in the Era of Evidence-Based Medicine: A Literature Analysis." *Evidence-Based Complementary and Alternative Medicine: ECAM* 2012: 409568. doi:10.1155/2012/409568.

Leung, Kam-tim, and P. H Cheung. 2012. *Fundamental Concepts of Mathematics*. Hong Kong [China: Hong Kong University Press. http://muse.jhu.edu/books/9789882201415/.

Plato. 1992. *Republic*. Edited by C. D. C. Reeve. Translated by G. M. A. Grube. 2nd edition. Indianapolis: Hackett Publishing Company, Inc.

Spencer Brown, G. 1979. *Laws of Form*.

Thompson, D'Arcy Wentworth. 1992. *On Growth and Form: The Complete Revised Edition*. Revised edition. New York: Dover Publications.

Turing, Alan Mathison. 1952. "The Chemical Basis of Morphogenesis." *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 237 (641): 37–72.

Wolfram, Stephen. 1984. "Cellular Automata as Models of Complexity." *Nature* 311 (5985): 419–424.

ISEA INTERNATIONAL

University of Brighton

HOSTS

광주광역시 GWANGJU CITY

AICC 국립아시아문화전당 ASIA CULTURE CENTER

KAIST

CT 문화기술대학원 Graduate School of Culture Technology

ORGANIZERS

art center nabi

AICI 아시아문화원 ASIA CULTURE INSTITUTE

SPONSORS

한국관광공사 KOREA TOURISM ORGANIZATION

INSTITUT FRANÇAIS 주한 프랑스문화원

JAPANFOUNDATION SEOUL

보해양조

CROWN GOOSE LUXURY GOOSE DOWN BEDDING BRAND

PARTNERS

Québec

Australia Council for the Arts

HYUNDAI

ROBOLINK

PABLO AIR (주)파블로항공

광주문화재단 Gwangju Cultural Foundation

광주문화재단 전통문화관

KOFAC

Kingdom of the Netherlands

GWANGJU cvb GWANGJU CONVENTION & VISITORS BUREAU

조선대학교 LINC+ University-Industry Cooperation QUEST 40

RADFORD UNIVERSITY Department of Dance

ZERO

AI AMERICAN ARTS INCUBATOR

KOSMA 한국영상학회

KSDA 한국무조영학회