xCoAx 2018

Proceedings of the Sixth Conference on

Computation
Communication
Aesthetics & X

xCoAx 2018 — MADRID

PROCEEDINGS OF THE SIXTH CONFERENCE ON COMPUTATION, COMMUNICATION, AESTHETICS & X

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FOREWORD

Welcome to the proceedings of xCoAx 2018, the Sixth International Conference on Computation, Communication, Aesthetics and X, which took place in Madrid from July 11th to 13th, 2018.

We had the pleasure to organise xCoAx in the capital of Spain for the first time, thanks to our gracious hosts of MACA (Máster Universitario en Comunicación arquitectónica) at the Superior Technical School of Architecture of the Technical University of Madrid, who not only allowed us to use their majestic premises for our conference and performances, but also liaised with the Complutense University of Madrid and with the Museo del Traje to give us an amazing space for our exhibition.

Apart from the novelty of the madrilenian environment, given that like last year we opened xCoAx with a Doctoral Symposium, followed by the inauguration of the exhibition and two days of presentations, enriched by two keynotes and the performance evening, one might think that this was xCoAx business as usual, but it was not.

This year, for the first time in xCoAx's still short history, the submissions of artworks and performances outnumbered those of papers. Naturally, one occurrence may not be very meaningful, but given that all xCoAx organisers are academics who, despite working in different universities, have witnessed the same phenomenon in their workplace, we might be onto something.

It has already been 10 years since the global economic crisis of 2008, but we haven't recovered from its rippling effects yet; in academia, where departments and schools had to elaborate new strategies to tackle further cuts in research funding by the government, more and more researchers are told to focus on journal publications, the only outputs that officially count for the research excellence parameters throughout the world, and to avoid conferences, which entail travel and lodging expenses that cannot be covered anymore.

While recognizing the fundamental role of research journals (selected articles from xCoAx are indeed published every year on a special issue of the CITAR Journal of Science and Technology of the Arts), we do not want researchers, especially those at the beginning of their career, to miss the opportunity to meet colleagues from all around the world to discuss, compare and exchange ideas. Searching and downloading articles and sending emails works, too, but only to a certain extent.

Despite our strong technological backbone, we still believe that meeting in person is much more effective, and also fun, thanks to the artists and performers who have been dealing with money issues long before the crisis hit universities, and who have anyway managed to come to us with their marvelous practice-based works that not only complement the current discourses in theoretical research, but stimulate new ones.

We at xCoAx are committed to enable as many artists and scholars as possible to take part in this extraordinary occasion for presenting, observing, and discussing theories and practices at the crossroads of technology and creativity.

Let this book show you what can happen at xCoAx and make you join us in our aspirations for the future.

The xCoAx Organising Committee

Keynotes

Mario Klingemann: Instruments of Creation

Abstract:

The ability to wield tools is one of the core qualities that define humanity. The evolution of human culture has always run parallel to the evolution of the tools and instruments at our disposal. Machine learning and what is commonly known as artificial intelligence is a very recent instrument that we have created and we are starting to apply it to all possible areas, including the creation of art. As with any instrument it takes time to learn how to use it skillfully or how to play it masterfully. Mario Klingemann has been experimenting with the possibilities to create visual art with artificial neural networks for several years and is beginning to understand the potential and limitations of these instruments. In his talk he will give insights into his process and show some of the latest developments in this fast-moving field.

6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

Pep Vidal: Constantly Variable

Abstract:

I was attending my first Calculus class and the teacher tried to explain us how one can manage to “feel” that between 0 and 1 there are infinite numbers. He drew a line on the blackboard and wrote respectively 0 and 1 at its two extremes. He said: “So, we have this line and the extremes are representing 0 and 1, all right. What if I move closer to the blackboard and focus on the initial part of the line?” The teacher did go closer, put his nose ON the blackboard and in that position he continued talking: “Well now I’m only seeing a small part of this line, let’s say that it is the part between 0 and 0.1.” So he changed the 1 at the right extreme by 0.1, leaving the line exactly as it is, same position and length. “Ok, now the extremes are representing 0 and 0.1. What if I move again closer to the blackboard and focus on the initial part of the line?” You can guess what happened next: he changed the 0.1 at the right extreme by 0.01, same line, same length. He repeated the example as many times he needed in order to get his nose completely white with chalk.

This example is telling us that everything is relative, it's about how "close" you are to the blackboard, having infinite numbers to choose.

0 ———————— 1

0 ———————— 0.1

0 ———————— 0.01

0 ———————— 0.001

0 ———————— 0.0001

0 ———————— 0.00001

0 ———————— 0.000001

Papers

6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

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From Light to Sound: Mediumsprünge and Absence as Creative Matter

Keywords: Media Art; *Mediumsprünge*; Light-to-Sound Translation; Absence; Visual Impairment; Self-translation.

Abstract:

The paper analyses media devices and artworks based on light-to-sound translations through the articulation of Vilém Flusser's media theory – namely considering the zero-dimensionality of electronic and digital media and the concept of Mediumsprünge. By focusing on the role of absence as creative matter, the discussed examples were selected from references and methodological tools used in a cross-disciplinary practice-based PhD research on photosensitive materials and devices conducted between 2014 and 2018. The reflection turns explicit multiple dimensions of the notion of absence within creative processes in Media Art, analyzed as experiences of translation of materialities.

1. MEDIA ART AS TRANSLATION OF MATERIALITIES

Considering the materiality of contemporary media devices and artworks it is possible to observe their organic and man-made elements through a lowest common denominator: electric current. The manipulation of matter at the atomic level, where it is subject to quantum mechanics, is the scientific ground of Vilém Flusser's media theory that places media development in the history of culture as part of a history of abstraction (Flusser 2008: 16-19). According to Flusser, history can be divided into four gestures of abstraction. The first human gesture was to abstract time, transforming the world into circumstance: a three-dimensional experience. Later, circumstances were abstracted into scenes, images, two-dimensional representations. The third gesture consisted of abstracting images into texts, which gave birth to history and linearity, the one-dimensional experience. Last, the linearity of texts was abstracted into numbers and calculations: the zero-dimensionality of electronic and digital media and their software.

These thoughts form a crucial point of departure for my own understanding of electronic and digital media and its specificities, formed and constantly updated by the combination and recombination of complex technical ensembles, embedded with an immense variety of sensors and actuators. The possibility of gathering all materialities under an abstract lowest common denominator of numbers and voltage changes, and, in a second step, transforming them into other possible materialities, makes the practice of media art an interplay between abstraction and concretization.

By viewing the creative processes of media artworks as processes of the translation of materialities, I call attention to the special possibility of programming and editing matter by transforming one type of physical or chemical stimulus into another. Through an expanded notion of language (Krippendorff 2011), this practice boosts the essential artistic impetus towards non-trivial articulations of objects and their relationships (Steyerl 2016), creating situations in which meaning emerges from the communicative experiences rendered by the specific combination of technical ensembles (Gumbrecht 2004; Simondon 1958).

2. *MEDIUMSPRÜNGE:* FROM LIGHT TO SOUND

In order to more concretely address how Flusser's ideas are manifested in media developments, I have cast some examples of media devices and artworks based on the translation from light to sound. These illustrate what Flusser called *Mediumsprünge:* acts of jumping from one medium to another, or from the logic of one system to another. Flusser elaborated and implemented this concept in different contexts: in his reflections on changes of media, comparisons between media, media as a form of translation, and media development (Guldin 2010: 166).

As the scholar Rainer Guldin suggests, it is also possible to bring Flusser's translation theory from the 1960s and his media theory from the 1980s into relation. Due to his immigrant background, Flusser's philosophical method was strongly based on translation and retranslation, and he even stated: "Perhaps, everything I am working towards is a theory of translation." (Flusser apud Guldin, undated).

Correspondences between different physicochemical phenomena and their specific logics are undoubtedly often implemented in current technological objects (implantable colour-to-sound chips, software, mobile apps, etc.) used for a variety of purposes. The history of media art contains countless accounts of light-to-sound conversions. A classic reference, for instance, is the *Very Nervous System* (1982-1991) by David Rokeby; another is Peter Keene's interpretation of Raoul Hausmann's *Optophone* (1999, 2000, 2004) (Donguy, 2001), and more recent examples include Leslie Garcia's *Pulsu(m) Plantae* (2010-2013), Kathrin Stumreich's *Stofftonband* (2013),

Yiannis Kranidiotis' *Pentatono* (2015) and his series of soundscapes based on classic paintings, and so forth.

Together with Flusser's idea of *Mediumsprünge*, these works raise a set of central questions concerning translations between materialities: Do they allow more freedom than those related to linguistic systems? What is at stake in the translation of materialities? Whether considering the media cases or the existential layer of the translation processes, what deserves special attention is the gap found between one system and another. The nothingness or absence that characterizes this transitional space can be investigated as a powerful substance for creative activities.

3. ABSENCE AS CREATIVE MATTER

3.1. Media development in relation to absence in sensorial experience

A popular example of absence as creative potential in audio-visual media history is connected to human endeavours towards verisimilitude culminating in the development of sound-film. Media historians who study sound in cinema betray a sort of ocular centricity in their narratives on the relation between image and sound in cinema history. Nevertheless, "*as long as cinema has existed, sound has been part of it – both in its presence and in its absence.*" (Beck 2011:64). The first so-called silent films were accompanied from the beginning by music performed by musicians, who also used to create live sound effects, a possibility that was later enhanced by the inclusion of pre-recorded sound effects. However, the insertion of sound in the material film itself revolutionized the cinematographic industry and language, both in terms of economic profit and satisfying the human yearning for immanence. The absence of sound in cinema annoyed those who sought to use cinematographic language as a means to achieve complete audience immersion, providing the most 'real' experience, in short, an experience that more closely mimics how the human sensorial apparatus enables one to perceive and shape the surrounding physical world. If immersion is considered as the full involvement of the spectator's senses, the film experience remained an incomplete media, even if a live musician or orchestra accompanied the film exhibition. With the liveliness of theatre as a reference, the absence of human voice[1] and other diegetic elements is what impeded higher verisimilitude. Scientists and technicians across the globe have worked on finding solutions to this "problem". In this media technological race, one of the protagonists was photosensitive matter, namely the chemical element selenium, discovered in 1817 by the scientist Jöns Jakob Berzelius (1779-1848).

Furthermore, the use of mechanisms able to translate light into sound in order to deal with visual impairment also harks back to the first experiments on the applicability of the photosensitive qualities of selenium. As an enthusiast of selenium's wonders and fascinated by the possibilities for converting light into sound (and vice-versa), the engineer Edmund Edward Fournier D'Albe (1868-1933) developed a version of an *Optophone* in 1912 as a means to aid visually impaired people with orientation in their environment and reading. (D'Albe 1924: 32) The device thus belongs today to the heritage of blindness and the variety of technological attempts to facilitate the life of people whose bodies were not aligned with the standard media of the epoch, which constantly and emphatically stressed the supremacy of vision.[2]

Indeed, the development of media devices is vigorously based on adaptations to the limits of the human sensorial apparatus and the corresponding endeavours to extend, assist, enhance, and/or adjust or modify them. While mostly oriented by a normative perspective, discourses and devices do occasionally emerge that use deviation as a means toward innovation. An instance of this is the *Optophone*, which remains an inspiring source for creative media technicians.

1. Therefore, sound-film is also called "speaking-films".

2. In Techniques of the observer (1990) the Art Historian and critic Jonathan Crary developed a deep and interesting analysis of how optical media have contributed to the abstraction of vision and the formation of visual-based consumers since the 19th century.

Media archaeologists have analysed the functional principles of former *Optophone* models, as depicted in Figure 1. D'Albe's reading machine resembles a primitive scanning technology, in which an object as a framed field is swept by light against a photosensitive surface (originally a selenium cell and nowadays an image sensor).

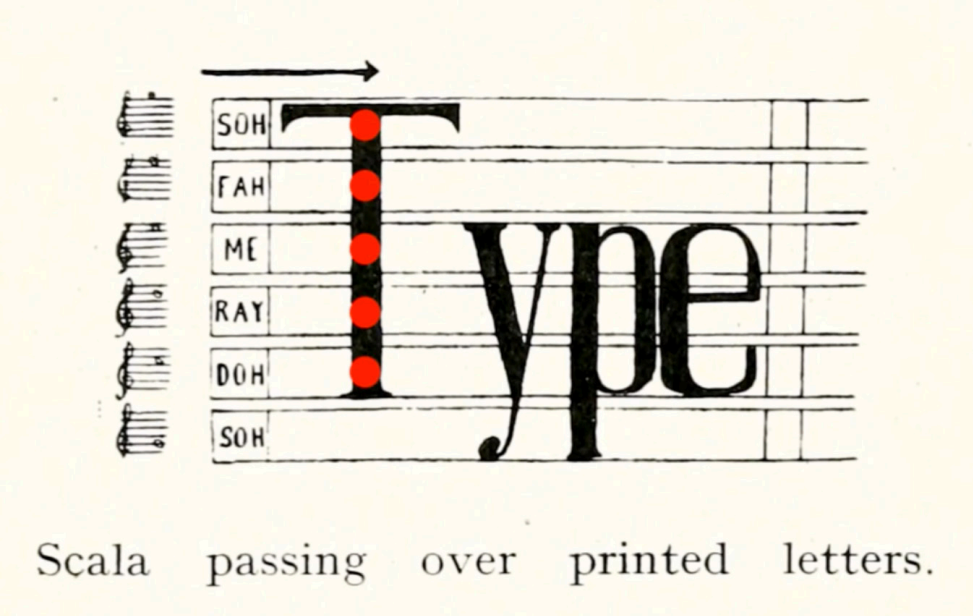

Fig. 1. Schema of the sound output of an *Optophone*. Source: Tiffany Chan/Maker Lab. July, 4th 2016.

Considering a Cartesian plane, axis x represents the path of the light source while axis y represents the acoustic notes. For each point detected in the scanned column, the corresponding notes that formed that letter were played. Although Fournier D'Albe claimed that through his invention the "reading problem of the blind was completely solved by means of selenium" (D'Albe, 1924: 94), the resulting combination of musical notes as feedback can still make it hard to properly distinguish each character, which probably contributed to the unsuccessful commercial lifespan of the device.

Contemporary attempts to use light-to-sound translations to develop assistive technological devices search for useful correspondences between visual and auditory stimulus that are more intuitive for users. Finding and establishing these correspondences is called by scholars image-visual to audio-auditory mapping, which necessarily presupposes an image encoder and software implementing methods to detect objects from the background of the visual scene. In a case of mapping reported by Matta et al. (2005), for instance, the images are transformed into a multiplexed auditory representation in which every frame is sampled, digitized and stored as a pixel matrix. Rows and columns of each matrix are individually averaged and the mapping translates the vertical position into frequency and horizontal position into time delay, while brightness is translated into amplitude. The mapping method suggested by Matta et al., however, since it also uses the image depth, becomes slightly more complex: Motion is translated into frequency shift (simulating the doppler effect); brightness into pitch; space into amplitude, reverberation, azimuth and elevation; and edge into duration. Although scientific efforts have aimed to find solutions that users could effortlessly adopt, scientists have been forthright in acknowledging the arbitrariness behind their inventions and have made it clear that the systems they develop require extensive training by the users, who have their own perceiving and learning idiosyncrasies.

Regarding light-to-sound translations in the Arts, Berlin Dadaist Raoul Hausmann also envisioned developing and patenting an *Optophone* (Donguy 2001: 217) at the beginning of the 1920s. Though less known for his difficulties obtaining scientific legitimacy for his ideas than for his photomontages and poster poems (Donguy 2001: 217),

the artist left a curious multifaceted scientific-artistic legacy, including what he called an *optophonetische Weltanschauung* (optophonetic worldview). Hausmann's theory aimed to harmonise cosmologic processes, modern media technologies and human life (Niebsch 2013: 19), and his propositions were clearly attempts to push the limits of the scientific and technological discourses to a symbolic and aesthetic level beyond the former utilitarian uses imagined for the *Optophone*, for instance. Convinced that the visual arts were saturated, Hausmann adopted destruction and recreation as his artistic method, artificially creating the absence of meaning and form that opened a terrain for him to let novelty emerge.

On the one hand, as an artist, he could play freely with the materials and techniques of his time. On the other hand, the scientific objectivism of the epoch remained sceptical of his endeavours – causing his patent applications to be rejected.

A casual look at the way artists and scientists create their light-to-sound translations induces one to perceive them as natural transpositions, as if the correspondences have always been there, and to ignore the human activity required to bridge the gap between one system and another. The arbitrariness of the established correspondences is necessarily bound to the subjectivities of those who have created them. As Wittgenstein noticed about Goethe's colour theory, such light-to-sound associations are due more to the psychological than the physiological theories. D'Albe addressed a similar issue by calling light-to-sound conversions symbolic rather than actual, while revealing the problem of the great physical disproportion between the range of frequencies of light and sound waves:

> "Light-waves are from forty thousand to seventy thousand to the inch, according to their colour. In duration they are even further apart. If we could slow down an average light-wave until it took one second to pass us, and could slow down an average sound-wave in the same ratio, it would take no less than two hundred million years to pass by!" (D'Albe 1924: 90)

Within D'Albe's trial of an objective consideration of the problem one must also notice that his idea of an 'average wave' can only be stated in relation to a specific frequency range, namely, the spectrum that humans can perceive. Such pseudo-objective positions reflect the constant attempt to define a 'standard human being' and the notion of normality, which frequently is not compatible with the specificity of each being.

3.2. Self-translations

3.2.1. Self-portrait of an absence

Similarly to Vilém Flusser, whose writings ground my understanding of electronic and digital media, I have a blind eye.[3] Being monocular implies a reduced field of vision (circa 25%) and the inability to see media-based stereoscopic images. To the contrary of what people usually think,[4] monocular people do see depth, because there are many other elements in the one-eye image (texture, perspective, etc.) informing the body of the three-dimensionality of the world, together with retrieved information from the other senses — especially from tactile and auditory senses — that is all interrelated in the brain.

The coincidence that the "philosopher of the black-box" also had this partial absence of vision motivated me to create a concrete dialogue with his work, particularly through the notions of self-translation and *Mediumsprünge.* As an exercise in playing between the abstract and concrete worlds of codes and materialities, the performance *Self-portrait of an absence* (2016) started as a poetic experiment on the search for the possible paths between sensing and making sense, by means of the confrontation between organic and machinic[5] light-sensitive elements, an eye and a camera.[6]

3. According to Guldin, with the outbreak of World War II, Flusser was dismissed by the Czech army because he had a blind eye. (Guldin 2010: 164)

4. I am often asked if I can visually perceive depth and how it works. Other frequent questions relate to how blindness looks: Is it totally black? Totally white? And people generally become intrigued when I say there is nothing. It is absent.

5. I adopt the term 'machinic' as synonymous to 'machine-based', as suggested by the media art historian and theoretician Andreas Broeckmann.

6. Eye and camera are black-boxes in the literal sense, but they also became epistemological objects for me in a second-order cybernetic perspective, both in performance and in my PhD thesis.

Technically, the artwork consists of an eye-tracking system programmed to generate and process sounds according to data generated from my asynchronous eye-movements. The eye tracking system was built in Python language using the library Open CV (Open Source Computer Vision) and a specific technique called Optical Flow, which is based on the recognition of the apparent motion of objects, surfaces, and edges in a given image, calculated by the relative changes within frames over time. Besides the eye tracking system, the software written in Python also sends the captured and processed data using OSC protocol to SuperCollider, another programming language for real-time audio synthesis and algorithmic composition.

Fig. 2. Performing *Self-portrait of an absence at Park am Gleisdreieck, Berlin*. June 27th 2017. Source: Video asset (https://vimeo.com/250959008**).**

How did this shape evolve? If the camera does not replace the blind eye in its functionality and sounds do not mirror what the camera 'sees', on what are the light-to-sound correspondences based? Here lie both the artistic freedom and the difficulty of achieving form in process-based media artworks. Simply copying and pasting pieces of code and schemas of the working system cannot explain how this initial absence is filled. One can access the documentation of the project at Github,[7] and I suppose the reader might be more interested in the imaginative path leading to the codes and the choices of materials and objects. The light-to-sound correspondences created on the software level were intimately related to other decisions made concerning interface and interaction design. As it was a complex non-linear creative process, I propose the following questions/answers format to cover the key elements:

What are the physical hints enabling the audience to notice the blindness?

Although indirect, the asynchronous movements of the eyes were the only effect of my partial blindness. The behaviour of the blind eye has always been an incognita for me, and thus this became the point of departure for the light-to-sound translation.

On the one hand, I was moved by the curiosity to know more about the behaviour of the blind eye and looked for a way to make it tangible to my own senses. On the other hand, I have taken advantage of my partial blindness to create a situation for triggering aesthetic experiences and dialogues with the audience.

Since I cannot hack the audience's sensorial and cognitive apparatus, how can I share this absence?

Besides the aesthetic influence by Janet Cardiff and George Bures Müller's audio- and video-walks, the performance was inspired by the delicacy of the animation *An eye for Annai* (2006), by Jonathan Klassen and Daniel Rodrigues, an animation in which Annai is monocular and is on a search for an element to complement the asymmetry of its single eye. I have interpreted the character's actions as a search for dialogue and for the possibility of making sense out of interaction, as is also suggested by the role of dialogue in Flusser's philosophy and conversation in Cybernetics

7. Codes and audio files used in the project are available at: https://github.com/grazilaut/self_portrait_of_an_absence Accessed April 24th, 2018.

(Pask 1976). Furthermore, the concern for sharing and going public reflected the cybernetic understanding expressed in the movement from Maturana's "*Anything said is said by an observer*" to von Foerster's "*Anything said is said to an observer.*" (von Foerster 2004: 12).

Since the performance depends very much on the auditory sense of the audience, moreover, going to a public space required an acoustically protected environment. Both issues were considered when choosing an umbrella to mediate the performance. Besides being an object that facilitates closeness and shared intimacy, it works as an acoustic shell and, since it is designed for two people, my limited visual field beside my body is suggested as empty space to be occupied by the participant.

How to suggest participation?

Wearing a special costume and accessories embedded with the necessary electronic devices, I went to a public space. This immediately frames my presence as an invitation to a performative encounter. By visually evoking strangeness through my unusual appearance, I observe the passers-by and through a corporeal gesture I open the system to enclose the visitor that demonstrates curiosity. If they accept, I start the sequence of sound modes that are the basis for a promenade with observing-listening exercises.

I also considered a way to discuss the notion of absence by means of relativizing what the notion of normality might be, by means of lending my eye tracking system to the participant. However, since the technical set up is not so simple and autonomous, this wish was set aside. This issue is nevertheless addressed, however, through the rhetorical question in the introductory narration: "Do you also have a blind spot in your body?".

Why light-to-sound translations?

Light as input was adopted because it is the physical element to which eye and cameras respond, organic and machinic case studies being analysed in my PhD research on photosensitive materials and devices within media history, media art, aesthetics and history. Any output could have been chosen, but opting for sound was based on my background in audio-visual media communication and technical feasibility in terms of available knowledge and resources.

How do the asynchronous movements of the eyes sound?

The sound aesthetics was created through the development of a soundscape enacting a hypothetical intervention in an urban space; the surrounding sounds were used as material for inspiration, as well as to predict potential technical problems that could arise while conducting the performance.[8] Out of this process emerged the five sound modes. Except for the introduction and farewell voices of the first and last sound modes, the other three modes were created using data generated from the synchrony and asynchrony between my left and right eye. The more desynchronized (D) their behaviors, the stronger the effects applied to the sounds being played. The five modes are: (1) pre-recorded voice greeting the participant and introducing the project's idea; (2) percussive sound whose rhythm loses its periodicity according to D; (3) bit-crushing[9] and downsampling[10] effects applied over pre-recorded audio samples,[11] more or less intense according to D; (4) tones synthesis, including vibrato[12] and panning[13] effects, according to D; and (5) pre-recorded voice thanking the participant and concluding the intervention.

3.2.2. He listens to colours

While developing *Self-portrait of an absence* and researching light-sound translations I discovered the case of the eyeborg Neil Harbisson, whose artistic statement is very close to that of Hausmann's *optophonetische Anschauung* and the old ambition of enhancing human perception through the development of new media. Inspired by his congenital disease achromatopsia, and in collaboration with the technicians Adam

8. For that, an audio recording of a walk through the Park am *Gleisdreieck* in Berlin was used as an initial reference. This strategy emerged from exchanges with the 3DMIN researchers.

9. Bitcrushing is a digital audio effect, which causes a distortion produced by the reduction of the resolution of digital audio. It is often combined with a reduction of the sample rate.

10. Downsampling refers to the reduction of the sampling points of a time series or other arrangements of discrete values. Except for special cases, the downsampling is thereby connected to loss of information.

11. The audio samples to be used can be captured from the surrounding environment where the performance is going to happen. In the case of the walk in Gleisdreieckpark, this effect was built over the birds' whistling.

12. Vibrato is a musical effect consisting of a regular, pulsating change of pitch. It is characterized by two factors: the amount of pitch variation and the speed with which the pitch is varied.

13. In audio technology, panning refers to the acoustic placement of a sound in a stereo image.

Montadon, Peter Kese and Matias Lazano, Harbisson has worked on the embodiment of a device that creates sounds according to the colours captured by a photosensitive sensor placed in front of his head. Harbisson reports that since the last update of the device, his perception of sound occurs through a direct connection with his skull, which has given him the new sense of 'hearing colours', a synthetic synesthetic experience that can be also understood as a process of translating materialities.

The existence of colours for human vision is the result of light-matter interaction, conditioned by the triadic material composition of the cones,[14] which are photoreceptors that form the retina together with the rods. (Guyton and Hall, 1996: 577-589) This basic physiological principle of human vision harks back to Isaac Newton's experiments in 1666, showing that white sunlight is not a single entity but a spectrum of infinite colours. Hausmann's concerns expressed in his texts about the *Optophonetische Weltansachuung* also address the different theories of colours[15] and reveal an attempt to merge the objective and the subjective aspects present in the dominant discourses of his period. "The eye connects space and brain through a subjective-optical creation to the temporal world-view, to an intuition of light, called optics. We do not see any light, we see colours."[16] (Hausmann, 2013: 76).

Today, considered as an electromagnetic radiation with wave-particle properties, the light-colour relationship is the basis of the measuring parameters commonly used both in scientific and aesthetic investigations. When isolated, the energy of a monochromatic beam of radiation is related to its wavelength and frequency. The subjective perception of colour, however, is not evidence of its supposed immaterial condition (Pedrosa: 1977), as some theoreticians defend. Looking more closely at light sensitiveness and the molecular structure of pigments, one finds a material condition enabling colours to be seen or not. (Guyton and Hall 1997: 577-589) The absence of specific material conditions within Harbisson's retina is the reason for his achromatopsia.

According to the artist, he was used to ignoring or avoiding colours in his everyday life until the moment he discovered studies relating colour frequencies to sound frequencies and felt motivated to investigate how he could perceive them. Ever since, his previous attitude of neglecting the absence has been transformed into a series of creative projects.

Although Harbisson does not provide information on how he developed his own relations between colours and musical tones, he has published what he named 'sonochromatic scale':

PURE SONOCHROMATIC SCALE		
(invisible)	Ultraviolet	Over 717.591 Hz
	Violet	607.542 Hz
	Blue	573.891 Hz
	Cyan	551.154 Hz
	Green	478.394 Hz
	Yellow	462.023 Hz
	Orange	440.195 Hz
	Red	363.797 Hz
(invisible)	Infrared	Below 363.797 Hz

SONOCHROMATIC MUSIC SCALE (basic 12/360)		
	Rose	E
	Magenta	D#
	Violet	D
	Blue	C#
	Azure	C
	Cyan	B
	Spring	A#
	Green	A
	Chartreuse	G#
	Yellow	G
	Orange	F#
	Red	F

Fig. 3. Neil Harbisson's sonochromatic scale: correspondences between colours and notes. Source: Wikimedia Commons, 2018.

14. Cones are classified into three kinds of cells, each type responding to visible light of different wavelengths on the electromagnetic spectrum. Long cones respond to light of long wavelengths, peaking at the colour red; medium cones peak at the colour green; and short cones are most sensitive to wavelengths of the colour blue.

15. The predominant influences were Newton's, Helmholz's and Goethe's theories of colours.

16. From the original in German: "*Raum und Gehirn verbindet das Auge durch eine subjektiv-optische Schöpfung zum Zeitlichen Weltbild, zu einer Anschauung vom Licht, Optik gennant. Wir sehen kein Licht, wir sehen Farben.*" (Translated by the author)

General methods for the sonochromatic music scale consist of microtonal and logarithmic scales with 360 notes in an octave, with each note corresponding to a specific degree of a colour wheel ranging from the pure colour to white, the maximum brightness. In contrast, Harbisson's sonochromatic scale is a non-logarithmic scale that includes infrared and ultraviolet, discards colour as being part of a colour wheel and ignores conventions on musical perception in order to overstep the limits of human perception.[17]

The search for correspondences between colour and sound seems to be an inspiring field of exploration for artists, as further historical examples demonstrate, such as the *Projet de clavier ultrachromatique* (1943) by the composer Ivan Wyschnegradsky[18] and the cybernetic *Musicolour* machine (1953-1957), by Gordon Pask (1928-1996) and Robin McKinnon-Wood (1931-1995).[19]

Since the translation from light to sound has been technically and aesthetically explored and discussed in a variety of forms, wherein lies the novelty and power of Harbisson's work? On the one hand, it relies on the technical audacity to embody a hybrid version of what the classic references have proposed. The automatic response of the system embedded in Harbisson's body, translating luminous stimulus into vibrations, has led to a self-organizing arrangement. Self-organizing principles were already very present in almost all Pask's artworks, but in Harbisson's case biological and machinic systems were merged in the artist's own flesh. He states that he is technology, since a cultural object and its abstractions (encapsulated knowledge through codes) are attached to his body, forcing a new stage of organization upon itself. On the other hand, what has substantially empowered his body experiment and its derivative artistic propositions is his wager on the creative use of absence. He approached his colour-blindness in an innovative manner, giving place for the aesthetics of disability to flourish.

Furthermore, by corporeally experimenting with processes of translating materialities one comes into explicit contact with the necessary betrayal and loss of information; however, it has still been a valuable exercise leading to a heightened awareness of gaps as creative sources, as open spaces for the emergence of novelty.

Facing the absence of the abyss between one system (light stimulus) and another (sound output), Harbisson's case and *Self-portrait of an absence* exhibit the freedom to create new correlations from inexistent ground. The interstitial zone of the absence is, in this sense, a fertile field of indeterminacy, in which artists can attribute and manage meaning from nothing. Experiments like these challenge the historical dichotomy between form and function attributed to the eye and camera, a revolution facilitated by the development of electronic and digital media and its zero-dimensionality.

Lastly, using one's own body and disability to query the notion of normality through art is a second-order cybernetic approach that allows the coincidence of both types of absences: one physiological and the other existential. In analogous way to how Flusser used translation and retranslation processes as philosophical tools (Guldin 2013) to react against the absence of meaning in life, media artists can wear similar lenses to exercise and create more meaningful artworks. Artworks and life are matters to which meaning can be attached.

4. SENSING AND MAKING SENSE IN ABSENCE

The translation of materialities relies on many in-between layers of abstraction (models and systems) between input and output. Manipulating matter through the zero-dimensionality of electronic and digital media potentially increases the number of abstract layers, which also leads to an increase in the level of complexity and noise.

In the case of *Self-portrait of an absence*, light variation entering the camera is captured and turned into data on the eyes' movements. The difference between the movements of the eyes becomes relevant information that will later be converted

17. An audiovisual reference on Harbisson's sonochromatic scale is available at the Youtube channel of the artist at https://www.youtube.com/watch?v=UawXwCpwDjo Accessed Jan, 6th 2018.

18. Images and brief description available at http://www.documenta14.de/en/artists/22761/ivan-wyschnegradsky Accessed Jan, 5th 2018.

19. *Musicolour* was in fact based on the translation from sound into light projection and movement (Rosen 2008: 131).

into sound. I used the zero-dimensionality of digital media and the approach of translating materialities to challenge relationships between form and function in reference to the eye and camera. Alterations in the material's resistance resulting from the interaction of light and matter[20] in the camera's image sensor constitute the zero-dimensional matter (or data, as some might prefer to term it) that enables light input to be directed and transformed into another physicochemical stimulus. In the specific context of the performance, when the light beam entering the eye and the camera is translated into sound in the vibrating membranes of the loudspeakers, a new meaning is attributed to the technical ensemble being used.

In Harbisson's case, light variation is decomposed into luminance and chrominance to form a colour system, and only then does it emerge as relevant information (defined by the artist) to be further codified as sound. These processes are here described in a very summary way, but every step taken in programming matters, and meanings, from input to output and their circularity, can be decomposed into several layers of abstraction – variables, functions, protocols, etc. This marks one of the main problems of translatability when the notion of translation is implemented in relation to physicochemical phenomena.

In this sense, Flusser's *Mediumsprünge* concept suggests an understanding between material-oriented approaches, expressed for instance in Kittler's idea that 'there is no software' (1995), and concept-based approaches, such as those able to consider software and coding as "the technique of providing a dynamic background to control the automatic evolution of meaning." (Goldsteine and von Neumann 1947 apud Chun 2011: 25). Through the concept of *Mediumsprünge* Flusser combines discourses from linguistic theory, information theory and arithmetic thinking (Guldin 2010: 168) and affirms that distortions are unavoidable in the process of jumping from one system of logic to another. Nevertheless, he postulates that distortion, or deviation, can be compensated by the benefits of new information, novelty and innovation – this is precisely what one can learn from the translation processes themselves.

By self-translating in the artistic context of programming matter and meaning, the inherent immaterial and material contiguity of cultural and artistic artefacts evolve into a human existential issue. With the possibility of self-translating, media artists manage to overlap and unite object and subject, elucidating the continuity of communication between organisms and machines. In this process, despite the objective choices needed to make it happen, artists need to radically adopt and ambrace the creative and subjective aspects of translation processes.

While transcending the stigma of absence as limitation and using it creatively, Neil Harbisson and *Self-portrait of an absence* are transgressive acts of self-translation that place the initial repression of standardization as a secondary and diminished problem. They spontaneously join the aesthetics of disability, comprising the refusal of "harmony, integrity, and beauty – as the sole determination of the aesthetic" (Siebers 2006: 64).

In conclusion, far from recommending the management of the audience's sensorial and cognitive apparatus through aesthetic experiences, translating materialities is a conceptual strategy to nurture more awareness about the void between the two sides of the systems undergoing translation. This perspective calls for the invention of interesting new bridges; bridges substantially grounded on the specificities of the contexts being correlated – the systems in translation and the absences themselves.

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20. In a beautiful essay by Peter Sloterdijk on light and resistance one can find similitudes between his and Flusser's perspective on the interplay between material and immaterial layers of cultural objects, with each using the same metaphor of a blade: "*Der Mensch ist ein Tier, das schneiden kann*". (The human being is an animal that can cut") (Sloterdijk 2015: 40, Translated by the author).

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Machines, Programs, and Aesthetics
A Human-Centered Contemplation

Keywords: Machine; Program; Algorithm; Computer; Beautiful; Art; Algorithmic Art; Computer Art; Walk-Through-Raster; Bauhaus.

Abstract:

The greatest cultural revolution of our times is the Algorithmic Revolution. It replaces all infrastructures by algorithmic, i.e. computable operations, objects, and processes. Machines and programs seem to be capable of performing, at high levels, operations, decisions, and processes that, until recently, were considered to be exclusively human. Growing numbers of human beings believe machines were learning, detecting patterns, deciding more considerately than humans. They trust machines more than themselves in issues of intellectual and artistic creativity. From a human-centred view of the world, it is, however, fact that computers are superior in relentless repetition of micro operations, whereas humans remain superior in macro recognition of patterns. To study some aspects of this general claim, the paper takes a look at Sol LeWitt's famous statement about the idea and the machine. It asks in which sense aesthetics (to avoid "beauty") may become subject matter of computation. And it characterizes two cases of generative art, one from 1966, the other one from 50 years later. Its focus is on how strong algorithmics may be in generative art, and how totally human-made all decisions remain. The argument is in the form of case study, not logical derivation.

1. INTRODUCTION

"Die Programmierung des Schönen" ("Programming the Beautiful"), was the title of an exhibition in memory of Kurt Kranz, an artist who had studied at *Bauhaus* during the last few years of its existence (1930-1933, in Berlin), and who later became a professor at the *Hochschule für Bildende Künste* in Hamburg (1950-1972). The *Stiftung Bauhaus* Dessau dedicated to him a retrospective show of his work from 19 November 2010 to 29 May 2011, celebrating his hundredth birthday.

Kurt Kranz (1910-1997) worked in series and variations. The endless game of change, and processes of transformation in series of images caught his interest more than the individual painting. Eventually, series became his exclusive mode of expression. An exhibition at Kunsthalle Hamburg in 1990, celebrating his eightieth birthday, was tellingly called "The infinite image". In her review of the show, Petra Kipphoff wrote in the German weekly newspaper, DIE ZEIT: Never was he aiming for the individual image; there never was for him a final form, only the experimental series of form, never a masterpiece, only variants.

By that time, algorithmic art (often called "computer art") was already 25 years old and well established. But what Kranz was searching for and what he expressed, belonged to the starting points and important lessons of generative (or, say, programmed, algorithmic, computational) art: The individual work, the static piece on the wall was hardly of any interest any more; it got replaced by the *class of works* the program stands for — always already infinities. We may conclude that, in consequence, there cannot be masterpieces any more. The form of existence of the work is of a double appearance — perceivable by humans, and computable by machines.

Hannes Meyer, the last director of Bauhaus during its Berlin period, had announced that he would work towards connecting three forms of human activity: (i) workshop practice with (ii) free art creation and (iii) scientific research. He was proposing a fruitful cooperation between those three fields of human cultural activities that had developed into different directions. For the Marxist Meyer, as for many innocent practitioners even today, this was a fundamentally wrong development. As a member of Bauhaus, Meyer formulated his position as a critique of the early Weimar phase of Bauhaus (1919-1925). Even more than the founder, Walter Gropius, he emphasized a strict functionalism serving the masses of people instead of serving the needs of the wealthy and rich few living their boring lives of luxury.

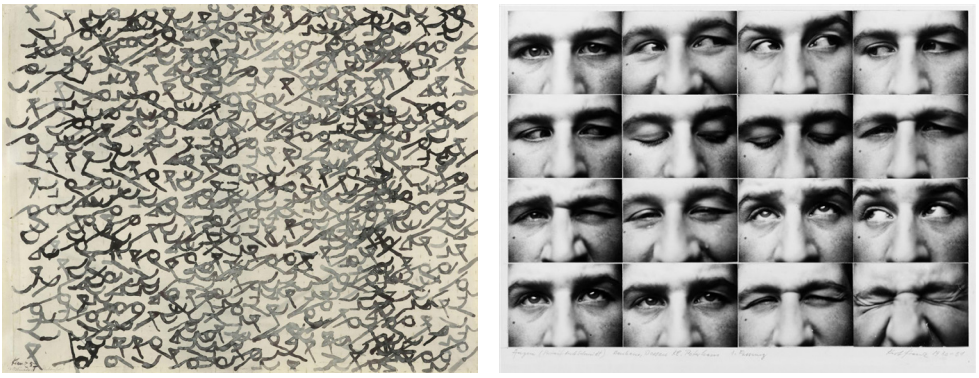

Fig. 1. Kurt Kranz, Two photographic works. "Ostinato" 1957 (left) and "Augen" 1930/31.

Following Petra Kipphoff's review mentioned above, Kurt Kranz learned from Josef Albers who was teaching the introductory course (*Vorkurs*) at Bauhaus, that creative and scientific work did not exclude each other, and that art could also be carried out as a research activity. Many of us would join in and welcome such a position. It essentially claims that research, the rational and enlightened approach to the world (as nature and culture), is not per se alien to the creative artist. For this is exactly what many are propagating nowadays and that they are trying to do in their actual work.

If the same was already suggested and proclaimed decades ago, it could only be welcome. However, it *is* now more than eighty years later. Has much changed? And if we rightfully notice and claim to see change, how does it actually show up? To which extent the concept of the present day, "artistic research", is really research, when compared to high levels of scientific research, to me remains an open question. To which extent does the word "artistic research" cover up more than reading some books, speculating about strange statements from physics, or developing a piece of software?

If this is so, we should ask ourselves why there is still no unification in sight of art and science happily collaborating. We do read a lot about similar goals and approaches, and about fruitful cases of cooperation. But yet the marvelous journal *Leonardo*, despite its many efforts in bringing together artists and scientists in joint adventures, has not really torn down walls. Only occasional odd projects may correctly be classified as requiring cooperative or transdisciplinary efforts. Usually in such cases, a small number of dedicated research-scientists struggle hard to generate results of creative works that are accepted as genuine results in both of those worlds.

The question may be, after all: Is *truth* and the search for it, the scientific goal and method, not fundamentally different from *beauty*[1] and interpretation of its claims, the artistic goal and method?

1. The word "beauty" appears here as a general formula standing in for other terms artists and critics are using for the values of art and aesthetics.

We may also ask what is different now with the basic infrastructure of, at least, Western-style societies that did not exist in the 1930s of Kurt Kranz and Bauhaus? To give an answer to this question, and a number of related ones, I know of nothing better than to point at the one technology that did then not exist at all, but that is now ubiquitous both in breadth and depth of its distribution. I mean, and everyone will share this with me: *computing technology* in all its variants. With only a tiny bit of exaggeration, we can say that today nearly everybody is roaming his or her city or village, home or workplace, morning or evening, individual or social activity, always already equipped with a computing machine of small and handy size, of enormous local and global power, and appearing as possessing tool-like and medial qualities at the same time. Computing technology, the *semiotic machine,* as Mihai Nadin called it (2007), is with us and upon us and underneath everything we do.

What is different, we may say, is that the deepest and most widespread cultural revolution of all times has taken place and is still conquering the seemingly last refuges, and discovering huge new areas of life, still to be turned upside-down such that the young generations rejoice, and the old ones mourn. This permanent revolution must correctly be called "The Algorithmic Revolution"[2]: The revolution of transforming into machinic computable form everything that *is already* computable, and of reducing to computable form everything that is *not yet* computable. This enormous epochal task has started its path through cultures soon after the founding scientists had come up with their ground-breaking results: Kurt Gödel,[3] Alan M. Turing,[4] and John von Neumann.[5] More and new works are still under way for the algorithmic revolution to creep into all the arteries of human individual and social life. In fact, it is on its way at an accelerating speed, and with an enormous impact. Much of it is devastating. In the rest of the paper, I want to contemplate two or three aspects or cases that, without necessarily thinking of computing, shed some light on that revolution.

2. Under this title, Peter Weibel organized an exhibition at ZKM (Center for Art and Media) in Karlsruhe, Germany, from 31 Oct. 2004 to 6 Jan. 2008. Unfortunately, he is now also using the term "Digital Revolution". — No publication directly came out of this.

3. (Gödel 1931)

4. (Turing 1936)

5. (von Neumann 1945)

2. FACTS FROM CURRENT TIMES

You find an entry in Wikipedia about *Deep Style*. A Google search generates hundreds of thousands of hits. We know that currently everything you do with a computer must lead to something "deep". It's the new word for "intelligent". You find around half a million hits in Wikipedia on *style*. The Google search for *style* generates 6 or 8 billion hits.[6] Restricting the search to "style in fine art" delivers about 194,000 hits, and 34,000 for "'deep style' in fine art".

6. Searches done on 11 February 2018, and again on 11 June.

Do such cheap experiments tell us anything? Not really. Such use of computing power is rather helpless, primitive, and stupid exercise. All I want to say here is this. An algorithm was published recently under the title of "A neural algorithm of artistic style" (Gatys et al. 2015). It immediately sparked an explosion of interest and work. The article is about separating — in fine art or anywhere else — *content* of a painting from its *style*. That separation is what the algorithm does.

That's not really interesting for us, with one exception, perhaps. For the exception, take a look at Figure 2. There you see on the upper left a photographic image of a scene in the town of Tübingen, Germany. To the right of it you see the style of William Turner applied to the Tübingen scene. In addition, the lower row displays the same for Vincent van Gogh's and Edvard Munch's styles. ("Style" here always is what the authors of the study have defined such that an algorithm may work with it.)

Parts of the world get excited about this, a large part of the population at least. Do you share this? I do not. If I were excited about this, what might be a reason for my excitement? I guess it would be something like this, a mixture, maybe, of ingredients from the following components.

> Oh, they have identified what a painting style is? That's absolutely fantastic. They can now separate contents from style, think of it! These categories have become manageable things. It's all done by computer. Is this computer not getting better than us? Deep neural networks! Think of it, that's our brains. It's great and fantastic, gorgeous, rough.

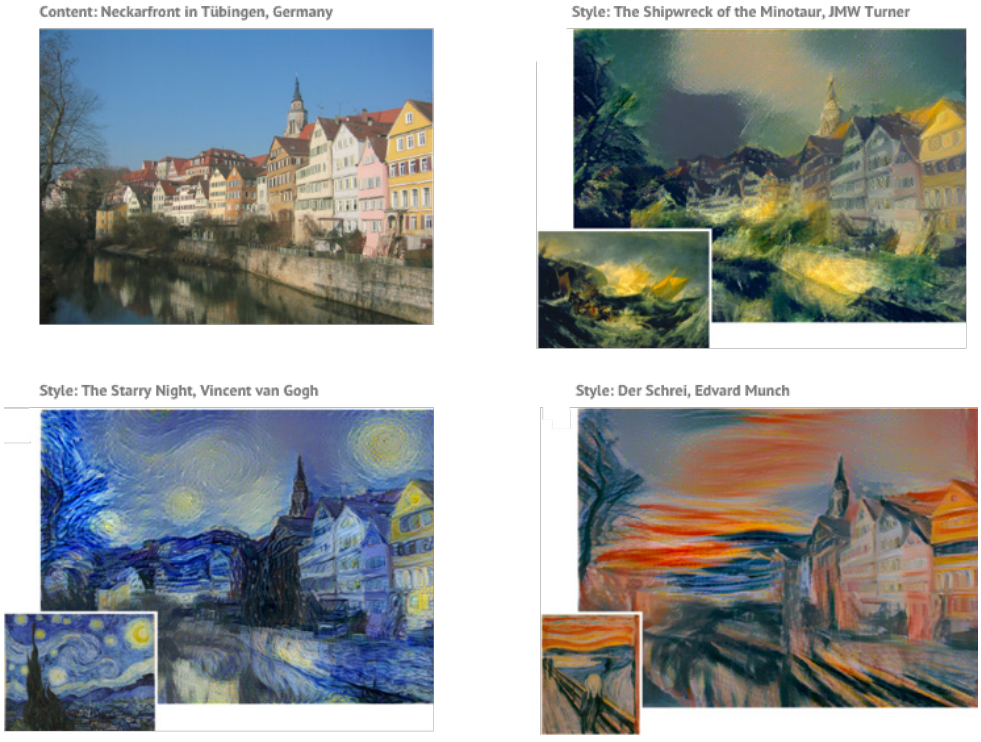

Fig. 2. Gatys et al., Three examples of mixing contents with style, 2015.

What Gatys, Ecker, and Bethge have done is, indeed, fantastic. They must be congratulated for their success. A success of courage. A success that, if we take it at face value, solves an issue that dozens of art historians were not able to solve over centuries. The books they have written, the ever new interpretations they have tried, the concepts and subtle arguments they have developed would now disappear and shrink to nothingness — if we take at face value what the Tübingen crew offers us.

This crew starts from the observation that painters have developed "skills to create unique visual experiences through composing a complex interplay between the content and the style of an image." (Gatys et al. 2015) Without hesitation, we are willing to study a painting and discuss it in terms of its content and its style. The form vs.

content dialectics has been most important and controversial throughout the history of all kinds and genres of art. But are we capable of giving a precise definition of the two concepts, *style* and *content*? Are we capable of doing this in a way that satisfies the requirements of computability and, at the same time, is rich enough to help us continue the discourse we are engaged in? That's freely taking up aspects from history, from aesthetics, from sociology or psychology, from the artist's life, from our personal tastes? All of them are aspects of style.

Our authors continue by deploring the fact that "the algorithmic basis of this process [between content and style] is unknown". That's a fantastic move in the development of a scientific investigation. The statement contains a hidden assumption that is essential to the entire work but void of plausibility. In order to make sense, the observation must be re-phrased into something like "As far as we know, nobody has tried to find out if algorithmic methods can take us closer to some more insight into the content / style dialectics. With the necessary caution, we want to try this." Without a section on the concept of *style*, however, nothing would make sense.

But none of this is in the paper! The three researchers have made a fantastic contribution to the technology of what they (with dozens of others) call *neural networks*. They are not more than an arrangement of layered and connected computations that have become feasible to be carried out because of technological progress. They know how to do this, so they do it. And they interpret what they do in bold terms that throw into the garbage bin entire conferences and libraries in the humanities. Only take a single look at the 800 pages of the collection on style (Gumbrecht & Pfeiffer 1986). Content and form have been discussed since Aristotle. Entire journals have been dedicated to the issue. It is so rich that in philosophy and the humanities you don't believe that there will ever be final answers.

Does this devaluate the work of Gatys, Ecker, and Bethge? Not at all. All it devaluates is the attitude the three authors take on. They have written software. They have applied it to images. Now they show the results. That's it. There is nothing but trivia when it comes to the issue of style. The authors seem to feel this. For they do not write, in their paper, what style should be. Neither do they say what content is, in their research. The two are just results of applying convolutions to images, a mathematical transformation of considerable complexity. The far-reaching interpretation of a separation of style from content does not seem to lead to anything new in the theory of style, and to *kitsch* only in creating new images.

3. PROJECTION BY MAX BENSE

Between 1954 and 1960, the German philosopher Max Bense (1910-1990) published four small books on aesthetics. In 1965, they were collectively re-published as one volume in slightly revised form (Bense 1965a).

The fourth of those *aesthetica*[7] had the title, *Die Programmierung des Schönen* (Programming the Beautiful). In the early 1960s, not everybody immediately thought of the computing machine and its operation when reading the word, "programming". But some certainly did. I assume this was Bense's intention. In a way, his title was a provocation. *Rationally* approaching in, perhaps, formally planned methods, the *beautiful* — this sounded like a contradiction in terms.

Also in 1965, for the occasion of the opening of the first exhibition of so-called computer art, Bense wrote a short essay under the title *Projekte generativer Ästhetik* (Bense 1965b). In a very general and abstract style, Bense here lays out a terminology that he intended to accompany the emerging algorithmic generation of works of aesthetic appeal. His essay does not directly address issues of programming. But some words are injected that indicate his expectations and intentions. Insofar, it appears justified to take this text as the founding document, the manifesto of algorithmic art.

7. Bense had borrowed the title, *Aesthetica*, for his books from Alexander Baumgarten's (1714-1762) great *Aesthetica* of 1750.

Be this as it may be, to program some aspect of the artificial world means to turn it into a rational kind of operation that can be carried out independently by many who do not understand in detail what the whole is to be. They must blindly follow systems of rules that, in their operational results, may be surprising even to those who have cooperated in following the rules.

It cannot come as a surprise to the reader to learn that the famous Swiss designer, typographer, and artist, Karl Gerstner (1930-2017), had in 1964 published his *Programme entwerfen*, a thin and greatly inspiring volume on programs that were not computer programs. However, each case of design the book dealt with was of programmatic kind. Gerstner offered a motto for what he meant by this: "Instead of solutions for problems, programmes for solutions." (Gerstner 2007) Given a problem, a programmatic way of solving it is, not to solve it, but rather to write something that constitutes a systematic, rational, clear way or instruction to find a solution. You take a step back in a more abstract direction, and describe characteristics and steps that the solution (*any* solution!) must obey.

By the way, when Gerstner in 1965 heard that in Stuttgart someone was writing computer programs to generate parameterized drawings, he immediately decided to insert a note on "programme als computer graphik" into the second edition of his book (which has in 2007 appeared in its third, now English, edition.)

But back to Bense's *existential rationalism*, as he himself called his philosophy. It was his intention to bridge the gap between the historic, social, scientific, and aesthetic approaches by the human mind to understand the world as it is and as it is made. He starts from the assumption that the world is artificially makable or constructable. Civilization is not a state, but a process. A process engraved into humankind. That process never stands still. It is in permanent exchange with nature and innovation. Metabolism and innovation build the basic occupation of humankind.

The development of Western civilization, in important areas, leads to a need of precision. Precision is the condition of engineering work and processes. Precision's technological correlate is measuring. Measuring, in turn, is a means of rationality. And rationality is analytic: it divides the phenomena into parts that are easier to treat in isolation. Only, when in the early Renaissance the human mind had reached this level and, thereby, the level of fundamental *makeability*, only then the description of physical processes reached the point of controllability and constructability by technology.

Such is Bense's basic assumption about humankind, an assumption that, in the mid-20th century, has led to decrease the distance between technology and aesthetics. Processes of information are responsible for this and, we should add, for processes of signs: *semioses*. Thus, the beautiful enters[8] the realm of machinic construction, of algorithmic description, and even of mathematical, computable optimization. Gaps may be closed by the rational mind.

Bense's own thinking, and the more concrete work by his disciples — Helmar Frank (1964) and Rul Gunzenhäuser (1962) — have established a theoretical framework within which such radical thinking makes sense. Further historical development has raised doubts against such extreme trust in the options of the rational mind. Semiotic description of computable semioses makes sense and is helpful. But not everything in aesthetics can be turned into computable form.

8. Using the term "the beautiful" is due to the historic account of Bense's writing. One of the reviewers has pointed out that it is rather old-fashioned. He or she is right.

4. PROJECTION BY SOL LEWITT

six-inch (15 cm) grid covering each of the four black walls. White lines to points on the grid. 1st wall: 24 lines from the center; 2nd wall: 12 lines from the midpoint of each of the sides; 3rd wall: 12 lines from each corner; 4th wall: 24 lines from the center, 12 lines from the midpoint of each of the sides, 12 lines from each corner. 1976

Fig. 3. Sol LeWitt, Wall Drawing #289, concept.

In 1976, the Whitney Museum of American Art in New York acquired a work that looks like what Figure 3 is saying. You will agree, I claim, that the figure is made up of text. A text more or less in plain English.

What LeWitt sold to the museum was a typewritten set of rules or guidelines, instructions really, of what to do and obey when the work is to be shown to the public. The visible work itself, in some way, never existed, or existed only temporarily. And it could exist at different places at one and the same time. For LeWitt's point was that the concept was more important than the visible work itself. The work, he says, consists of a concept and its realization. More important of the two is the concept. His, the artist's, involvement ended with a certificate that the Whitney owned the concept.

In the history of art up until the mid-20th century, concept and realization of the work were more or less one and the same. At least, they were inseparable. But the artist usually did not sit down and explicitly formulate the rules according to which he would carry out the work.

He would, however, quite often sketch parts of the work. He might do several sketches, and start creating the work only when he was convinced of his sketching having reached a state where he felt a good artistic work would result. But in the act of realizing the painting, even with the final sketch in front of him, he would not necessarily slavishly copy the sketch, but feel free to deviate in each and every detail he was carrying out in following the concept.

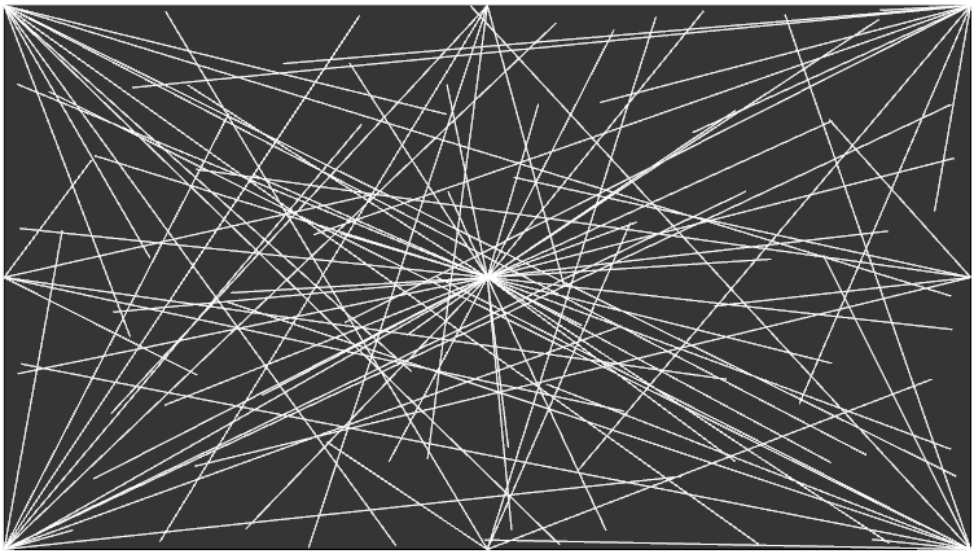

Fig. 4. Sol LeWitt, Line Drawing for Wall Drawing #289, 1976.

In 1967, Sol LeWitt summarized what he had done over the last couple of years, and what he intended to do in his minimalist future, in his famous "Paragraphs on conceptual art" (LeWitt 1967). The central paragraph is this:

> The idea becomes the machine that makes the art.

Let me repeat this in my own words. There is an idea, wherever it comes from. We only know it exists. It is there without question because otherwise we could not talk about it. This idea undergoes some sort of transformation of which, again, no detail is given. But as this transformation is happening, the idea becomes something new or other: It turns into a machine. This may already be considered a kind of miracle. But then this new machine starts doing something. It is making something. And that something that the machine is making ("generating") is called "art". Who is saying, it is art? Who is there to know? — We may depict the LeWitt automatic process as:

IDEA (becomes) MACHINE (makes) ART

A lot has, of course, been written about such a simplistic way of identifying the process of art making. But a very simple fact must not be forgotten. You may formulate

the idea for a piece of art that, in LeWitt's case, is realized as a wall drawing. That wall drawing, when the exhibition is over for which it had been done by assistants in the first place, is painted over by white or some other paint or material. So the painting disappears. The concept, if explicitly written down ahead of time, however, remains. It can be repeated elsewhere, or even at various locations at the same time. So the idea *equal to* the concept does indeed remain as the essential aspect of the work. We may tend to find LeWitt's concept a convincing thought. At least in the kind of art that allows for the clear separation of concept and work. The idea (or concept) is the human's; the work is the machine's. *Myself and the other* — this is the old theme of art, but now in modern times.

We had encountered such an hypothesized separation before, in our second example. Only then it was a separation of content and style.

In algorithmic art, the idea must be formulated in a much more precise manner than in traditional art. It must be done in such a way that the explicit concept is equivalent to a machine — it "becomes" the machine. Such a machine does now exist. It is exactly the computer. Algorithmic art thus appears as what LeWitt's minimalist and constructive art was approaching.

But, beware! When the explicitly formulated idea is being performed by people following the rules, they are still free to interpret those rules in many ways. There are still selections to be taken as, e.g., the colours and paints, the kind of brush, and more. LeWitt is aware of this fact. He takes it into account. The idea that becomes a machine must be *interpreted* in order to become that machine. The program must be fed by concrete values for all its variable parameters. The autonomy of the machine in making art is rather restricted. And, by the way, who is judging the art of the "art"?

5. FACTS FROM EARLY TIMES

Writing a program, or developing an algorithm, is often involving at least a bit of doing mathematics. Required is a kind of thinking permanently getting close to the unforgiving rigor and precision of mathematics. However, this is not the same as mathematical thinking.

Mathematics progresses, in the small and in the large and, speaking very coarsely, only in form of statements whose truth can be proved and must be proved. Mathematical thinking stops when the proof, or its contrary, cannot be given.

Algorithmic thinking, however, is thinking in terms of actions. Some process is to be described, again: with utmost precision and without any ambiguity. The process, if carried out successfully, is supposed to generate a state or result or experience of a kind that you had wanted and requested. The result may exactly be what you had expected or, depending on further contexts, it may be within a certain narrow domain around an ideal that you want to get at.

The two kinds of thinking — mathematical and algorithmic — share precision in each and every detail. But they differ in what they expect of the world. Mathematics assumes there is truth.[9] And thus celebrates a permanent festival of truth. Algorithmics is sequences of actions. Its dimension, if there were such, is time. Mathematics happens much more in structured spaces.

Designing and writing algorithmic components for aesthetic objects is a process in the domain where aesthetics, algorithmics, and a bit of mathematics meet. There are selections you must perform for the visual (and other) materials that may appear in the work. There must be selections of formal models that you are to use in your description of actions. They take you into mathematics. And there must, of course, be a concentration on the actions themselves and their efficient and effective working.

This sounds terribly abstract. I want to show results from a program from 1966 which, I believe, convincingly moved back and forth between those three aspects:

9. Mathematics happens to be the last refuge of truth. There, and only there, you can still positively relate to truth. Because in mathematics, truth is a purely formal concept, empty of contents.

mathematics, algorithmics, and aesthetics. The mathematics was quite explicit and formal, but powerful. Algorithmics was more open but became demanding in keeping track of all the possible events. And aesthetics, of course, is the ultimate criterion under whose roof everything is happening. It is done by human subjective judgment. Only within narrow limits, the mathematics and the settings of parameters may be such that their results are convincing the audience. That's the same across all forms of art, and therefore not different in the aesthetic realm.

The program in question is called "Walk-through-Raster". It requires a repertoire of signs to be selected, simple or complex (aesthetics!). It requires transition probabilities to be given that control what is going to happen next; they are allowed to differ depending on where on the image you are (mathematics!). And it requires that you specify some more parameters, the most influential of which is the mapping of a chain onto the two dimensions of the plane. Figure 5 shows examples. An edition of 40+4 pieces was generated, each one different, for the Abteiberg Museum in Mönchengladbach, Germany.

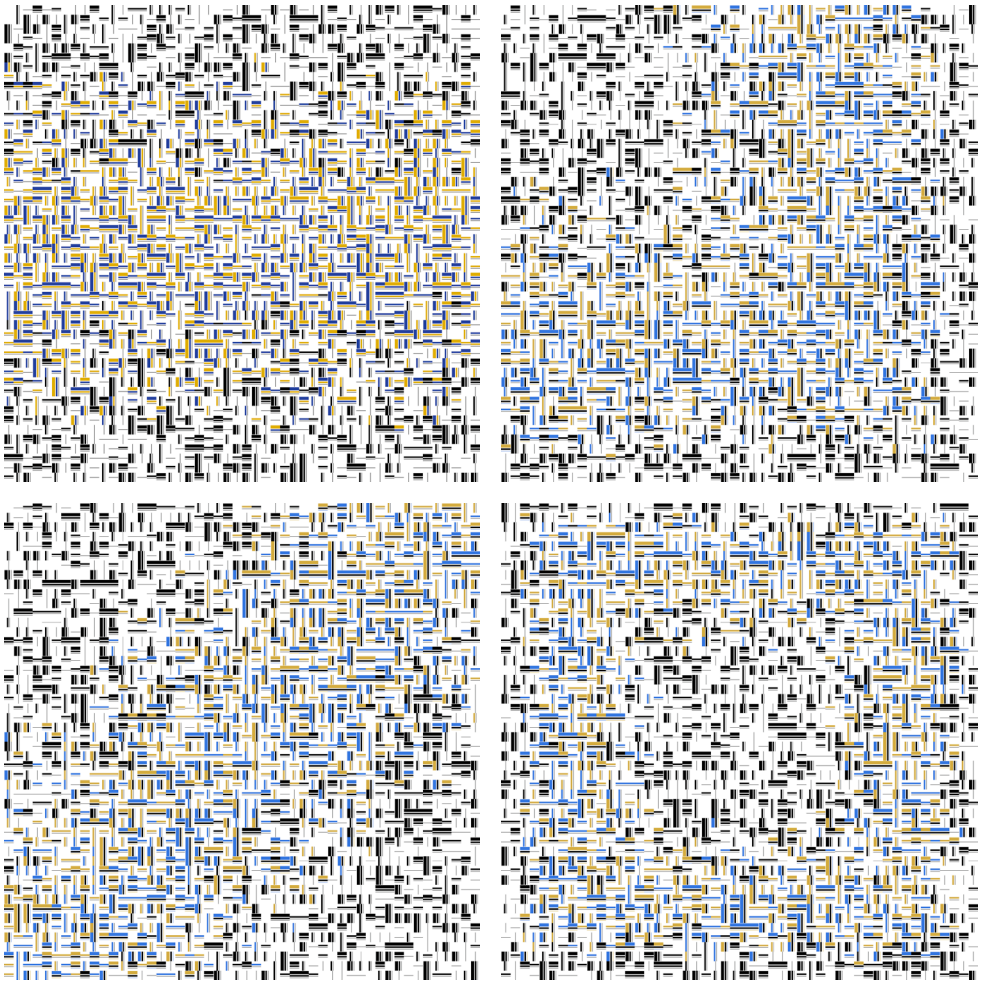

Fig. 5. Frieder Nake, Walk-through-Raster, new version of 2005.

Without giving more space to a discussion of these four drawings, what you see is how a selection of a *repertoire* of mild complexity helps dealing with a sort of richer aesthetics. Further, how the mathematical power of the *Markov chain* (borrowed from probability theory) allows for some first global patterns emerging from local control, in particular if, as here, the transition probabilities are not stationary. And finally, how various mappings of linear chains onto the plane create similarities of an abstract kind.

Comparing the geometric straight-line aesthetics of these four drawings with the flashy deep structured style exercises of section 2 may draw all attention to the landscape images. In them, the Sunday painter re-appears after having been squeezed

10. In generative art, you develop algorithmic descriptions of images to appear without seeing images but only formulae and algorithmic structures.

through a neural network torture. Big data easily win over mathematics of probabilities and pseudo-randomness. Image processing in its results appeals more to an immediate judgment than "painting with eyes wide shut".[10] I offer the examples and statements of this essay as stuff to further think about.

6. BEAUTY AND PROGRAM

Kurt Kranz and Max Bense knew each other. They may have been friends. They occasionally met in Hamburg. In the 1960s, Bense wrote prefaces to Kranz's catalogues. Did they influence each other? There were commonalities: the rational approach to making art by selection, variation, series, experiments. The processual character of aesthetic objects in the 20th century. The denial of the great piece that shakes the world of art.

In 1965, Bense coined the term "generative aesthetics" in the context of computer programs being used to generate first drawings of an aesthetic claim (I have mentioned this before). In retrospect, Kurt Kranz in his experiments was working like a programmer. But he himself was, of course, carrying out the program that he had thought up in his mind where he still kept it. He had *not* formulated that "program" in a proper programming language. But as we see, ideas are floating around, shared by different persons who are not even aware of the other person sharing the same idea.

Neither did Sol LeWitt write computer code to automatically run the conceptual schemata he had thought up for the generation of a work. Again, such schemata either remained in a state of only rough formulation without realization of a concept; or LeWitt had to go through the trouble of performing the operations himself if he and others should actually see the new piece (he did not usually realize those works as material forms. The gallery hired people to do that.) In this way, Sol LeWitt's machine was a human machine.

The question of "beauty" or, better, of aesthetic evaluation — "can aesthetically interesting results be generated by an algorithm?" — must, of course, be answered by: "Yes, this may be the case." But the answer also is: "Whether or not it actually happens, is not an issue of the algorithm." Artists generate works. Of course, they want their work to become art, great art. But this is not theirs to decide. Society only, in extremely opaque ways, is perhaps turning an artist's work into a work of art. In the old days, such work was then called "beautiful". Now it suffices if some person finds it interesting.

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Design Thinking, Bullshit, and what thinking about Design could do about it

Keywords: Design Thinking; Bullshit; Innovation; Maker's knowledge; Philosophy of Design.

Abstract:

Design thinking has been heavily promoted as a powerful tool for human-centred innovation and as a versatile problem-solving method for any issue involving sociotechnical systems. Recently, however, some critical voices within design and science & technology studies have called bullshit on the soundness of such claims, accusing design thinking of essentially trivialising design methods to serve purely commercial goals. Through an analysis of the recent history of design research and an overview of some (philosophical) accounts on the concept of "bullshit", this paper aims to clarify whether there are sufficient reasons to dismiss and belittle design thinking in such terms. Designers, educators, and anyone concerned with how obfuscatory and vacuous discourse threatens deep reflection on design perhaps will be interested in this account.

1. INTRODUCTION

Over the last four decades, in most countries, neoliberalisation[1] has gradually but steadily caused public and private power to merge "into a single entity", "rife with rules and regulations" (Graeber 2015, 17). This process of "total bureaucratisation"[2] has involved not only radical economic and political realignments, but also a cultural shift. Accompanying deregulations and privatisations, the idiom and practices that originally emerged in the "corporate bureaucratic culture" of financial and management circles have spread to every area of human activity where "people gather to discuss the allocation of resources of any kind" (2015, 21). Paradoxically, however, this bureaucratic takeover now comes disguised in the language of *innovation*. Change has been transformed — from a means — into an end in itself. Organisations of all sorts are now crowded with people (managers) who do not think of themselves as bureaucrats but whose only job is to constantly devise new procedures, regulations, and metrics to improve "accountability" or "productivity". Concocting such "hollow change" requires a constant "supply of new management fads and fashions" (Spicer 2017a); recently, those providing them have turned their attention to Design for inspiration. The idea roughly being that *design thinking* — i.e., approaching problems and constructing solutions the way designers supposedly do — can be learned and employed by anyone in any context and for any reason.

The most vocal proponents of design thinking characterise it as "a human-centered, creative, iterative, and practical approach to finding the best ideas and ultimate solutions" (Brown 2008, 92); as a seemingly unparalleled method to "innovate". This conflation between design thinking and innovation is recent, yet, both concepts have rich histories of their own — the latter's spanning for hundreds of years and involving several shifts in meaning (Godin 2015). The main ideas behind design thinking have been discussed at length by theorists such as Richard Buchanan (1992, 2009, 2015), Nigel Cross (2001, 2006, 2011), and Kees Dorst (2011), amongst others. The common theme in their accounts is roughly that Design is not only a creative practice but should be regarded as an epistemic approach halfway between the sciences and the humanities. Recently, however, some critical voices (Jen 2017; Vinsel 2017) have called into question — or rather, have *called bullshit* on — design thinking and the way some of its advocates promote it. They accuse them of being reductive, vacuous, uncritical, and of focusing on (simplistic) processes rather than on evidential outcomes. Since neither of these critics is a design scholar and the channels where they voiced their concern are not academic, it would be easy to dismiss their complaints as mere straw-man bashing or, worst, as a non-issue. Nonetheless, design thinking is indeed becoming popular amongst members of the neoliberal bureaucratic culture, who are often attracted to "business bullshit" (Spicer 2017a, 2017b). While name-calling rarely, if ever, leads to fruitful discussions, we can at least regard this blunt criticism of design thinking as an opportunity to gain some understanding about Design, and about bullshit as a phenomenon.

This paper does not (and cannot) offer an exhaustive and definitive account of design thinking. Instead, by surveying what can be understood by "bullshit" from a philosophical standpoint and by briefly looking at some of the theoretical foundations of design thinking, it aims to clarify whether the arguments of its critics are unfounded or not. The first part offers a synopsis of the main objections against design thinking. Next comes a summary of the origins of design thinking and an overview of the philosophical understanding of bullshit. The following section provides a discussion in light of the previous accounts. The main argument advanced by this paper is that design thinking is far from being a homogeneous concept or phenomenon. It contends that while some implementations of design thinking could indeed be accused of serving as a vehicle for the obfuscation of "the truth", this judgement cannot be generalised. Furthermore, it suggests that perhaps the problem is not design thinking

1. Meaning the "open-ended and contradictory process of politically assisted market rule" (Peck 2010, xii).

2. As Graeber (2015, 9) notes, despite the contempt of neoliberals for government bureaucracy, any policy intended for reducing government interference, actually produces *more* regulations and bureaucratic procedures. Thus, as Peck (2010 xiii) puts it, far from being the antithesis of regulation, neoliberalization is "a self-contradictory form of regulation-in-denial".

but the way the bureaucratic culture portrays and thinks about innovation and its relation to Design.

2. CALLING BULLSHIT ON DESIGN THINKING

In a recent talk, Natasha Jen (2017), a designer from Pentagram, denounced what she described as a "complete lack of criticism" of the "design community" against design thinking. She argued that a simple Google search showed how design thinking has been reduced in recent years to a process consisting of five (seemingly linear) colour-coded steps,[3] buzzwords and, above all, Post-it notes. Jen's main objection was that although the five-step model appears to be thoroughly reasonable, it lacks a crucial component: criticism.[4] Being a practitioner, she contends that critical feedback and evaluation throughout the entire design process are the *only* means to improve potential solutions to a given design problem. Jen's second objection concerns design thinking's apparent reduction of design tools to a single medium: Post-it notes. For her, this is a token of the extent to which promoters of design thinking have reduced the complexity of professional Design. She thus offers her definition of design thinking as something that:

> packages the designer's way [of thinking] by working for a non-designer audience by codifying their processes into a prescriptive, step-by-step approach to creative problem solving, claiming that it can be applied by anyone to any problems. (Jen 2017, min 4:14)

Being aware of the historical roots of design practice and the epistemic lineage behind design research, Jen contends design thinking was originally a rigorous framework for industrial design but has since then been latched-on and appropriated by other design fields. Mostly, she is concerned about the way business jargon is supplanting serious reflection about design methods and procedures. Unimpressed by examples of products supposedly developed with the aid of design thinking, Jen's third objection is its focus on processes rather than on results. Because, the way she sees it, genuinely successful designs (such as those created by Charles and Ray Eames) always involve a tangible "evidence" of the results. Therefore, she challenges design thinking promoters to prove, not procedurally but via concrete results, how and why their method can live up to the hype.

Expanding Jen's criticism, in a recent *Medium* piece, Science and Technology Studies professor Lee Vinsel (2017) compares the influence of design thinking to late-stage syphilis infection. While he is sympathetic to Jen's objections and relies partly on them to make his case, the primary targets of his acerbic critique are not design methods *per se*. Vinsel's first objection concerns the way design thinking promotes "innovation" — which he derisively qualifies as a "lipstick-on-a-pig idea of innovation". He is appalled by the suggestion that design thinking could become "the new liberal arts"[5] and thus be incorporated "into many other parts of education". Vinsel is unimpressed by such proposition and by the idea — advanced by some proponents of design thinking — that the ultimate goal of education ought to be "social innovation". Vinsel connects such ideas to what he calls the "*adolescent* conception of culture" that advocates of design thinking have promoted. Finally, he summarises his position by arguing that design thinking is not about design, the liberal arts, or meaningful innovation, but about commercialisation and "making all education a shallow form of business education".

For all their bluntness, Jen's and Vinsel's commentaries make valid points: openness to feedback is crucial for any creative enterprise and, in a field such as design, tangible outcomes are the *only* thing through which the merits of a given solution can be judged. Furthermore, innovation is a nebulous, relational concept, and shallowness is the least desirable feature one should hope to associate with education.

3. These are: 1. Empathise; 2. Define (the problem); 3. Ideate; 4. Prototype; and 5. Test.

4. This is no mistake, the critical component is absent by *design*, the reason being that bringing in criticism in an early stage may hamper the creative process, inhibiting the emergence of "out-of-the-box" ideas.

5. Vinsel cites a recent article in which history professor, Peter N. Miller (2015), discusses precisely that possibility.

However, name-calling and pungent commentaries only go so far when it comes to building fruitful criticism. Our goal here is to understand whether design thinking is being unjustly lambasted or not, and in the latter case, to contribute to preventing Design from becoming yet another source of "business bullshit" (see Spicer 2017a). Hence, perhaps it is best to clarify the terms involved in the controversy at hand. The following sections summarise the origins of "design thinking" and provide an overview of the (philosophical) criteria to determine whether we can reasonably dismiss it as "bullshit".

3. A (SHORT) GENEALOGY OF DESIGN THINKING

As a phenomenon, Design is "quintessentially modern" (Parsons 2016, sec. 1.4) — at least in the West; its historical origins, although contested,[6] lie somewhere in the early Industrial Revolution. For the past 250 years, Design evolved from a trade activity that displaced "tradition-based craft" (Parsons 2016) to a "segmented profession" to a "field for technical research" (Buchanan 1992) and scholarly discipline. While its philosophical roots are to be found in the Renaissance, Design as a genuinely independent practice only emerged in the twentieth century. For its part, theoretical reflection on the wider social, economic, and cultural implications of Design began to develop in the late nineteenth century with the Arts and Crafts movement. The Interwar period brought schools such as De Stijl and the Bauhaus, and the Postwar witnessed the rise and fall of the Ulm School of Design (*Hochschule für Gestaltung Ulm*) which, in turn, played a central role in the rise of the design methods movement and design science during the 1960s-70s. The last decades of the twentieth century brought design studies, and the early 2000s the prefiguration of what now may be called "philosophy of design" — see Galle (2002) and Love (2000) for a short overview.[7] Discussing at length each one of these approaches is beyond the aims and possibilities of this paper. Nonetheless, we could say that all of them regard Design more or less as a particular epistemological system mainly concerned with the built environment.

While the exact origins of the term "design thinking" are difficult to trace, a quick search in Google's Ngram Viewer reveals its usage first began to take off in the 1930s and grew more or less steadily throughout the following decades. In 1987, Peter Rowe published *Design Thinking*, a book that aimed to show how architecture, Design, and urban planning are manifestations of the same strategy of inquiry. Since the early 1990s, however, the incidence of the term shows a steep rise. Perhaps we can attribute this growth to a series of conferences organised around this time — such as the *Design Thinking Research* symposia, and to publications on the topic by theorists such as Cross and Dorst (see Cross 2001).

In the early 2000s, Todd Kelley and Tim Brown from the design consultancy agency IDEO branded their in-house "problem-solving" process as design thinking[8] and began promoting it as a new comprehensive strategy to foster innovation. By 2006 Kelley and his colleagues secured a generous donation from the German software businessman Hasso Plattner to establish the "Stanford d.school" (Miller 2015). Officially named the "Hasso Plattner Institute of Design", the d.school became the de facto think tank of what henceforth I will be referring to as IDEO-style design thinking. Through the d.school, Kelley and his associates have successfully popularised the (synecdochical) notion that buzzwords, rituals and practices associated with managerial culture, Post-it notes, and, above all, the five-step design process are the essence of design thinking. However, despite its simplification of Design and its commercial outlook, the d.school brand still manages to stay true to a notion that has guided design research since its origins.

The core assumption behind design thinking, in general, is that Design as an activity and practice involves a particular mindset: a "third way" (Brown 2009) to regard

6. As Parsons notes, some of the conceptual problems associated with the origins of Design concern the distinction between the craftsperson and the designer (2016, sec. 1.4).

7. Whereas design theory is mainly concerned with the practice of Design, philosophy of design is concerned with Design and its specific aims and problems "in light of the fundamental questions that philosophy examines: questions about knowledge, ethics, aesthetics and the nature of reality" (Parsons 2016, Introduction).

8. Reading Tim Brown's book, *Change by Design*, one gets the impression that the very concept of design thinking originated in the early 2000s during a casual conversation between him and Kelley (see Brown 2009, Introduction).

and address problems, which stands in-between intuition and (logical) rationality.[9] The design theorist L. Bruce Archer argued, for example, that "there exists a designerly way of thinking and communicating" that is different from those of the sciences and the humanities "when applied to its own kinds of problems" (1979, 17).[10] Archer contended the traditional division of scholarly subjects between these two domains "leaves out too much", in particular, competencies concerned with "material culture" (1979, 18), and hence called for the institution of a "third area" in education. Design "with a big D" would have equal standing in education alongside Science and the Humanities but it would comprise "the collected body of practical knowledge based upon sensibility, invention, validation and implementation" (1979, 20). Furthermore, whereas the "essential language[s]" of Science and the Humanities are, respectively, (mathematical) notations and natural language, Design would rely on models. In short, Design represents a distinctive "approach to knowledge" and "a manner of knowing" that are irreducible to either pole of the conventional Western epistemological framework.

Building upon and expanding Archer's ideas, Nigel Cross promoted the notion of a "designerly way of knowing" in a series of homonymous publications. There, Cross further characterised Design as a discipline concerned with the "man-made [sic] world" that values "practicality, ingenuity, empathy, and a concern for 'appropriateness'" (1982, 221–22); which normally deals with "ill-defined, ill-structured, or 'wicked'" problems (1982, 224). Cross defends the epistemological autonomy of Design, urging scholars and practitioners to "avoid swamping our design research with … cultures imported either from the sciences or the arts" (2001, 55).[11] He has sought to understand how and why designers think the way they do, and to show their epistemic stance is, in fact, a manifestation of a fundamental aspect of human intelligence in general (2006). More recently, echoing the title of Rowe's ([1986] 1991) previously mentioned survey of the relationship between design practice, architecture, urban planning, Cross (2011) published a book titled *Design Thinking*. There, he aimed to articulate the basic cognitive and creative skills that designers employ, characterising them as a kind of "natural intelligence"[12] (Cross 2011, chap. 8) that is available to anyone willing to develop it.

It is clear from the previous survey that design thinking constitutes a rather ample problem space, and that IDEO'S d.school is far from being its catalyser. We can now proceed to the following sections, which summarise the criteria for determining what counts as bullshit and also discuss Jen's and Vinsel's objections in light of what we have learned so far.

4. IDENTIFYING BULLSHIT

In everyday language, "bullshit" is unmistakably a derisive expletive, but in the mid-1980s Harry Frankfurt ([1986] 2005) turned it into a subject of serious philosophical enquiry. Originally published as an essay in 1986 and republished two decades later as a book, Frankfurt's *On Bullshit* is a seminal work on the study of this phenomenon.[13] Frankfurt begins his conceptual analysis by dissecting Max Black's (1982, 23) characterisation of "humbug" as (a deliberate) "deceptive misrepresentation… of somebody's own thoughts, feelings, or attitudes". While Frankfurt agrees humbug might share some qualities with bullshit (namely, the intentional misrepresentation of one's intentions), he contends Black's account is not sufficiently adequate nor accurate for describing "the essential character of bullshit" ([1986] 2005, 18). For in Frankfurt's view, such essence lies in a lack of concern for the truth; in the bullshitter's utmost "indifference to how things really are" ([1986] 2005, 33–34).

Humbug, like lying, is intentionally deceptive and insincere, but bullshit as Frankfurt sees it, *does not need to be false*. This feature makes it more culturally tolerable but also more ethically dangerous. Liars deliberately conceal the truth; what they hide

9. Defences of such epistemological middle-ground echo C.P. Snow's ([1959] 2012) "Two Cultures" account, as well as his latter, more conciliatory characterisation of a then-emerging "third culture" (Snow [1963] 2012).

10. Archer characterises design problems as "ill-defined", more or less following Horst Rittel's concept of "wicked problems", i.e. the kind in which there is no consensus about the definition of the problem itself nor its solution. For a more thorough discussion of wicked problems see Churchman (1967); Rittel and Webber (1973); and Coyne (2005).

11. One cannot avoid noting the resemblance between Cross' statement and Clement Greenberg's ([1940] 1999) quintessentially modernist defence of the "purity" of the artistic medium.

12. It is important to note that Cross partially builds this particular argument on the insights of Howard Gardner's ([1983] 2011) "theory of multiple intelligences".

13. As well as a commercial and popular success. As Hardcastle and Reisch (2006) note, despite being a typical, unassuming academic work, the book made the New York Times bestseller list — where it stayed for twenty-six weeks, guaranteeing Frankfurt an appearance in *The Daily Show* with John Stewart.

is their attempts to lead their audience "away from a correct apprehension of reality". In this sense, liars know (and care) about the distinction between true and false information. By crafting falsities, liars are "responding" to and — to such extent — being "respectful of the truth". Conversely, a bullshitter does not "care whether the things he says describe reality correctly". Bullshitters merely select, or "make up", information to suit their purposes ([1986] 2005, 55–56). Whereas a liar intentionally *rejects* "the authority of the truth", the bullshitter does not even *acknowledge* its existence. This omission makes bullshit "a greater enemy of the truth than lies" ([1986] 2005, 61). It follows that in Frankfurt's account, the *intention* — and hence, the mental state — of a person is the crucial factor in determining whether what he or she is saying can be qualified as bullshit.

Frankfurt's account, however, is not without challenge. In his essay, "Deeper Into Bullshit", G.A. Cohen argues that Frankfurt's "activity-centred" definition is "too narrow" (2002, 337). "Frankfurt-bullshit", Cohen notes, is "just one flower in the lush garden of bullshit"; it is exclusively concerned with "ordinary life", leaving out, for example, the type of bullshit "that appears in academic works" (2002, 323). Cohen calls into question Frankfurt's insistence on the "essential" features of bullshit because such definition is not, in fact, characterising the utterance itself, but the bullshitter's (morally questionable) state of mind. Cohen further questions Frankfurt's sharp distinction between bullshitting and lying. He argues that "it is neither necessary nor sufficient for every kind of bullshit" to be uttered by someone indifferent to the truth (2002, 332). An honest, truth abiding person could be, unbeknownst to her, uttering bullshit out of ignorance — or even due to self-deception or more charitable reasons, as we will see below. Cohen thus suggests a different criterion for identifying bullshit: "unclarifiable unclarity". Here, bullshit is discourse "that is not only obscure but which cannot be rendered unobscure", since any attempt to clarify it yields "something that isn't recognisable as a version of what was said" (2002, 332–33). Cohen thus places the blame not on the bullshitter but on the bullshit itself. In this way, what is criticised is the product of bullshitting, which is visible, rather than the process that led to it, which is opaque (2002, 336). In summary, in Cohen's "output-centred" approach, unmasking a bullshitter does not require proving that he did not care about the truth, but showing that his utterance, even when reformulated, makes no sense.

A kind of middle-ground between Frankfurt's and Cohen's accounts is offered by Scott Kimbrough (2006). Kimbrough agrees that Frankfurt's definition leaves out unintentional bullshitting, but he nonetheless endorses the notion that bullshit *results* from a lack of connection with the truth. Kimbrough objects that we should not and perhaps cannot eradicate bullshit because it would compromise many aspects of our social interactions. Bullshitting, whether we like it or not, is crucial for civility and politeness, at least in most Western societies. Frankfurt calls bullshit whenever the truth is disregarded, but while his definition is correct, it is also true that people often engage in bullshitting to avoid confrontation, to protect someone's feelings, or to socialise. In such instances, there might be justifiable reasons to disregard the truth. Kimbrough's thus contends that "bullshit must be recognised for what it is and restricted and sanctioned to truly justifiable uses" (2006, sec. 5.). Since the mere act of justifying why bullshit is preferable over truth in any given situation implies being able to distinguish between the two.

Kimbrough, nonetheless, cannot endorse Cohen's output-centred criterion, insofar as rejecting the product implies rejecting the process behind it and hence the people responsible for it. Despite Cohen's attempt to separate the bull from the shit, so to speak, "it's just not possible to call bullshit courteously" (2006, sec. 4.). As Kimbrough notes, qualifying something as bullshit means marginalising it and excluding it from serious discussion. Many people call bullshit not because they feel the truth is being disregarded, but because the object of their scorn threatens their beliefs or values.

Frankfurt's truth-centric definition remains valid because it circumvents such potential relativism. Kimbrough's way to reconcile Cohen's insight that bullshit can be produced unintentionally while retaining Frankfurt's truth-centric criteria is by shifting away from psychological processes (states of mind) and towards "methodology". In this manner, the way bullshit is produced continues to be the determinant factor: bullshit being the result of adopting "lame methods of justification, whether intentionally, blamelessly, or as a result of self-deception".

Bullshit constitutes a type of discourse which, depending on the context of utterance and the values of the audience, is judged as having neglected the truth for poorly justified reasons. The following section will discuss Vinsel's and Jen's objections against design thinking in light of the aforementioned criterion for identifying bullshit, to determine whether their criticism is indeed justified.

5. DISCUSSION

5.1. The epistemological problem of design

Recapitulating, Jen's first objection concerns the absence of an explicit critical component in the five stages to which IDEO-style design thinking reduces the design process. Her decades-long experience informs her criticism as a professional designer who understands that creative improvements often come at the cost of relentless (and often harsh) feedback. This objection is not trivial; it is intimately linked to one of Design's most crucial problems; one that arguably stands behind every attempt to formalise and systematise design methods and processes: how can a designer be confident that what she creates will duly serve its purpose? That her solution will work?[14] The problem is epistemological — and involves a certain degree of futurology; it asks what kind of knowledge designers require to create adequate solutions for any given problem?

Design is, by definition, a projective and *poetic* activity. It does not seek explanation and prediction (like the sciences) nor insightful understanding (like art and the humanities), but it rather aims to change and (re)construct aspects of the world. Although definitions may vary, Design is more or less characterised as an activity concerned with "*the conception and planning of the artificial*", to borrow Buchanan's (1992, 14) words. Or, to put it in different terms:

> design is the intentional solution of a problem, by the creation of plans for a new sort of thing, where the plans would not be immediately seen, by a reasonable person, as an inadequate solution. (Parsons 2016, sec. 1.1)

To paraphrase Parsons (2016, secs. 2.1–2.2), Designers attempt to create plans for *novel* devices or processes that solve fundamentally practical problems. And they do so while taking into consideration the functional, symbolic, aesthetic, mediating, and even sociopolitical aspects and implications of their creations. In Design, there are no *a priori* judgements. Whether such fundamentally creative process can be effectively broken down into "objective" stages and procedures or will forever remain governed by the mysteries of intuition is the crux of the tension between design science and other approaches to design research.

Jen's pragmatic way to overcome this epistemological dilemma is by focusing on tangible "evidence", on concrete assessable outcomes, rather than to muse endlessly over which might be the best solution to a given design problem. Conversely — and this answers another one of Jen's objections, the objective of IDEO-style design thinking is precisely to focus on the process. IDEO-style design thinking is (purportedly) a method for *coming up* with "innovative" solutions — however outrageous they might initially seem. Because it promotes a (dubious) kind of epistemological anarchism, this branch of design thinking *deliberately* excludes criticism,[15] here "thinking-out-

14. For a lengthy discussion on this problem see Galle (2011) and Parsons (2016, sec. 2.3).

15. The rationale for doing so is best summarised in the following quote: "design thinking involves a commitment of participants and facilitators to discouraging criticism in product development interaction [...] Deferring adverse judgments has been argued to fundamentally help improve creativity in idea generation processes" (Reimann and Schilke 2011, 53).

of-the-box" means anything goes, preferably if it involves a solution that has not been tried before.

As for the last of Jen's objections — i.e. the reduction of design tools to a single method, Brown (2009) is adamant that Post-it notes are just one of the many tools used in IDEO-style design thinking. However, reading through his accounts, it is clear that (a) Post-its play a central role in every one of the 5 "modes" of design thinking, and (b) that Brown is mesmerised by them. He describes them both as "important tools of innovation in and of themselves" and as unbeatable devices to "extract the intuition" of a group during "project reviews" (see Brown 2009, chap. 3).

Interestingly enough, Jen's and IDEO's way of understanding where the importance of the design process should be placed (either on the outcome or the process, respectively) overlaps with the ways Cohen and Frankfurt identify Bullshit. For Jen, the design process is too complex to be reduced to well-demarcated steps. The only potentially objective judgement we can make has to be done on the final object. Similarly, Cohen argues the processes that lead to bullshit are opaque and not necessarily intentional. Bullshit ought to be judged as a standalone product by its (lack of) clarity. Conversely, IDEO-style design thinking emphasises the "how" rather than the "what". The result is secondary because what matters is how it is achieved. Frankfurt's moral criteria for identifying bullshit also fits that description. Whether this connection can tell us something about ethics or epistemology, could perhaps be addressed elsewhere.

5.2. Design, liberal arts, and maker's knowledge

As noted in section two, Vinsel's first objection concerns what he calls design thinking's "lipstick-on-a-pig conception of innovation". Drawing on his scholarly knowledge of the history, dynamics, and socio-economical impact of technological change, he contends that "there is no evidence that IDEO, design thinking, or the d.school have contributed to deep [sociotechnical] change". Vinsel is particularly critical of the "superficial" way in which organisations such as IDEO employ the very term "innovation".

Indeed, a simple exploratory reading of IDEO-style design thinking literature shows that innovation is used extensively as a noun, verb, adjective, and more. However, finding anything even remotely similar to a definition of this term proves remarkably difficult. Consequently, it is perhaps best to assume that, "innovation" is used by promoters of design thinking as a slightly fancier substitute for (technological) "change". This kind of conceptual vagueness is a clear example of the "obfuscatory way of speaking" that Spicer (2017a) identifies with "business bullshit."[16]

Vinsel's second objection, as we saw at the beginning of this paper, concerns the proposition that design thinking could become the core of (a new strain of) liberal arts. This idea can be initially traced to the notion, discussed in section three — that design constitutes a particular epistemological framework midway between the sciences and the humanities. Vinsel's critique is mainly informed by Miller's (2015) article, wherein the latter ponders the potential benefits of the d.schools "anti-establishment" (i.e. unstructured) approach to training in design methods. Although seemingly seduced by the d.school's slogans, Miller is nonetheless careful to critique the way IDEO literature eschews virtually all "serious consideration on 'pastness'" in favour of present-tense problem-solving. Neither Miller nor Vinsel seem to be aware that the characterisation of design as a liberal art precedes the foundation of the d.school for at least a decade.

In his article *Wicked Problems in Design Thinking*, Buchanan (1992, 5) contends design "should be recognized as a new *liberal art of technological culture*". For him, a liberal art provides above all an "integrated understanding of human experience" and, seen under such terms, the hypothetic role of design would be to "integrate useful knowledge from the arts and the sciences alike" (1992, 6). Buchanan draws

16. An even less charitable interpretation is David Graeber's. He identifies the "new bureaucratic language" inspired in the (Esalen Institute's) "'self-actualisation' philosophy" as a "kind of individualistic fascism" due to its insistence on the ideas that "we live in a timeless present, that history means nothing, [and that we] … create the world around us through the power of the will" (2015, Introduction).

heavily on John Dewey's (pragmatist) understanding of "technology" as an "art of experimental thinking" (1992, 8), rather than meaning the artefacts themselves and the knowledge required to produce them. By "liberal art" Buchanan explicitly means a "discipline of thinking" that may be shared by everyone, and that could be mastered by a few individuals "with distinctive insight". In other words, Buchanan is reframing the kind of literacy, or rather "design awareness", that Archer (1979, 20) had envisioned a decade before. Both Archer and Buchanan regard Design as an "architectonic" field capable of providing a type of insight that is not accessible to traditional humanistic or scientific disciplines: something akin to a "maker's knowledge" wherein practical and theoretical know-how complement each other to reach "full and useful *episteme*" (see Floridi 2011, 288).

6. CONCLUSIONS

The most salient implication arising from the previous accounts is that design thinking is by no means a homogeneous concept or phenomenon. By itself, this conclusion could be sufficient to suspend our judgement on whether design thinking is bullshit. Nonetheless, if we go beyond the synecdochical portrayal of design thinking promoted by IDEO and the d.school, *some* forms of bullshit begin to emerge. A simple skimming of IDEO-style design thinking literature shows that it is filled with (obfuscatory) business jargon which their promoters rarely clarify. This feature partially meets the criteria of Cohen-bullshit.

Some of the ideas advanced by IDEO-style design thinking indeed have their roots in the products of rigorous design research. But either their focus on "innovation", academic sloppiness, or ignorance prevents a significant number of promoters of IDEO-style design thinking from acknowledging their sources and honouring conceptual clarity. This carelessness meets the criteria of Kimbrough-bullshit. Beyond these and other similar infractions, it would be quite difficult to give more reasons to call bullshit on IDEO-style design thinking without a more extensive account of the methods they promote. Thus, as a summary, we could say that after a superficial analysis, IDEO-style design thinking does not meet the criteria of the stronger and more morally-reprehensible Frankfurt-bullshit. However, its promoters do occasionally engage in more tolerable forms of bullshitting, but whether they do it out of self-deception or carelessness remains an open question.

Jen and Vinsel's critique, although blunt and incomprehensive does manage to touch on core issues of contemporary design research. Before deciding whether design thinking could be dismissed entirely as bullshit, it was necessary to establish *which kind* of design thinking we were talking about. As we have seen, design thinking is a rather heterogeneous notion. By promoting a synecdochical (and unacknowledged) identification between their brand of design thinking and the one supported by traditional design research, IDEO and the d.school have hijacked the meaning of the term. As a result, many complex ideas underpinning historical design thinking have been washed off, forgotten, or supplanted by business jargon. In the eyes of those who stumble upon IDEO and d.school literature, and who possess little or no knowledge of the rich history of design research, design thinking appears (depending on their leanings) as a seductive tool or as yet another management fad. Unbeknownst to them, is the fact that "traditional" research on design thinking represents, to borrow Buchanan's words, a sincere attempt to recognise and elevate the dignity and importance, not only of design but of *maker's knowledge* in general. Such state of affairs calls for a stronger and broader critique of IDEO-style design thinking and the concepts it promotes (such as innovation and creativity) because it contributes to trivialise the aims and history of an entire field of research. But also to safeguard the actual potential contributions that design, as an epistemological field, can bring to other domains of human activity.

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Schallmauer: Composing Tactile Sound for the Solid Medium

Keywords: Sound Installation; Sonic Interaction Design; Tactile Sound; Acoustic Architecture.

Abstract:

In this article we describe the *Schallmauer*, a site-specific interactive sound installation at the new *Musiktheater* opera house in Linz, Austria. This installation explores the tactile qualities of musical composition and interactive sound, while invisibly integrating into the existing architecture of the building. The installation reacts to the presence of the bypassing audience, intending to attract their attention and motivating further explorative interaction. Through a series of interactive infrasound compositions, it emphasizes the experience of sound within the solid medium of a wooden wall and beyond, which expands the predominant auditory and visual impressions of an Opera House by directing the focus to the listening through the body. Apart from the conceptual and technical background of this project, we also present some relevant related artworks in the area of tactile sound interaction and composition.

1. INTRODUCTION: MUSIC FOR THE TACTILE MEDIUM

As we listen to music, we often find ourselves also bodily feeling the sound, the embodied perception of sound is cross-modal. Besides the auditory perception, physical sound also stimulates the proprioceptive, vestibular, and/or tactile cutaneous afferents from the somatosensory system (Huang 2013). The sensory cortex, separated from the auditory cortex, is the part of the brain that recognizes tactile, or touch, feedback. We know that deaf people are not able to hear sound but they are able to feel it and even to recognize songs (Livadas, 2011). The vibrotactile aspect of music is also crucial in achieving immersive experiences. For this reason, various human computer interaction devices enhance entertainment within media (Saddick 2007) through vibrotactile stimulation: video-game gamepads with haptic feedback, cinema seats with body shakers, etc. Taking this particular dimension of music into consideration, the art installation we are presenting extensively uses vibration for creating a vibrotactile soundscape within an architectural space.

The *Schallmauer* (the German word for "sonic wall", stands at the same time for "sound barrier") is a large-scale interactive sound installation exploring the possibilities of composing sound for the tactile medium. The project origins from a commission from the new *Musiktheater* opera house in the city of Linz, Austria for transforming a long neutral corridor into a space for musical interaction. Our artistic proposal was the production of an interactive installation where visitors could actively experience a series of compositions through their whole bodies. The *Schallmauer* incorporates a large number of sound transducers, sensors and single board computers featuring a simple and modular hardware and open source software system that can be re-implemented by others.

Sound transducers are acoustic drives that are able to turn almost any solid surface or object into a speaker. Being essentially like any other standard aerial speakers, their coil is not attached to a cone, but is fixed to a pad conducting its vibration onto the object it is attached to. The resulting resonance disperses as a flat field through its surface producing the sensation that the whole surface emits sound. By attenuating some frequencies and amplifying others, these resonating objects act like natural filters adding their particular acoustic profile to the reproduced sound.

Using these devices, sound also becomes graspable through vibrotactile perception if we keep a physical contact with these vibrating objects and its surfaces. In Human-Computer Interaction, early studies of this phenomenon dates back to the 1920s when Gault created machines for transferring speech into vibrotactile stimuli (Gault 1924). More recently, the growing field of multimodal human-computer interfaces has established the basis for presenting haptic information to users using tactile and kinesthetic devices (Saddik, Chouvardas et al, Eid et al 2007).

The use of sound transducers in media art and music is also not recent. According to John Driscoll (Driscoll 2001), sound transducers became commercially available during the decade of the 1960s and descended from a design developed for underwater speakers used by the US Navy. In June 1966, the "Popular Mechanics" magazine described to the home hobbyist how to "Build a FANTASTIC CONELESS LOUDSPEAKER!". Interestingly, among the papers found at David Tudor's workshop, a copy of this magazine was found. In particular, David Tudor employed sound transducers attached to radio-controlled carts in his work *Bandoneon!* (1966) and later at *Rainforest* (1968) where transducers affixed to everyday objects caused them to resonate. In Laurie Anderson's *The Handphone Table* (1978), the viewer's elbows touching two transducers serve as conductors for listening the otherwise inaudible sound. This is also an example of bone conduction, the conduction of sound to the inner ear through the skeleton and skull bones. Markus Kison's *Touched Echo* (2007-2009) uses the same technology for conducting sounds of cities devastated during the Second World War through the arms of the visitors. Carola Bauckholt's composition *Doppelbelichtung*

(2016) illustrates a recent musical application of sound transducers. It is a composition for one violinist and five other violins hanging in the air and equipped with tactile transducers. The reproduction of nature sounds through these transducers make the recordings acquire the spectral characteristics of a violin. Vibrotactile communication has been extensively employed in media art. For instance, Kaffe Matthews' *Sonic Bed* (2005) and Satoshi Morita's *Sound Capsule* (2014) stimulate the visitor's whole body creating a dynamic, multi-sensory approach to experiencing music. In Juri Hwang's *Somatic Echo* (2017) listeners experience a sonic image shaped by sounds traveling through their head structure and through vibrations applied to their skin. In conclusion, all these works let us experience sound through our skin, but they also make us aware of our body through sound. Captions of these works can be observed at Figures 1.1. to 1.3..

Vibrating surfaces can be also used to create immersive spatial or architectural installations. The key concept here is turning the found objects of an architectural space into sound sources. These vibrating soundscapes augment spatial architecture towards the aural and the vibrotactile level. For instance, Otso Lähdeoja and Lenka Novakova's *OVAL (*Lähdeoja 2014) is a large installation where ten large sheets of glass equipped with transducers are hanged forming an oval inside of a dark room. The work creates a spatial polyphony of aurally active glass sheets designed to warp visitor's perception of sound in space. Using a tracking system, the installation changes its musical content depending on the location of the audience.

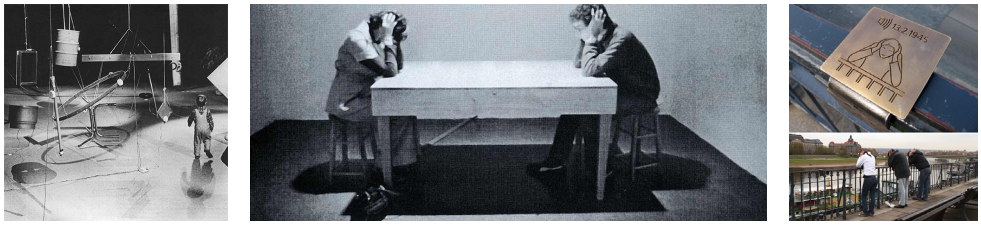

Fig. 1.1. Tudor's *Rainforest*, Anderson's *Handphone-Table*, Kison's *Touched Echo*.

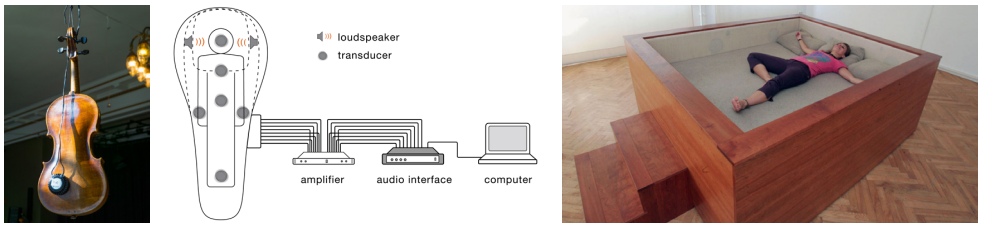

Fig. 1.2. Bauckholt's *Doppelbelichtung*, Morita's *Sound Capsule* and Matthews' *Sonic-Bed*.

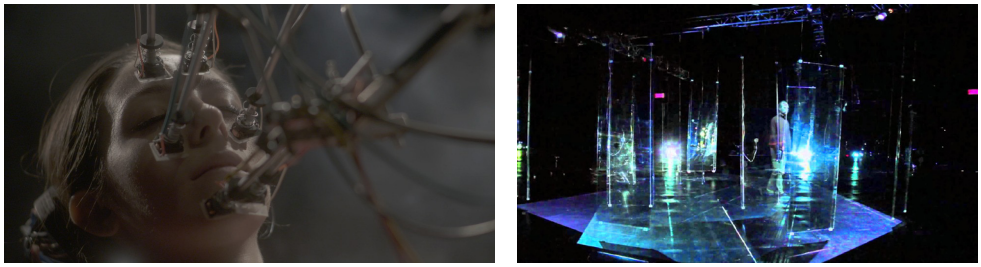

Fig. 1.3. Hwang's *Somatic Echo* and Lähdeoja & Novakova's *OVAL*.

2. THE SCHALLMAUER INSTALLATION

Our design intention was the creation of an interactive medium for exploring tactile communication. Thus, the installation is not only conceived as a space for contemplation but also a place for interaction. Audiences had to have the power to transform sound through touching actions while at the same time, they would also feel the installation with their bodies.

2.1. Artistic Intention and Design Description

The Schallmauer was commissioned by the Musiktheater Linz, the new opera house designed by Terry Pawson which was inaugurated in April 2013. The theatre management wanted to incorporate a new sound installation into the *Klangfoyer*, a large vestibule decorating the building with various contemporary artworks. The space dedicated to the installation would be the long corridor between the concert hall entrances of the second floor of the building. It is a roughly 30-meter long straight corridor defined by large wooden panels on the concert hall side, while the other side is open and communicates visually with the rest of the foyer (see Figure 2.1.). While this space would remain empty during most of the day, it would be crowded by the audience before and after an opera or concert performance. The management also was planning guided tours for groups up to 40 persons.

The conceptual proposal we presented to the theatre followed these design patterns:

- Architectural neutrality: The Schallmauer would be only represented through sound, no other significant visual design should be added.
- Interaction: audience and artwork should mutually interact, not only contemplated.
- Scale: interaction should be possible for a single person and for a group at the same time.
- Activity: the Schallmauer would remain silent if nobody is present at the corridor.
- Sonic identity: the musical content would be inspired by sounds from the city of Linz.

At the technical level we sketched the following ideas:

- The corridor should be understood as a unidimensional array of sound sources along its full extension. We were interested in creating a linear spatialization system which would feature listening to sounds moving at the distance, approaching and leaving, all along one only axis.
- The Schallmauer would incorporate sound transducers to produce vibrotactile sound through the wall itself, from infrasonic vibrotactile frequencies to the audible domain.
- As the corridor was subdivided into fourteen pieces of wooden panels along the distance, a modular system would be designed following these separations.
- Interaction would be based on the visitor location within the corridor, as well as the audience touching the wooden panels.
- The work would have different stages of interaction depending on audience activity.
- Open Source: we decided to use only open hardware and software technologies.

The theatre accepted our proposal in late 2013. A budget was negotiated and the opening date was fixed for September 2014. As it was impossible to develop the work directly at the corridor, we created an initial prototype at the Kunstuniversität Linz.

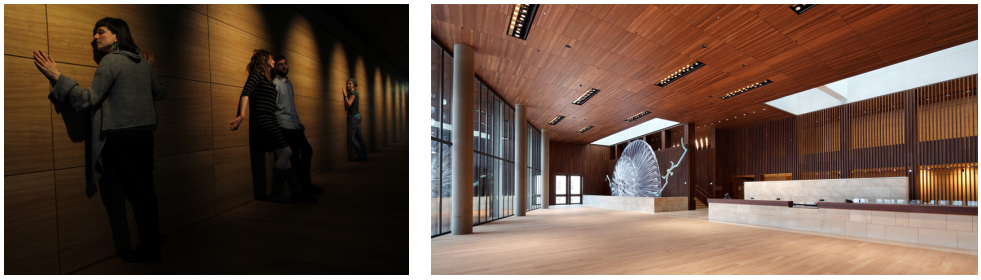

Fig. 2.1. The Schallmauer (left) in the Klangfoyer (right) of the Musiktheater in Linz.

2.2. Vibrotactile Prototyping

We built a structure of four identic wooden panels in order to evaluate various transducers, to measure the resonant properties of the wooden panels and to test the interactive sensor system. This configuration also afforded the production of sound materials and inspired new interactions.

After searching for different type of transducers, we decided to use Sinuslive Bass Pump III (80 Watts, 4 Ohms) for low frequencies and Visaton EX 60 S (25Watts, 4 Ohms) for medium and high frequencies. We also found the affordable four channels amplifier Basetech AP-4012 (4x50Watts) quite adequate, as it already incorporates low or high frequency filters to be used with our two different transducers.

For testing the resonance of the overall system, we built a simple apparatus. A computer reproduced a slow frequency sweep from 1 Hz to 20KHz through the transducers. A reference aerial microphone and another contact microphone attached to the panels were used to record the resulting sound response. A frequency analysis of these recordings clarified that our mechanical system had two critical resonant bands (15-21Hz and 35-39Hz) where the panels started to resonate in a very intense and possibly dangerous way. As we also wanted to work and play with these particular frequency bands, we decided to incorporate a digital filter to our system, which flattened these resonances.

We also discovered that the performance of the mechanical system radically depended on the physical junctions between the wooden panels and the supporting wooden frame. The substantial part of the vibrotactile content had to be dampened accordingly, and we experimented with combination of silicones and textile to buffer the vibration at these junctions.

2.3. Technical Description and Architecture

The 25m-long relevant portion of the wooden wall on the top floor of the Klangfoyer has been divided into a total of 14 segments, each of which is comprised of four wooden panels with a size of 176x62cm each. Omitting the bottom and top panels, we converted the total of 28 conveniently reachable panels (as a matrix of 14x2) into the active components of our interactive sound installation. We first removed the complete wooden assembly and attached all interactive components such as speakers and touch sensors to the back of each panel, while the single board computes, amplifiers and power supplies were attached onto the wall behind the top panel. Once reassembled this resulted in a completely unaltered appearance of the original wall, with the exception of barely visible motion sensors on the top of each vertical segment. 14 independent single board computers and a total of 56 contact speakers (two on each interactive panel, ergo four per segment) represent the elements of a modular multi-channel installation for tactile sound. Each of the 28 interactive wooden panels is equipped with six capacitive contact sensors, which allows to control the installation through a total of 168 segments touched by the hands and body. The 14 motion sensors that are distributed throughout the length of the corridor allow to detect the presence and motion of the visitors.

2.3.1. Hardware Components

As described above, the installation is divided into 14 equally designed segments, which are practically scalable to any number, but in this case defined the actual configuration of the corridor. Each segment consists of two wooden panels as the interactive component for sound reproduction and user interaction, as well as an additional control unit, containing a first generation Raspberry PI single board computer (SBC) (single ARM core, Model B), the four-channel Basetech AP-4012 amplifier

as well as a suitable 12V power supply and a 5V converter for the SBC. Although the overall sound quality of the first-generation Model B computers was rather limited, we used the direct Stereo output from the SBC connected to the four-channel amplifier through a simple headphone splitter, instead of a dedicated multi-channel sound card. The built-in high/low frequency filters of our amplifier effectively allowed us to drive the two low-frequency Bass Pump transducers as well as the two high-frequency Visatone transducers with the simple stereo signal from the SBC.

A high/low frequency assembly of these transducers was firmly screwed onto a small wood and metal board sandwich, which was then glued to the centre of each wooden panel. In addition to that, the full back area of each panel was covered with six segments of large aluminium sheets, which served as capacitive touch electrodes. These electrodes were connected to a MPR121 touch sensor, which provides a total of 12 sensor pins (six for two panels). This sensor breakout board provides the according touch interaction states to the SBC through the I2C bus. In addition to the touch interaction the system is also detecting the presence of a visitor standing in front of a segment through a simple analogue PIR motion sensor attached to the ceiling above.

As a modular installation, the overall composition was controlled by one additional Raspberry Pi SBC, which maintained a global view of the user interactions within the corridor, which determined the general states and behaviours of the installation. This master computer was connected to the remaining 14 segments through Ethernet, and also provided an additional WIFI access point for control and configuration purposes as well as a 3G modem for remote control and monitoring.

Fig. 2.2. Background view of an interactive panel: dual transducer assembly and six touch electrodes.

2.3.2. Software Components

As its overall computing infrastructure is based on the Raspberry Pi SBC, the software architecture of the Schallmauer installation is also based on the Linux operating system. We therefore used a standard Raspbian distribution with a custom real-time Kernel in order to achieve an acceptable performance with the limited resources of the first-generation model B. For the sound synthesis and playback, we used optimized builds of the Pure Data (Puckette 1996) sound programming environment as well as the Jack audio server, which resulted in a perfectly usable software configuration for our purposes.

For the acquisition of the user interaction data from the touch and motion sensors, we developed a simple background application keeping track of the current touch states and user presence at each panel and segment. The resulting overall state updates were continuously broadcasted using *Open Sound Control* (OSC) (Wright et.al. 2003) to all other segments as well as to the master computer. The master computer processed the OSC input from all interactions at the individual segments, in order to determine the global state of the installation. Global state changes were then also

communicated to the segment computers via OSC, which adapted their local program accordingly.

The whole system was configured to boot automatically into a functional state, which was indicated by an individual start-up beep from each system segment as well as a finalizing welcome tune controlled by the master computer. In this general interactive state, the system is ready to respond to the visitor presence and interactions, which largely determine the states and behaviours of the Schallmauer installation. In addition to that, we also provide a simple web-based control interface, which can be configured through a mobile phone connected via the integrated WIFI. This allows the overall maintenance and individual adjustments to the installation, such as the control of the global volume or the selection of dedicated behaviours or demonstration modes.

2.4. Interaction Design and Composition

Since the Schallmauer is invisibly integrated into the existing architecture of the Klangfoyer corridor, it will generally remain silent when no audience is present. Once the presence of one or more bypassing visitors is detected by one of the lateral motion sensors the master computer is notified and subsequently switches the installation into *Attention Mode* in order to guide them into a dialogue with this interactive musical instrument. In this mode the Schallmauer intends to catch the attention of the bypassing visitor through the subtle playback of knocking sounds, as if someone would be knocking from the other side. If the visitor decides just to walk by without interacting, the installation would simply switch back into *Silent Mode* after losing track of any present visitor. If the visitor on the other hand would remain within the corridor, still being detected by one or more of the motion sensors, the installation would intensify the *Attraction Mode* by playing back silently whispering voices in addition to the occasional knocking sounds, which are following the path of the visitor.

As soon as the visitor would approach and eventually touch one of the interactive wall segments, the installation would immediately switch into *Interaction Mode*. In this mode each interactive panel would respond with the sound of creaking wood, which again in a similar manner as the knocking sounds would correspond to the wooden materiality of the corridor wall. In addition, the wall would start to play back several low frequency sweeps that are close to the resonant frequency of the wooden panels and therefore cause occasional strong vibrations when going through the location of the visitor.

If this encourages the visitor the further interact with the wooden panels, the installation would consequently switch into the final *Listening Mode*, which would play back one of the three infrasonic compositions, which we developed for this sound installation. These compositions represent the inner sounds of the city of Linz with a metaphorical arrangement of underwater sounds from the Danube, the industrial sounds from the steel factories, as well as the motion from the public transport system. All these compositions play with the sound vibrations through the solid medium of the wooden wall, which can be experienced by listening into the wall or just by touching the wall with the body.

If the visitor stops interacting with the wall, the installation would immediately switch back into *Attention Mode* and subsequently into *Silent Mode* if the visitor leaves the installation area. If the visitors decide to keep on playing with the installation after the playback of the first composition, they are rewarded with an interactive *Interlude Mode*, which basically turns the Schallmauer into a large scale interactive instrument, which plays low-frequency harmonic sounds for each of the individual touch segments on the full extension of the wooden panels. Alternatively, the Schallmauer can also be manually switched into a simple *Marimba Mode*, which again emphasizes the

Fig. 3. A video demonstration of the Schallmauer installation: https://vimeo.com/96206403.

wooden materiality of the corridor through the interactive playback of pitched wood sounds in a large-scale Marimba instrument.

2.5. Conclusion

As of today, the Schallmauer installation has been in continuous operation for almost five years at the Musiktheater in Linz, only interrupted by the occasional alternative use of the corridor for photo exhibitions. The overall software and hardware design has proven to be sufficiently stable for long-term usage, and only required occasional maintenance and updates so far. The compositions and the interaction design of the installation also have been very popular with the daily audience and the guided tours at the opera house. An analysis of log files of the installation revealed, that the visitors interacted as intended with the installation, and we can observe both the prolonged individual exploration of the infrasonic compositions, as well as the more ludic interactions of larger audiences.

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The *Gatorra*: a Technologically Disobedient Instrument for Protest Music

Keywords: Circuit Bending; Hardware Hacking; Gatorra; Experimental Music; Electronic Music.

Abstract:

The present paper is an introduction to the *Gatorra*, an electronic experimental instrument developed in southern Brazil by builder and musical artist Tony da Gatorra. The author presents some of the findings from original research on its circuit design and its origins, in relation to similar designs of electronic circuitry made popular in hobbyist and DIY magazines. References are also discussed to establish a theoretical framework to be used as a basis of an analysis of this production in further works, using Reed Ghazala's notion of *Threshold of invention* as a starting point.

"My name is Tony and I've built an instrument, To speak, to express myself and to protest"[1]

Fig. 1. Still from the videoclip for "Meu nome é Tony".

1. INTRODUCTION

1.1. The artist

The Gatorra is the brainchild of one Antônio Carlos Correia de Moura, born on August 3rd, 1951 in Cachoeira do Sul, a small city about 150 miles west of Porto Alegre, capital of the southernmost state in Brazil, Rio Grande do Sul. Being one of 8 siblings in a family of humble beginnings, Antônio studied at a public boarding school until the age of thirteen, at which he started working as a lathe turner apprentice. At the age of 25, whilst still working as a lathe turner, he took a mail order course in electronics, at the end of which he set up a TV and stereo repair shop at the city of Esteio in the Porto Alegre sprawl, where Antônio still lives and works to the present day.[2]

Tony da Gatorra was born about two decades later, following an inspiration to build an instrument to make protest music. Tony's own account on how long its research and development stage went for varies from two to four years starting in 1994, but it is certain to say that by 1998 an operational prototype of the Gatorra was used to record the first batch of songs released on a demonstration CD.[3] The uniqueness of Tony's delivery and composition quickly drew the attention of local radio producer Eduardo Santos, and nationally famous producer and TV celebrity Carlos Eduardo Miranda.

Both producers helped Tony attain a certain visibility through contacts in traditional media outlets in Porto Alegre and São Paulo, Brazil's biggest city and a hub for national TV and radio broadcast, and also through Miranda's project website *Trama Virtual*[4].This led to a couple of releases through independent labels — Peligro re-released the original demos under the title *Só Protesto* in 2005, Slag Records released *Novos Pensamentos* in 2008[5] — and concerts throughout Brazil, with additional dates in the US, the UK and continental Europe.[6]

Over the last decade Tony self-released the albums *Paiz sem Lei* (2013), *Gomorra* (2016), and an EP with guitarist / producer Tainam Dias in 2015. In 2010 Turnstile Music released *The Terror of Cosmic Loneliness*, a collaboration between Tony and Welsh musician Gruff Rhys,[7] and in 2013 Reco-head released *Tony da Gatorra e os Ufonistas*, a collaboration between Tony and musicians from the experimental electronic music scene in São Paulo: Paulo Beto, Arthur Joly and Eloi Chiquetto.

1. Lyrics of "Meu nome é Tony", by Tony da Gatorra and Bruno Ramos.

2. Esteio is located around 20 miles north of Porto Alegre, with a population of about 80 thousand and a HDI of 0,842, which is considered high. Tony, however, lives in one of the poorest areas of the city. Data available at: https://pt.wikipedia.org/wiki/Esteio, as of February 10, 2018.

3. Tony has been interviewed several times by the author since 2013.

4. Trama Virtual was a web portal for musicians and bands, lasting from 2002 to 2013, and was a launch platform for several independent artists.

5. The author was the mixing engineer for the *Novos Pensamentos* album in 2007.

6. As of February, 2018, Tony's channel on You Tube features his entire discography: https://www.youtube.com/channel/UCseC4OMbcugna-n8CPYLBxA.

7. According to the liner notes, the album was recorded in 2007 during the practice sessions for a series of concerts featuring Tony and Gruff, and mixed "in Cardiff, Wales in one 12 hour session with the aid of 5 flasks of coffee, 75 sticks of gum and a bank of vintage compressors".

In parallel to his musical career Tony has, over the last two decades, taken orders to build Gatorras and other instruments by demand of musicians and fans, including Gatorra #5 custom-built for Lovefoxxx of the band CSS, Gatorra #7 custom-built for Scottish musician Nick McCarthy of the band Franz Ferdinand[8] and Gatorra #21 for composer and guitarist Marcelo Birck.

2. THE INSTRUMENT

2.1. The circuit

Research by the present author on the construction of the Gatorra was guided by an aural realization that the instrument sounds very similar to an electronics project of a handheld electronic drum kit made popular in Brazil during the 1980s and 1990s. Handheld kits such as these would be sold in electronic supply shops in most capital cities in Brazil, and DIY projects for such kits were published in amateur electronics magazines for hobbyists and such. In the past few years a few music producers have unearthed units of this drum machine as an addition to their repertoire of studio tricks.[9]

Fig. 2. A SLICIE drum kit. Photo by the author.

An attempt to find out more about this kit, widely known either as *SLICIE* or one of several commercial names,[10] led to findings on its history from DIY electronics blogs and forums. On one particular website an engineer named Nelson Ribeiro (2005) describes the process of reviving a specimen of this drum machine, and recreating its design for handmade production. In the same post, Ribeiro mentions the similarities with a project published in the hobbyist magazine *Popular Electronics*, published from 1954 to 2003,[11] and a source for more information on the origins of this particular design, DJ and teacher Eric Marke.

Two projects for automated rhythm sections were published in Popular electronics Magazine by John Stayton Simonton Jr. in the early 1970s, the *Thumpa-Thumpa* in the February 1970 issue, and the *Drummer Boy* in the July 1971 issue.[12] The Thumpa-Thumpa is a very simple circuit offering two sounds — bass drum and woodblock — and

8. This instrument has since been given to Graeme Ronald of the band *Remember Remember*, who informed the author in a Facebook chat message. The instrument can be heard on the following track: https://www.youtube.com/watch?v=DTdAFR9VMSU&index=5&list=PLYE-r8eJxWcvQLAVMqsfFKZbB5CP3ji-M

9. The SLICIE can be seen being played by producer Homero Basílio on this video: https://www.youtube.com/watch?v=J4W0oX-noriU&t=2s. The final version of this same track can be heard at: https://www.youtube.com/watch?v=9fAebO3mP9I

10. Other commercial names include *Dinâmica*, *Pontus*, *Slcie*, *Batronic 7* and *Spineer* (Ribeiro 2015).

11. As of February, 7, 2018 the entire run of the magazine is available for download at: http://www.americanradiohistory.com/Popular-Electronics-Guide.htm

12. Simonton was also the founder and one of the designers of PAiA Electronics, a company founded in 1967 in Oklahoma City specialized in selling electronic kits by mail order. From the 1970s onwards PAiA started selling kits for electronic music instruments, and PAiA kits of the Thumpa Thumpa and the Drummer Boy. More information on: http://www.paia.com/.

controls to set the speed and the pattern in which the sounds play (Simonton 1970). The Drummer Boy is a more complex project divided in three sections: a counter used to control tempo and the length of the rhythm loops, a switching and decoding system used to change between different rhythm patterns and a tone generator that creates the drum sounds themselves. Simonton suggests early in the article that the tone generator section can be built as a standalone unit and operated as a hand-held, finger-operated electronic percussion instrument (Simonton 1971).

The tone generators in both the Thumpa-Thumpa and the Drummer Boy are based on the *parallel-* or *twin-T* oscillator principle, whose workings can be explained in layman's terms as "applying a sharp pulse to a parallel-T audio oscillator that is normally just below the point of oscillation" (Simonton 1791, 30). Different combinations of the electronic components involved account for the differences in pitch for different sounds, and a slightly different combination of components is used to implement a noise generator, used for cymbal-type sounds.

The origins of the SLICIE-type drum kit in Brazil are attributed to George Romano (Marke 2017, 159), a designer of electronic circuitry working on research and development for electronic musical instruments for the most of the 1970s and 1980s, a period in which he also manufactured his own brand of electronic organ, Audac. While designing a rhythm section for electronic organ manufacturer Gambitt, Romano came up with an implementation of the twin-T oscillators for the tone generator, employing a CMOS integrated circuit instead of the transistor approach which made its energy consumption more efficient. Romano designed a version for this rhythm machine which would be built into the Gambitt organs, and also a standalone version aimed at players of other instruments, both versions coupled with sequencers Romano designed based on existing projects that also used integrated circuits.

It was while building the tone generator, however, that the idea of a standalone version without the sequencer came about. In Romano's account when he accidentally touched the circuit, assembled in a protoboard, one of the drum tones sounded. This sparked the idea of using touch plates to trigger the sounds instead of regular switches. Romano, however, never got around to manufacturing such a design. In his own account, he gave it to a friend that also worked in electronics, and this led to the manufacturing of the first units that reached the shops (George Romano, telephone interview with the author, February 2, 2018).

Romano's account of designing this drum machine does not mention Simonton's projects directly, but rather the vast repository of circuit projects that populated hobbyist's publications, and also electronics compendiums and literature published by integrated circuit manufacturers, such as Texas Instruments and Fairchild, among others. Although being unable to recollect the exact time this happened, Romano believes it was at some point between 1975 and 1980.[13]

13. In Ribeiro (2015) this is dated as happening between 1983-84.

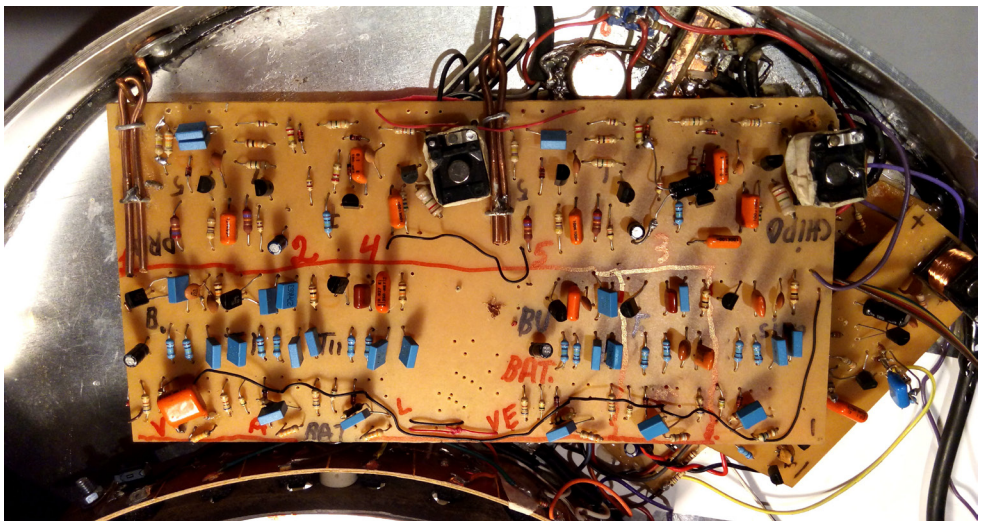

Fig. 3. Part of the tone generator in Gatorra #19. Photo by the author.

The Gatorra tone generator follows a similar project using general-purpose NPN transistors (in the example featured here, BC549), which function similarly to the ones used both in the Thumpa Thumpa (2N5129) and the Drummer Boy (2N2712). Tony describes that the development of the Gatorra started from projects he found and experimented with in electronics magazines, and on his accounts no mentions are made directly to the SLICIE-type drum kit. It is likely, however, that he was aware of the existence of such instruments due to their vast availability in supply shops. As mentioned above, Tony spent a number of years in the process of adapting the circuits to his own design, as well as adding some extra features.

2.2. Layout and assembling

Fig. 4. Tony playing the Gatorra #1 live at Casa do Mancha in São Paulo, along with producer Paulo Beto, seen here playing the Gatorra #15. Photo by Eloy Silvestre used with permission.

As seen on Figure 4, the Gatorra is laid out in a fashion similar to a traditional guitar. On a regular, right-handed, instrument the right hand plays seven push buttons located at the bottom side of the Gatorra's "body", as well as controls knobs and sliders located in its front panel. Halfway across the front of the instrument's "neck" there are two rows of buttons: usually on the bottom row there are seven buttons that trigger the same circuits for the seven sounds playable on the body plus an additional button that plays an extra sound; on the top row there's a variable number of extra buttons for additional sounds. The seven-button layout on the body is consistent throughout the entire series of the Gatorra, whereas the layout for the neck buttons varies greatly. On the back of the instrument there's a RCA jack that connects to a foot pedal, which doubles as a trigger for the kick sound.

Apart from its general shape, the seven basic sounds and the buttons both on the body and on the neck, most other features change from Gatorra to Gatorra. The body shape that can be seen on Figure 4 for Gatorra #1 is more or less consistent from instruments 1 through 13. Gatorra #14 is already built with a body shape that has been consistent from that instrument onwards, and can be also seen on Figure 4.[14]

To build the instruments, Tony employs both discarded materials purchased at junkyards and found in recycling bins and garbage disposals in general, as well as discarded electronic equipment. On some instruments the tuning panel for conventional CRT TV sets is repurposed as a tuning interface for some of the sounds, as seen on Figure 5. Additional slide controls and knobs are sometimes added to control the individual volume of some sounds, as well as rotating levers that control the pitch of specific sounds:

14. Gatorra #14, exceptionally, uses touch contacts for the body and neck instead of push buttons.

Fig. 5. Detail of Gatorra #3, equipped with a TV tuning panel.

> [On] the first few I built, I put a plastic tuner from a TV set, up to the 4th, 5th, 6th, you could tune all the 12 sounds. But then I ran out of tuners, and couldn't find any more for sale, so I switched to potentiometers. (Tony da Gatorra, interviewed in November 2016 by the author)

The sides of Gatorras are shaped from aluminum profiles, riveted together at junctions and also to anchor internal parts. Panels for the front are usually made either from reused Formica laminate or aluminum panels, whereas panels for the rear are made out of repurposed acrylic panels formerly used as shower enclosures or toiletry cabinets. Starting at Gatorra #21 transparent polycarbonate panels have also been used for the front and sides of some instruments.

Tony has also been producing scaled down versions of the Gatorra in the shape of the *Minigatorra* and also the *Batucador*,[15] which employ the same tone generator. The Minigatorra looks similar in shape to a regular Gatorra, only smaller in size, and has 5 of the regular timbres plus a variable number of additional sounds ranging from 3 to 4, whereas the Batucador is usually limited to 3 or 4 sounds, with a built-in repeater device based on a 555 microchip. At the time of writing Tony has built 25 Gatorras, 7 Minigatorras and 5 Batucadores. Each instrument has its own modifications and tweaks, which makes Tony believe a patent for the instruments would be unobtainable:

> I'm always trying to improve the Gatorra, you know? Each of them has something different, I'm always looking for something new to add to them. For the next one I want to add a wireless transmitter... (Tony da Gatorra, interviewed in March 2015 by the author)[16]

3. ANALYSIS

Similar accounts of accidentally making sounds from a piece of electronic equipment by touching or shorting its circuit are also given by Reed Ghazala (2004, 97) and Michel Waisvisz (2004), which quote such experiences as an inspiration to develop touch interfaces in electronic instruments.[17] Although both acknowledge each other's work — along with the work of other artists which are broadly similar, such as Nicolas Collins — and have started their experiments with touch interfaces in the late 1960s, it is unlikely that there was any influence between the two until much later, if ever.

15. *Batucador* comes from the verb *batucar*, which is a synonym to drumming.

16. A wireless Gatorra has indeed been built, but only in early 2018.

17. Ghazala is widely known as the "Father" of Circuit Bending, whereas Waisvisz was a prolific composer involved in the development of a number of experimental music instruments and interfaces, and also the artistic director of STEIM in Amsterdam from 1981 onwards.

Just as unlikely is the possibility that either George Romano or Tony da Gatorra had any influence from Ghazala, Collins or Waisvisz. Throughout most of the military dictatorship period in Brazil, lasting from 1964 to 1985, the customs policy applied prohibitive import taxes to electronic goods as a strategy to foster the growth of the national technology research, development and production. It is beyond the scope of this paper to discuss such a policy further, but in practical terms such development fell short of its expected results and during this period a lot of initiatives in terms of developing technologies for music consisted in cloning foreign designs that were already cherished by the music industry (Pinto 2002). Both Brazilians learned the ropes of electronics during said period, and worked for the most part of their careers in environments mostly unrelated to the experimental music and academia communities.

> I took several courses on electronics, even before I went to trade school. I got interested in the Theremin because at this particular school they had this mounted jaguar at the reception, and as you came in it would light its eyes and do this screeching noise. I started to research how that worked and learned about the working principle of the Theremin, and that got me into building instruments. (George Romano, interviewed in February 2018 by the author)

Ghazala (2005, 6) describes this coincidence as a "principle of simultaneous discovery" he calls the *threshold of invention*. He goes on to posit that the popularization of transistor-based, miniaturized electronics, along with the widespread use of electronic music in popular culture — by means of soundtracks and the use of electronic instruments in pop records — brought about the threshold of invention that made circuit bending and the *Kraakdoos*[18] possible. The relationship between creativity and a certain technological zeitgeist is also discussed at length by Nicolas Collins (2008) in relation to his own experience as an apprentice to David Tudor, Gordon Mumma and David Behrman in their own exploration of analog circuitry and early microchip technology as alternatives for making experimental electronic music that didn't follow the commercial path of Moog, Buchla and ARP synthesizers.

A different sort of zeitgeist also relates to some experimental electronic music genres of the late twentieth / early twenty-first century: that of repurposing electronic consumer goods that have been discarded either by malfunction of as a consequence of replacement by newer versions, a process that can be related to the industrial practice of *planned obsolescence*. Hertz and Parikka (2012, 426) argue that, while the repurposing of everyday objects as artistic output has been acknowledged since at least the 1910s, artforms based on the repurposing of electronic commodities deal with the mass production and discard of such items.

Tony's work sheds light onto a different perspective to analyse such claims. Whereas Ghazala's *threshold of invention* and planned obsolescence in industrial design are valid in the Brazilian perspective, they should be assessed from a different point of view. Both in North America and western Europe, playing with electronics is

> characteristic of the early-20th-century wireless and radio culture, post-World War II electronics culture (especially post-1970s electronic amateurism), hobbyism or DIY-tinkering. (Hertz and Parikka 2012, 426)

While this certainly holds true to examples springing from the Brazilian middle class,[19] Tony's approach originates from a maverick drive rather than communal exchange, given his humble origins, the circumstances of a hand-to-mouth existence and also the fact that neither his electronics apprenticeship nor his instrument development ever qualified as hobbies.

Although Tony's research and development for Gatorra building over the past two decades has at times crossed paths with the brazilian DIY electronic scene, it wasn't informed by it at the time of its inception. Beyond their artistic collaboration, Tony has

18. *Kraakdoos* is the dutch name for *Cracklebox*, the electronic instrument developed by Michel Waisvisz together with Geert Hamelberg in the late 1960s and further developed after Waisvisz joined STEIM in 1973, as described by Waiswisz at http://www.crackle.org/CrackleBox.htm.

19. An extensive account of which can be found in Pinto (2002).

exchanged some electronics expertise with synthesizer builder Arthur Joly, which led to building an Atari Punk Console into Gatorras #18 and #20. He has also discussed plans of developing an instrument in collaboration with the *Garoa Hacker Clube* hackerspace in São Paulo, however Tony's own concerns about his intellectual property — namely the fear of someone stealing the Gatorra design and profiting from it — have at times stood in the way of collaborations and workshops. In this sense, it can be stated that although the Gatorra is very much a DIY instrument, it was not developed within the collective learning environments normally associated with the DIY / DIWO / DIT[20] and the "Maker" trends of the recent decades.

An important concept in the literature concerning the development of new musical instruments is that of hyperinstruments, associated with the hyperinstruments project developed under the guidance of Tod Machover at the MIT beginning in the 1980s. The basic concept of hyperinstruments in their first generation is defined my Machover (1999) as: "to take musical performance data in some form, to process it through a series of computer programs, and to generate a musical result", and hence the goal of hyperinstruments can be defined as producing "music of unprecedented subtlety, complexity, richness, and generation expressive power that is intimately, but not obviously, linked to the original intent of the performer / composer".

The values embedded in Machover's discourse exemplify the application of the "Californian Ideology"[21] to interactive music-making in the late XXth century, and they entail a degree of virtuality that's absent in the raw electronic correlations present in an instrument such as the Gatorra. Perhaps, in terms of the hyperinstrument discourse, the Gatorra would fit in better with the second generation of hyperinstruments, developed from 1991 onwards, aimed at amateur musicians (Machover 1995).

Bowers and Archer (2005, 6) discuss the notion of hyperinstruments in contrast to that of meta-instruments and virtual (cyber) instruments in the context of the NIME conference,[22] summing up their capabilities as: rich interactive capability, detailed performance measurement, engendering of complex music, expressivity and virtuosity. In the same paper, the authors contrast said approaches to what, in 2005, was deemed a growing influence of approaches such as Ghazala's and Collin's in instrument building, proposing the concept of *infra-instruments*. Hence an infra-instrument's capabilities would be: a constrained interactive repertoire; the use of fewer sensors and fewer gesture measurements; to engender relatively simple musics restricted in their virtuosity and expressivity (Bowers and Archer 2005, 6).

At least one of the infra-instrumental principles of construction proposed by Bowers and Archer, "Take Something Non-Instrumental and find the Instrument Within",[23] resonates with one of Tony da Gatorra's guiding principles: "The circuit tells you one thing, and you find other things in it" (Tony da Gatorra, interviewed by the author in May, 2016). Although the Gatorra as a control interface has clear hyperinstrument potential, it is itself more of an infra-instrument in its actual state.

The work of Oroza (2012), analysing the repurposing of technological goods in Cuba with an emphasis on the *período especial*,[24] helps establish some groundwork to discuss practices such as Tony's. Oroza postulates that the scarcity of consumer goods fostered an attitude of *technological disobedience* towards commodities designed for markets with a much higher level of consumption, and borrows the term *Revolico* to describe the extreme repurposing of such commodities.[25] Drawing from Oroza's work, Obici has coined the term *Gambioluthiery* to describe:

> the construction of instruments originated around the logic of *gambiarra*,[26] which involves activities such as composing, decomposing, inventing, proposing, constructing, collecting, adapting and appropriating materials, objects, artifacts, devices, instruments or system setups. (Obici 2017, 89)

Obici's *Gambioluthiery*, along with Oroza's *Revolico*, seem more adequate as a starting point for a deeper understanding of Tony da Gatorra's approach. The factors behind

20. Acronyms for Do-it-yourself, Do-it-with-others and Do-it-together, respectively.

21. "The Californian Ideology" is an essay published in September, 1995 by Richard Barbrook and Andy Cameron that critiques Silicon Valley dominant school of thought of "naturalising and giving a technological proof to a libertarian political philosophy, and therefore foreclosing on alternative futures". Available at http://www.metamute.org/editorial/articles/californian-ideology as of February 2nd, 2018.

22. The New Interfaces for Musical Expression conference, or NIME, has been happening annually since 2001. Available at: http://www.nime.org/.

23. The others being: "Take an Instrument and Make it Less"; "Take Materials Partway to Instrumenthood"; "Build and Instrument but include Obvious Mistakes"; "Find Infra-instruments Readymade" (Bowers and Archer 2005, 6).

24. The *período especial en tiempos de paz*, or special period in times of peace, is the name given to period of severe economic crisis in Cuba, roughly situated between 1991 and 1997: https://en.wikipedia.org/wiki/Special_Period.

25. The term *Revolico* is a Cuban term that means disorder or an alteration of the regular pattern of events. It has been chosen as the name of an e-commerce cuban website in which heavily modified vehicles are bought and sold, among other repurposed and modified goods. Available at https://www.revolico.com/ as of February 11th, 2018.

26. *Gambiarra* is a word in Portuguese widely used in Brazil to describe a makeshift, improvised solution to a practical problem, and has been applied in the brazilian art discourse since the turn of the 21st Century to describe "an improvisational method of working with materials, devices, technology and/or institutions" (Obici 2017, 87).

the ebb and flow of Brazilian economy are somewhat different from those of the Cuban economic crisis of the 1990s, but a mixture of such economic conditions, along with the technological and informational blockage of the dictatorship period — the effects of which were influential for a much longer time — prompted a similar attitude towards electronic musical instruments, exemplified in Tony's creations: a meeting point between engineering and scavenging, designing and repurposing which is in stark contrast to the "Californian Ideology" ideal of technological evolution.

4. CONCLUSION

This paper attempts to present part of the author's research on the experimental instrument building scene blossoming in Brazil over the last two decades, focusing on Tony da Gatorra's own career and agenda and its intersections with the wider scene. Part of the obstacles found in order to sketch a linear history of the Gatorra's development since its inception in the 1990s had to do with contemporary archiving: valuable sources of information such as Tony's own blog, his *Trama Virtual* page and a number of other pages documenting the first ten years of Tony's artistic activity have been preserved only in their textual content, if at all. Most media attached to such websites that would be valuable to retrieve further information is unavailable.

Other obstacles were found in terms of actual memory and language: Tony's own recollection of what went into each instrument and about who owns each instrument vary from time to time, and attempts to reach Gatorra owners and players showed varied results. It is important to bear in mind that successful ones also presented limitations as to what could be gathered: the grammar available to describe established electronic instruments is not consolidated for the general public, in the context of a unique instrument such as the Gatorra it is gargantuan in its variety.

Future developments of this research include deepening the archaeological findings on the Gatorras, an attempt to closely examine the specimens, which would entail something akin to a pilgrimage. On the other hand, there is greatest interest in developing the Gatorra design for other purposes: the possibility of printing the circuit boards at professional facilities in order to make Gatorra production easier for Tony himself, researching the interface potentials of Gatorra-like instruments, and exploring the educational possibilities of building electronic instruments.

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Evolutionary Experiments in the Development of Typographical Posters

Keywords: Graphic Design; Poster Design; Evolutionary Design; User-Guided Evolution.

Abstract:

During the 19th century, the poster, driven by technological advancements, becomes the primary Graphic Design's medium for mass communication. However, these posters were not evolved by a graphic designer (in the current sense of profession), but by joint work between the printer and the client. Based on this production method, we present an evolutionary system to generate poster designs from a given text input. To assign the individuals' fitness we resort to a semi-autonomous scheme set by hardwired and user-guided measures. Three main aesthetics measures define the scheme: (1) Composition; (2) Design; and (3) Client satisfaction. In this paper, we will describe the system, and discuss its ability to interactively evolve the poster designs. We will also analyse the outcomes of the system in the development of typographic poster designs using a typographic superfamily, and the impact of the user criteria in the results.

1. INTRODUCTION

The poster is Graphic Design's (GD) "blank slate" — like the artistic "blank canvas." It is often the medium used by graphic designers to make self-reflective exercises or express concerns (Blauvelt 2011). It has always been considered one of the most important media to visual communication. Already in the Ancient times, posters were set in a certain location and were used to proclaim notices, news, political campaigns and advertising announcements to the passers-by (Hollis 1994; Meggs and Purvis 2012). This role was eventually supplanted with the democratisation of print and the consequent emergence of newspapers (Blauvelt 2011).

However, the earliest times of Industrial Revolution (England, c. 1760–1840) had a dramatic impact on typography and graphic arts (Carter et al. 2014). Over this period, the amount of energy generated by steam power increased a hundredfold. Electricity and gasoline-fuelled engines increased the productivity, new factory systems-based machine manufacturing systems and novel labour-division theories were developed, and new materials (e.g. iron and steel) became available. Thereby, people moved from the countryside to the cities lured by the employment in the factories, and cities grew rapidly. Therefore, buying power increased and stimulated the emergence of mass production (Meggs and Purvis 2012). Through this scenario of abundance, society saw an advertising explosion. Consequently, poster was reborn proclaiming the new emergent commercial contexts and reaching its high point at the end of the nineteenth-century as a result of the advances made in large-scale reproductive technologies, such as the introduction of the silkscreen or the invention of colour lithography (Blauvelt 2011; Godlewsky 2008).

Similar to today, the technological innovations radically altered printing and stimulated a shift in GD's practice. Wood-type letterpress had become the key method of printing, enabling type founders to try every possible type design permutation (Carter et al. 2014; Lupton 2010). In these permutations: typographic proportions were distorted; new ways of decoration were developed (especially in serifs); the classic typographic shapes were changed, e.g. traditional body part of letters were embedded or engorged. These experiences led to the emergence of a new kind of typography (Lupton 2010; Bringhurst 2004). Furthermore, they also turned the poster into the key medium of communication at the time (Meggs and Purvis 2012). In this way, posters intrude throughout the cities' spaces, multiplying themselves over the sides of the buildings (Blauvelt 2011).

Contrary to the ancient types of posters — where a unique message was anchored to a precise location — the nineteenth century's poster emerged as a multiple reproductions' artefact. A paradigm which revolutionises graphic designers' mind-set about the creation of posters until now (Blauvelt 2011). However, the production of these posters, at the time, did not involve a graphic designer in their present-day sense. The poster was composed by a composer that — in consultation with the client — selected and composed the typography with the ornaments and the wood-engraved illustrations (Meggs and Purvis 2012).

Based on the operating mode of these print-houses, we develop a digital system to generate posters through a similar design process. To simulate this process, we use Evolutionary Computation (EC) paradigms. Like in the Victorian era print-houses, the poster is composed by a composer (i.e. the system) in consultation with the client (i.e. the user). Although it is still a work in progress, the system is already automatically generating posters from text strings. Beyond the description of the functional prototype of the system, in this paper, we also will contribute with: (1) a Genetic Algorithm (GA) wherein individuals are composed by text boxes; and (2) a set of measures for evaluating poster's graphical quality.

The remainder of this paper is organised as follows: Section 2 presents related work, considering applications of evolutionary techniques in domain of GD; Section

3 thoroughly describes the approach used in the development of the system; Section 4 presents the analysis of the experimental results; and finally, conclusions and future work are presented in Section 5.

2. RELATED WORK

Evolutionary Art (EA) systems have been around for some years — the idea was introduced in the 1980s (Dawkins 1986) — and since then has been used, over the last decades, to generate artistic imagery. Briefly, these systems produce graphic actions throughout an image (e.g. adjust the position of a graphical element or change its visual properties, such as colour, hue, transparency, etc.). Matthew Lewis (2007) gives a good overview on the subject. One of the fundamental issues of these systems is the development of the proper fitness assignment schemes. In the domain of visual arts, we found five essential approaches, that sometimes are combined amongst themselves: (1) Interactive Evolution (IE), i.e. the system allows the user to drive the evolution; (2) similarity based, i.e. the system evolves towards a specific image or images; (3) hardwired fitness functions; (4) machine learning approaches, i.e. the system learns how to evaluate aesthetics; and (5) co-evolutionary approaches, i.e. the system evolves its population interacting with another population (Machado, Romero, and Manaris 2008; Lewis 2007).

These systems, as mentioned above, encapsulate the basic set of actions that a graphic designer performs during his/her working hours. In this sense, they have an enormous potential to be a useful tool to graphic designers, especially the IE systems, which allow the designers' choices to drive the system (Anderson et al. 2008). However, graphic designers seldom use these systems. In most of the cases, designers do not have the necessary quantitative background to learn how to use an EA system; additionally, the developers of these systems often are not concerned about mass appeal, stability, or usability issues. In this sense, the use of evolution-based techniques to support GD processes still is not a very explored field.

In the fields related to GD, Type Design is the field most explored. Butterfield and Lewis (2000) developed a system to evolve the deformation of typefaces, using an IE. Michael Schmitz (2004) developed *GenoTyp*, a Flash-based program that allow users to experiment generating new typefaces through genetic rules. Martins et al. (2016) developed *Evotype*, a GA able to automatically generate alternative glyphs from scratch, using line-segments. Unemi and Soda (2003) built a prototype of a type design system for a Japanese Katakana alphabet. On the other hand, *The Alphabet Synthesis Machine* (Levin, Feinberg, and Curtis 2002) creates and evolves alphabets to an "imaginary civilisation." These abstract letter shapes are created from a physically based writing simulation, using a GA with a fitness function based on user inputs.

Although with less frequency, EC experiments are also developed to create content to use in GD artefacts, and / or to support the exploration in the earliest stages of a design process. Carnahan et al. (2005) developed a user-centred design process to create anthropomorphic pictorial symbols for visual communication (e.g. warning pictograms). Cunha et al. (2017) used GA with multiple populations to generate visual blenders, using as the basis the concepts of an angel, a pig and a cactus. Anderson et al. (2008) developed an IE system, the *EvoDesign*, to develop regular lattice tiles (e.g. to use in walls or floors). Oliver et al. (2002) proposed a method that creates and iteratively optimises the look of websites (i.e. text and background style) and the layout of a page (i.e. the position of the different elements on a page). Deniz Cem Önduygu developed *Gráphagos* (2010) an evolutionary approach to create GD's artefacts (e.g. a poster or a book cover). The system starts with a randomly generated design, composed of different visual elements (such as text, shapes, and images) from a given text string. At each run, the user selects the outputs he / she prefers. Denis Klein also noticed that IE methods streamline the GD process in its preliminary

stages. With this in mind, he developed the tool *Crossing, Mixing, Mutating* (2012). This tool generates variations of a template given by the user through the application of genetic operators; subsequently, this tool was updated and released by the studio Less (co-founded by Denis Klein and Lisa Reimann) as an Adobe InDesign plug-in named *Evolving Layout* (Less 2016).

Michael Schmitz (van Nes 2013, 165; Schmitz 2006) also explored the use of evolution paradigms in the development of dynamical graphic identities. Schmitz's *Evolving Logo* is system for the creation of generative visual identities, which uses an evolutionary algorithm to adjust itself to the institution's current state. This system allows the creation of different variations of the logo, through genetic operators (e.g. mutation and recombination). The logotype is evaluated in two ways: (1) the system compares candidate solutions' attributes with a set of variables which reflect the company's state; and (2) the company's employees occasionally choose their favourite logo. The *Evolving Logo* system was implemented in the Max Planck Institute of Molecular Cell Biology and Genetics (Dresden, Germany).

3. THE APPROACH

The main aim of this system is organising a set of text boxes in order to design a typographic poster. To achieve this, we implemented a GA to evolve and evaluate the candidate solutions which, in this case, are poster designs. As stated above, the system is projected to operate in a semi-autonomous way, using the data provided by the client (in this case, the user) to guide the evolutionary process.

Although the problem is similar to the traditional 2D bin packing problems, the traditional packaging algorithms (e.g. Button-Left Packaging, Jakobs 1996) are focused only on the solution of problems linked to the optimisation of the space, i.e. finding the best way to organise a set of shapes; accordingly, they are not being concerned with the visual appearance of the compositions. Furthermore, they work with shapes with the size already defined; however, in this case, besides the typeface positions and disposition, we will also evolve the text boxes' sizes. In this sense, the use of this kind of algorithms, in this context, is not workable. Therefore, we achieve the evolution of the rectangles by evolving parametric information of the text boxes' size (e.g. width and height) and adding visual information to the candidate solutions (i.e. text box font).

The system enables the user to guide the evolutionary process, i.e. the user can communicate his / her typographical preferences to the system. The communication is performed through the user's definition of the system's *visual parameters*. In the current state of the system it is possible to set the definition of the *horizontal motion*[1] and the *weight*[2] of the target font. The interaction with the system, currently, is made using the keyboard, and the user can see the target typeface in the system interface (presented in Figure 1). The current system's interface is only designed for exploration and debug; nonetheless, it already gives the necessary means to enable the user to communicate his/her desires to the system.

The posters are constructed in a modular grid of sixteen horizontal modules by twenty-four vertical modules in the same format as A series of ISO 216. While the system is generating posters, the user can improve the visual parameters (e.g. improve the horizontal movement) and, so, bring closer the current solution to his / her desired composition. Although the system stops at the end of each run, the user can continue running the algorithm until he / she feels satisfied with the outcome.

To generate poster designs, the system employs a GA to generate the first population of posters and, afterwards, evolve this population. The process begins with the generation of a population with randomly created individuals. Thereafter, the individuals are evaluated and, then, selected for recombination and mutation according to their fitness. The process is repeated until the system finds an individual with optimal

1. *Horizontal motion* is the horizontal proportion of the typographic composition. In this system, this variable influences the choice of the target typeface. In other words, the variable controls the condensed – extended property of the typeface. On the other hand, the higher is the variable's value, the more extended is the typeface (see Bringhurst 2004, 25).

2. According to Bringhurst (2004, 332) the weight of a typeface is the "darkness [...] of a typeface, independent of its size."

Fig. 1. Snapshot of the temporary interface of the system. Poster content retrieved from the poster "Amerika is Devouring its Children" designed by Jay Belloi (1970).

fitness or a predefined number of generations is reached. Early experiments prove that the operations made by genetic operators were extremely destructive, leading to the creation of unstable populations. To solve this, we implemented an elitist approach — passing the best individual of each generation to the next generation. The dimension of the search space is reduced using a rectangular grid that constraints the coordinates and position of text boxes.

Each candidate solution's genotype is a sequence of a set of parameters, or genes, that encode a poster design (see Figure 2). The set (1) and (2) are the poster's grid and size, respectively. The set (3) encodes the text boxes: (a) and (b) are related to the text box size, and (c) to the typeface used in the text box. The set (4) stores the text boxes' content. The set (3) and (4) are organised in the same order. The posters' size and posters' grid are defined during the initialisation. The number of text boxes is also defined when the population is created. This number is defined by the number of text lines on the text file supplied by the user.

Typefaces are loaded into the system through a CSV file. Each typeface is imported with a set of constants (e.g. vertical ratio, horizontal ratio, serif type or weight). In the first experiments, multiple typefaces were loaded into the system; however, often the results were not satisfactory — the poster had a crude, unorganised and inconsistent appearance. In this sense, we decided only to load one typographic family at once.

The phenotypes consist in a graphic translation of the genotype, i.e. a poster created from the genotype encoded parameters. The expression process consists of drawing a set of text boxes — defined in genotype — and placing the text content aligned in the middle point of the box (see Figure 3).

The system is developed using Processing 3. The operating mode of the system is divided into two main modules: (1) *the Creator*, i.e. the module that implements a GA to create candidate solutions and employs the genetic operations (see subsection 3.1); and (2) *the Appraiser*, i.e. the module that implements the fitness' assignment and evaluates the candidate solutions (see subsection 3.2).

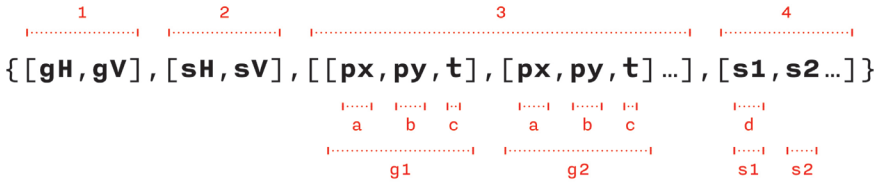

Fig. 2. Genotype encoding. The genotype is composed by a sequence of four set of parameters: (1) poster's grid; (2) poster's size; (3) text boxes' encoding; and (4): text boxes' contents. The third set (i.e. the text boxes' encoding) is a list with the attributes: (a) box's width; (b) box's height; and (c) used typeface; The text boxes' content (4) is organised in the same order of (3); for instance, the content of text box g1 is the string s1 and so on.

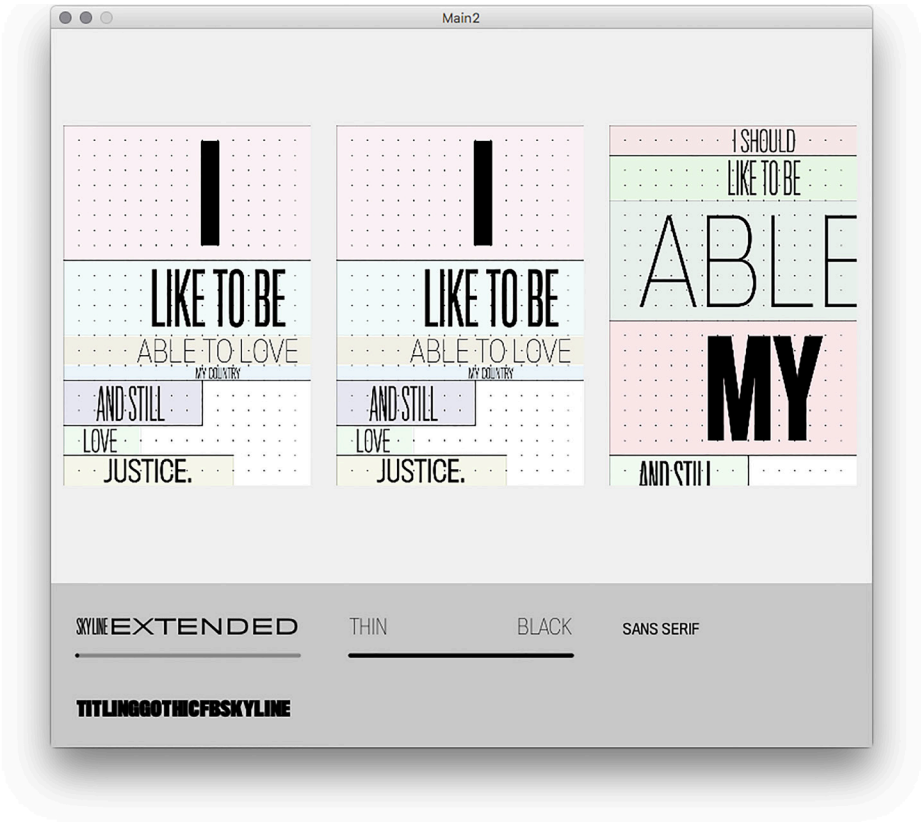

Fig. 3. Example of rendered phenotypes. The text boxes are presented in distinct colours. The points are the grid delimitation spaces. Original content by Albert Camus and published in the book *Resistance, Rebellion and Death: Essays* (1995).

3.1. *The Creator*

New candidate solutions are created throughout the evolutionary process by applying genetic operators. In this section, we describe the genetic operators designed to manipulate the representation proposed above, namely: initialisation, mutation, and crossover.

3.1.1. Initialisation

The first population is seeded with randomly generated genotypes. Each genotype is created through the reading of the given text file. For each line in the text file, the system creates a text box. To define the text boxes size and typography the system employs a set of methods to generate the text box's width, the text box height (or the leading between the words) and the used typeface. These methods are not completely stochastic and are dependent upon the input. The definition of the text box width is directly related to the string's length. This value is multiplied by a random float number (between 0.25 and 4) to generate less predictable compositions and to enable the application of different styled typefaces. Baseline leading (and, consequentially the text box height) is obtained by generating a random number between 1 and h / 2, where h is the height of the poster. On the other hand, the text box's typeface is selected randomly from the set of the typefaces loaded in the system.

3.1.2. Recombination

For recombination, we implemented a *uniform crossover* method, i.e. to each position on the child's genotype, the parents' genetic material is exchanged with the same probability. The offspring is selected using Stochastic Universal Sampling. For each parent in the offspring, a second parent is randomly selected from the population and the genotype content is exchanged creating two children. Repeating this process, in the end, two distinct offspring are created and added to the population. The recombination operator only exchanges genetic content in the list of parameters that encode the text boxes (see Figure 2).

3.1.3. Mutation

Mutating a candidate solution involves stochastic modifications and/or the introduction of new genetic material in some parts of the genotype. The mutation, in this system, is designed to ensure that the search space is fully connected, i.e. to ensure that all the solutions are reachable from any starting point. Such as the recombination operator, this mutation operator only performs alterations in the list of parameters that encode the text boxes (see Figure 2). Besides that, the operator is designed to perform alterations in all the levels of this genotypes list; therefore, it performs mutations in the list sequence and in the values inside the list. This resulted in a total of seven mutation operators. The operation to be performed in each generation is chosen randomly by the system. Each operator has always the same probability of choice.

The developed mutation operators are as follows: (1) *Independent Mutation*, i.e. a method that flips each gene in the list and randomly changes its values. Each gene is flipped with a low probability; (2) *Gene Mutation*, i.e. an operator that randomly chooses a text box parameterisation and replaces it by a new one; (3) *Gene's value Mutation*, i.e. an operator that randomly selects a value in the genotype and replaces it by a new one; (4) *Gene Swap Mutation*, as the name indicates, this operator randomly selects two text boxes parameterisation and swaps them; (5) *Value Swap Mutation*, i.e. an operator that randomly selects two text boxes parameterisations and swaps one of their parameters. In the system's first versions, the population stabilised without reaching an optimal composition (e.g. a text box needed more than one grid width value, or the text box typeface was bigger than the available space). In this sense, we developed two more operators to accelerate the evolutionary process, they are: (6) *Change Text Box Width*, i.e. a function that flips each width parameterisation in the genotype and increases, keep, or decreases these values; and (7) *Change Typeface*, as the name indicates, that method flips each typeface parameterisation in the genotype and changes, or keeps, these values.

3.2. *The Appraiser*

The evaluation of results in an EA system is not an easy task. Since the aesthetical evaluations are subjective, typically, the systems use IE to evaluate the results (Lewis 2007); however, this can be a fatiguing task to the user. In this sense, autonomous evaluation approaches have been developed, such as, machine learning approaches (Baluja, Pomerleau, and Jochem 1994), hardwired fitness functions (Machado, Romero, and Manaris 2008), co-evolutionary approaches (Dorin 2004), or personalised fitness functions (Machado et al. 2016). These methods have proven to be useful tools to alleviate some of the burdens of coding the fitness function and automates some aspects in the IE.

Therefore, we developed a measure to evaluate a poster design process, combining hard-wired fitness assignment with user-guided evolution. The merit of each can-

didate is evaluated according to three main aspects: (1) merit of poster's composition; (2) merit of the poster's design; and (3) merit of the system's typography decisions in relation to the user's preferences. Each aspect has different weights in the fitness function. By empirical exploration, we defined the following weights: the composition measures are a third part of the total evaluation; the poster's "design" represents around 46.7% of the evaluation; the typographic evaluation is a fifth part of the evaluation.

3.2.1. Composition Measure

The composition of the poster is evaluated by the calculation of the similarity between the poster text boxes disposition, and the disposition of the target solution. The similarity, between the individuals, is calculated by subtracting the size (width and height) and comparing the area of the candidate solution to the best solution. In the end, this value is normalised between [-1,0].

3.2.2. Design Measure

We measure the "design" value of a poster calculating, for each text box, the distance between the textbox width and the width of text after rendering. In the end, the design value of all the text boxes is calculated and normalised between [-1,0].

Three measures are implemented to calculate the outcome's "design" value in this system: (1) *linear*, i.e. the value of distance does not alter if text width is bigger or smaller; (2) *non-linear*, i.e. the value of distance is bigger when the content is bigger than the text box; and (3) *truncate*, i.e. the value of distance is only calculated when the text width is bigger than the text box's width.

3.2.3. Client's Satisfaction / Typography Measure

As previously mentioned, it is possible for the user to define a set of graphics variables that will be used to evaluate the typographic decisions of the system. To give the system the ability to measure the typeface, each font is loaded with a set of constants that define its *horizontal motion* and its *weight*.

To evaluate the typeface choices, the candidate's solution typefaces are compared with the values inputted in the system by the user. The distance between the used typeface and the desired typeface is, then, normalised (as a value between [-1,0]) and encoded into the individual's fitness.

4. EXPERIMENTAL RESULTS

We conducted experiments to assess the adequacy of the EC System and to reply to our two main questions: (1) "Is the system able to create readable posters?"; and (2) "How do the user's preferences influence the evolution of the poster design?" To develop these experiments, we used the typographic superfamily *Titling Gothic FB*, published by Font Bureau (2005), and designed by David Berlow.

First, we assess the result of the GA compared with a simple Random Search Algorithm (RSA), i.e. for each generation, the system generates a random population and saves the best individual to the next generation. We conclude that the use of the GA presents a constant growth of the individual's fitness. On the other hand, the RSA, albeit sometimes produces good outcomes, the growth of the individual's fitness is inconstant, and its quality is only related with the system's capacity of to produce good random individuals (see Figure 4 and Figure 5).

We also conclude that low mutation rates and high crossover rates enable the system to produce good solutions faster; however, the population stabilizes faster.

On the other hand, high mutation rates and low crossover rates allow a slower increase of the fitness of the population; nevertheless, the population is more diverse.

As we have seen in Figure 6, the system creates readable posters compositions. Although the evaluation of the quality of the GD artefacts is not easy and unanimous and should always be made by the user, the authors believe that the results, albeit with some limitations, are interesting.

As already explained, each aspect of the fitness function has a different weight. Although the client's satisfaction measure is only a fifth part of the fitness function, as we can see in Figure 6, the system chose to use fonts "closer" to the target typography. Therefore, although the visual parameters are not fundamental in the creation of readable poster compositions, they add value to the system in the user's point of view, and, so, are a fundamental part of the system. We define this value because, in the first experiments, the system often did stagnate without a perfect composition. This occurred because the target typeface was not allowing the system to compose (e.g. the target typeface was too wide for the available space).

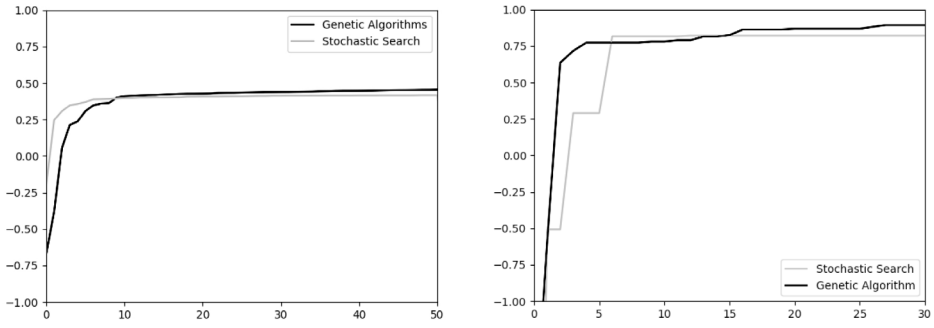

Fig. 4. Comparison between the system's outcomes using a GA or a RSA. Left: Average of 25 runs' outcomes over generations; right: outcomes of one example run. System Setup: Number of generations: 50; Selective Pressure: 2; Mutation rate: 45%; Crossover rate: 55%; Target typeface: Titling Gothic FB Skyline Black (horizontal motion: 0 / weight: 1); Design measure: Truncate. Content: "What, You Don't Know Grapus?" retrieved from the Léo Favier's book cover with the same name (2014).

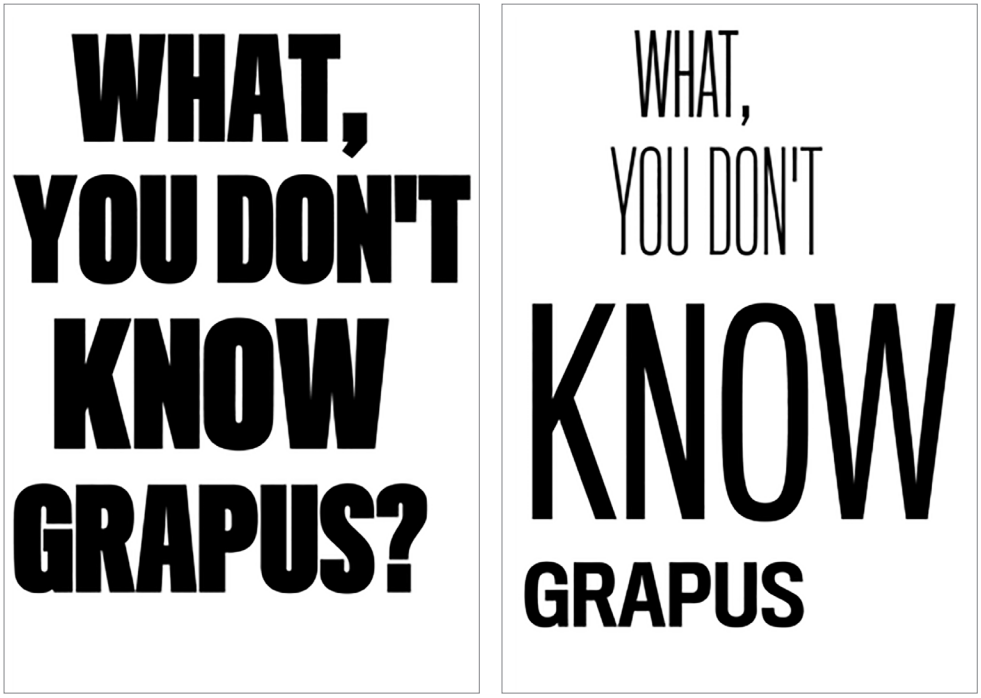

Fig. 5. Comparison between phenotypes generated by the system using a GA and a RSA. Left: phenotype of the best individual, in the end of an example run, using a GA; at Right: phenotype of the best individual, in the end of an example run, using a RSA. Using the same setup from experiments in Figure 4.

Fig. 6. Selected poster designs generated using the system. The stop point is defined by the user. These posters are generated using the same setup as in Figure 4, except the target typeface (which is defined in in the image) and the content.

5. CONCLUSIONS AND FUTURE WORK

During the 19th century, the poster was reborn with the advertising's explosion. The wood-type letterpress became the key method of production printing enabling the appearance of the new typographic permutations. This led to the poster reaching its high point in the ends of the 19th century. However, back then, the creation of a poster did involve a graphic designer, in the profession's current sense. The posters were composed by a composer that — often in consultation with the client — selected and composed the typography with the ornaments and the illustrations.

Based upon this idea, we developed an evolutionary system for the automatic generation of poster designs. Although it is still a work in progress, the system already automatically generates posters. The system presents a semi-automatic fitness assignment scheme based on three main criteria: (1) the composition of the poster; (2) the design of the poster; and (3) the client's satisfaction with the typographic decisions of the system. During the building of the system, we also developed: a representation that allows the definition of poster designs; the corresponding genetic operators; and an aesthetical measure to evaluate the generated poster designs. To keep the typography consistency of the poster, the system composes only with one typographic superfamily.

Future work will focus on: (1) increasing the number of parameters that the user can influence; (2) developing an interface that allows the user to step backwards one or more generations and reset the evolution to this point; (3) including illustrations in composition; and (4) developing a physical implementation of the system.

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Interacting with (Hi)Stories, through a New Media Art Project

Keywords: Tangible and Embodied Interaction; New Media Performance; Interactive Installation; Archive; Narrative; Opensource Software; Computer Vision; Dynamic Projection Mapping; Augmented Physical Objects; D.I.W.O.; Local Community; Collective Production.

Abstract:

This paper presents a new media art project for interactive visualization of archival material. The interactive interface allows the establishment of new associations between *phygital* (physical/digital) elements and the articulation of plural narratives, through tangible and embodied interaction. It introduces the interactive installation and performance *Memory Containers*, where digital footage and physical objects merge into an augmented interactive space. Visuals are mapped on found objects and follow their movement, through a custom opensource real-time projection-mapping software. Thus, the users can rearrange the objects and build physical structures, while they create new links between the digital images. The project was a result of the collaboration between interdisciplinary artists and local community agents. The paper describes the D.I.W.O. (Do It With Others) practices applied, and the technical solutions adopted. It also discusses the ways that interactive visualizations of archives provide opportunities for broader access to archival material, forging a revisiting, reappropriation, and reframing of (hi)stories.

1. THE CONTEXT

The *Memory Containers* project was developed during the *Koumaria* residency 2014, organized by the Athens-based interdisciplinary arts collective *Medea Electronique. Medea Electronique* was founded in 2006 and consists of artists who work in the broader field of contemporary art. They are active in fields such as music, animation, multimedia, art installations, interactive technologies, and multimedia event production, merging separate research and practice fields.[1] Since 2009, *Medea Electronique* collective organizes a 10-day experimental artist residency annually at Sellasia village, near Sparta in Greece, focusing on improvisation and new media practices. Artists from all over the world come together to create a multicultural and cross-media 'dialogue' culminating in a collective presentation in Athens at the end of the residency.[2] The 2014 *Koumaria* residency focused on the theme of i*mprovisation and politics in collaboration with the local community.*

Under this context, resident artists spent ten days in an olive grove situated in the region. During that time, they had the opportunity to meet the inhabitants of the village, attend their daily activities, get involved in discussions and interview some of them. They also had the chance to incorporate in their creative work images from the photographic archive of Sellasia, courtesy of Mr. Ioannis Kapetanakis. The archival material was combined with contemporary footage of the area, created by the resident artists during their stay in the region.

The *Memory Containers* project was premiered at the abandoned olive processing plant of the village, which opened its doors after many years for the occasion. Moreover, all the found objects used in the project belonged to the equipment of the plant, including tools used for olive harvesting, storing, transportation, pressing and oil extraction. The engagement of the local community at all stages of production and exhibition of the artwork was remarkable.

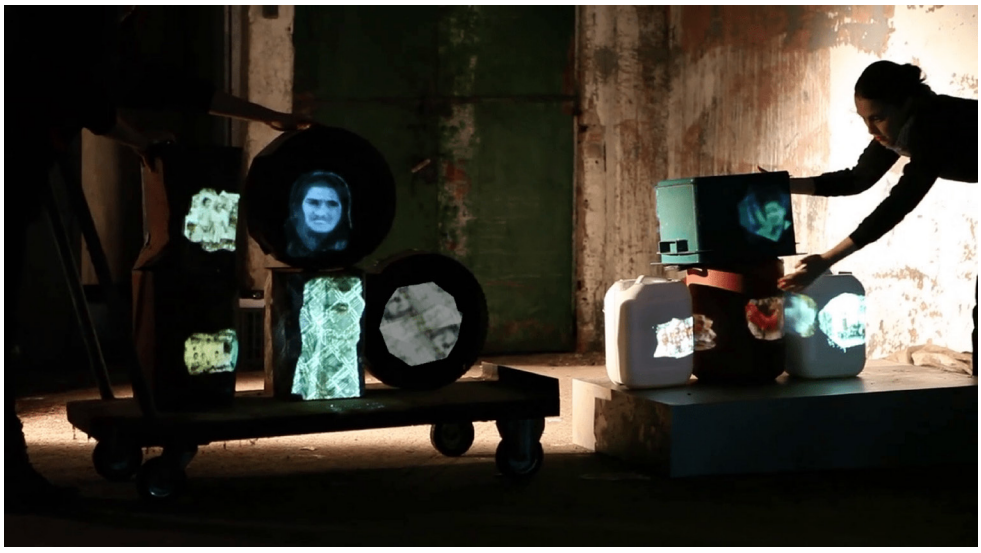

Fig. 1. Memory Containers at the abandoned olive processing plant of Sellasia.

2. REAL-TIME INTERACTIVE VIDEO MAPPING SOFTWARE

During the *Memory Containers* interactive performance and installation, archival visual material and contemporary footage were projection-mapped on physical found objects. The projections followed the movement of the objects, through a custom real-time projection mapping software. The software was built with opensource technologies, such as the *openFrameworks* C++ toolkit[3] and the *ArUco* library. The interactive computer vision interface consisted of a camera, a computer, a projector and a set of augmented reality (AR) markers attached to the rear surface of the found objects, which were used in the performance.

1. Medea Electronique, accessed January 28, 2018. http://medeaelectronique.com/

2. Koumaria residency, accessed January 28, 2018. http://medeaelectronique.com/koumaria/

3. openFrameworks, accessed January 28, 2018. http://openframeworks.cc/

The software received the input video stream of the camera, processed each frame in real-time and detected the AR markers. For this purpose, the *ofxAruco* addon[4] was employed, which wraps the functionality of the *ArUco* library. The library is based on *OpenCV* and is developed by the *Artificial Vision Applications (AVA)* research group of the University of Cordoba.[5] *ArUco* detects squared fiducial markers in images and supports various dictionaries of markers (*ArToolKit+, Chilitags, AprilTags, ARTAG, ArUco*), while it allows users to create custom dictionaries (Applications of Artificial Vision 2018; Garrido Jurado et al. 2014).

The camera used in the project was calibrated so that the library could estimate its pose with respect to the markers. This process was fundamental because it determined where the virtual information superposed to physical objects should be projected. The *ArUco* calibration board was used to calibrate the camera and calculate the intrinsic parameters (the focal length of the camera lens, the optical center of the sensor and the distortion coefficients) and extrinsic parameters of the camera (3D rotation and 3D translation). Each detected marker was an instance of the *Marker* class and provided access to the following properties: a vector of four 2d points (representing the corners of the marker in the image), a unique id, its size (in meters), and the translation and rotation that related the center of the marker and the camera location.[6]

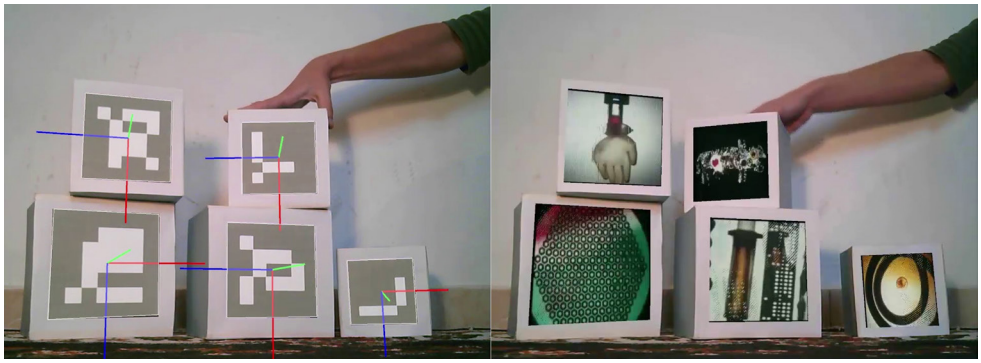

Fig. 2. Demonstration of the custom opensource interactive video mapping software.

Fig. 3. Found objects augmented with video projections. The objects belonged to the equipment of the abandoned oil processing plant.

The custom software used this information to determine the position and orientation of the projected videos. This way, a unique AR marker printed on paper and attached to the rear surface of each object was used to video-map dynamic projections on the object. The mapping was interactive as the projections followed the 3d position and orientation of the physical object, according to the real-time data provided by the AR markers.

The camera was placed at the rear part of the performative space, facing the audience. The markers positioned at the rear surface of the objects were invisible to the audience and could be captured by the camera. The projector was situated at the frontal part of the stage so that the video projections were projected on the frontal surfaces of the objects.

4. ofxAruco: openFrameworks addon for marker-based AR using ArUco, accessed January 28, 2018. https://github.com/arturoc/ofxAruco.

5. Applications of Artificial Vision, accessed January 28, 2018. https://www.uco.es/investiga/grupos/ava/

6. ArUco: a minimal library for Augmented Reality applications based on OpenCV, accessed January 28, 2018. https://www.uco.es/investiga/grupos/ava/node/26.

3. INTERACTING WITH THE ARCHIVE

The photographic archive of Sellasia included a variety of photos covering a broad period of the life in the region. The older photos were dated back to the first decades of 20th century. The images depicted the everyday life of the villagers, as well as special occasions. The archive included pictures of traditional houses of the village, the families living there, men working in construction projects, women attending classes of handicrafts, marriages and other celebrations. It also included photographs of the school, the students and the teachers, the central square and the cafes located there, immigrants descending from Sellasia, together with their travel documents, even sketches of the family trees of some of the local families. Similarly, the contemporary audiovisual material depicted locations of the village such as the central square and the cafés, the mini market, the school, the olive grove and the olive processing plant. It also figured the inhabitants of the village during their daily activities, their working routine and their leisure, such as the gathering at the café or a course of traditional dances.

Fig. 4. Photos from the photographic archive of Sellasia, courtesy of Mr. Ioannis Kapetanakis.

During the exhibition, the digitalized archival images and contemporary footage were visualized simultaneously in a dynamic and interactive way. The interactive nature of the project allowed the manipulation of the visual content in real time and the establishment of new associations between past and contemporary images, which opened the material to new interpretations and forged the articulation of plural narratives.

The contemporary footage can be perceived as part of the archive, if we consider the archive as an open, dynamic structure—an on-going process—rather than a closed static entity. This dynamic process allows the artists and other participants to provide new entries and constantly enrich the archival material. In the digital era, the archival material becomes more fluid, easily transformed and updated. Past records, once digitalized, enter the realm of permanent reconfigurability of digital data, thus providing "different ways to hack into these digital memories." (Ernst 2013).

In *Memory Containers* project, physical and digital elements create a non-hierarchical network of nodes open to reflection. The juxtaposition of different temporalities allows participants to revisit history and reexamine its relation to the present (Panagiotara and Tsintziloni 2015), while they reflect on the socio-political parameters that influenced the life of the local community during the last decades. The visual elements appear as augmented physical objects that can be rearranged dynamically in

the physical space. The relative position of the objects, their physical proximity, and contiguity establish new links between the digital elements mapped on them. Moreover, the physical structures built with the objects, create ephemeral hierarchies and correlations, that result in the articulation of new (hi)stories that potentially "escape prevailing discourses." (Panagiotara and Tsintziloni 2015).

Fig. 5. M*emory Containers* at the *Onassis Cultural Center* in Athens, performed by Katerina Toumpa and Nirit Rechavi.

4. D.I.W.O. PRACTICES AND COLLECTIVE ARTISTIC PRODUCTION

Short time artistic residencies constitute a fertile ground for the development of intense collaborations and peer enactments. In particular, Koumaria residency takes place in an isolated rural region, where interactions with local agents are encouraged. Creating with restricted resources — equipment, internet access and time — was challenging and reinforced the necessity to collaborate and share knowledge and materials. Under these perspectives, the production and development of the projects followed D.I.W.O (Do-It-With-Others) practices, where "a rich mixing of components from different sources crossover and build a hybrid experience." (Garrett 2012) The projects had the form of open experimentations where the emphasis was placed on "the creative process and its socially empowering dimension rather than the final artefact/event or its signification." (Koutsomichalis and Rodousakis 2015) Moreover, collaboration expanded from everyday household tasks to artistic creation, resulting in an interesting fusion between art and everyday life.

Manolis Manousakis, co-founder of *Medea Electronique* collective, introduces the term *Temporary Symbiotic Collective Art Process* to describe the mode of production applied to the projects produced during the *Koumaria* residency. "*Temporary Symbiotic Collective Art Process* is an art production process that takes place in a short period of time involving a number of artists that choose to live together in order to work on a common project. [...] Within this short period of time the artists are called to develop complex communication skills, eliminate their own personal identities and aesthetics and reconstruct their art making by involving themselves in a collective environment." (Manousakis 2016).

These collaborative practices and collective processes could transcend the boundaries of artistic residencies and can form a more generalized paradigm of artistic production. Collective production and D.I.W.O practices provide pragmatic solutions to budgetary limitations and can render artistic production affordable in economies in recession. (Koutsomichalis and Rodousakis 2015) Especially in cases of interdisciplinary new media artworks, that involve numerous artists and professionals, the

Fig. 6. Resident artists collaborating with the local community (left) and with *Medea Electronique* collective members (right).

formation of collectives is often essential. (Manousakis 2016) According to Enwezor (2004), "Collectives tend to emerge during periods of crisis; in moments of social upheaval and political uncertainty within society. Such crisis often forces reappraisals of conditions of production, reevaluation of the nature of artistic work, and reconfiguration of the position of the artist in relation to economic, social, and political institutions."

Particularly in the case of Greece, the recession of the economy fueled the rise of the D.I.W.O movement and workshop culture (Koutsomichalis and Rodousakis 2015), which were proved sustainable in the new economic conditions. According to Koutsomichalis and Rodousakis (2015), this workshop culture resulted in a shift from "(Not-)Doing-It-Yourself to Doing-It-(Cheaper)-With-Others."

5. TOWARDS A CONCLUSION

The paper introduced the *Memory Containers* project and discussed issues related to the production and exhibition of the project. It reflected on ways to engage a broader public (audience, artists, local communities) to the creative process both during the exhibition of the project (through user interaction) and during the production of the project (through D.I.W.O practices).

The digitalization and the interactive exhibition of archival material provided wider access to the archive and created opportunities for active engagement of the audience with this material through tangible and embodied interaction. The interactive exhibition opened the archive to new interpretations and questioned its static nature. The archive became an open process rather than a fixed entity that involved the audience to performative enactments and archive-making acts, which further enrich the archival content by creating new records.

Artistic projects often take advantage of the obscure traces of the archival material and the discontinuity of the stored elements, which offer opportunities for articulating narratives that give meaningful coherence to the stored data (Ernst 2004) and reveal the "unfulfilled beginnings or incomplete projects-in art and in history alike-that might offer points of departure again." (Foster 2004) The production of new entries is often equally important to the reappropriation and reuse of past records. Performative arts can facilitate such processes in various ways, such as the process of 'performative archiving,' a dynamic process of archive-making which evolves in the present, receiving archival entries which are readily available for editing and further uses. (Kouros 2012)

Through the dynamic projection mapping software, the digitalized archival material acquired a physical dimension creating an interactive memory/narrative space. In this space different temporalities, events or memories were decomposed into their (non-hierarchical) constitutive elements and laid open to user interaction. (Weinbren 2003) This way the audience and the performers were able to rearrange the physical objects and the digital memories dynamically, providing the opportunity to suggest "connections and reflections on the past, or make it anew, in order to avoid conformism and to propose new engagements and relationships between past and present while forming a sense of sharing or community." (Benjamin 1968).

Apart from the exhibition of the project, its production also pursued the participation and collaboration of the wider public. The production of Memory Containers, in the context of an artistic residency, forged collaborative processes and facilitated local community engagement. Moreover, the use of open new media infrastructure, including opensource and D.I.Y. (Do-It-Yourself) technologies and the numerous knowledge sharing communities developed around them (Kuznetsov and Paulos 2010), as well as open data and public domain licenses, provided handful resources for the support of these less centralized modes of artistic production. The paper presented the modes of collective production and the D.I.W.O. practices that were applied during the residency. Finally, it was argued that these modes and practices could transcend the boundaries of artistic residencies and form a more generalized paradigm of artistic production. This paradigm could provide pragmatic solutions in the case of interdisciplinary projects developed inside societies in an economic recession.

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History of the Infinite Publication

Keywords: Publishing; E-book; Digital History; Science Fiction; Social Media.

Abstract:

The aim to increase the space for content in publications has been part of the more general and natural need to overcome the limits of a fixed space. But the need to overcome the size limits in publications can be formulated as a technological question as the printed format easily reaches its limits when it becomes either unreadable, with the content excessively reduced in scale, or unmanageable, or exceeding a certain threshold in binding or physical presence. Historically the first approach to increase this space has been manifested through the progressive mechanically-induced collapse of content in the given space. Before that, the amount of readable space had to be established in advance, being either a page or a certain amount of openness of a scroll, and the content would just be able to fill it under certain ratio rules.

THE OPTICAL COLLAPSE OF CONTENT SPACE

This idea of collapsing the space of content has become popular especially during the 20th century, as a consequence of a society progressively information-based on a global scale, thanks to the mechanical and electrical technologies. The first wave of attempts to collapse the content space, have been based on optical technologies.

Breaking the boundaries of the print publications was something envisioned by El Lissitzky in 1923 in his *The Topography of Typography* manifesto. He concludes it with: "The printed surface transcends space and time. The printed surface, the infinity of books, must be transcended. THE ELECTRO-LIBRARY". This sentence has been credited for envisioning the internet, or rather the current digital space of publications. But in it we can identify two specific visionary elements. The first is "the infinity of books" as a unifying vision of the whole printed knowledge as a single space, which can potentially be addressed as such. And the second is the concept of *transcending* space and time, which in that period was probably embodying the dream to overcome the slowness and heaviness of printing limits with some electricity-empowered technical innovation. So transcending space can be interpreted as breaking the physical limits of content space; and transcending time can be interpreted as accomplishing an asynchronous access to the content, which would have allowed to access multiple content sources at the same time. Before the above mentioned ending sentence there's another point of El Lissitzky's manifesto stating: "the continuous sequence of pages: the bioscopic book", whose first part can be interpreted as another attempt to consider a vast, even undetermined, content flowing in a continuum, with the consequence of not being able to determine a priori the size of the involved content or publication. The size of this *continuous* publication would remain unknown unless we'd have reached its end, which is not so distant, as a concept, from the current perception of digital publications, whose size is unknown until we reach the end of the file.

A few years later, in the second half of 1930s, there were already some tests on the so-called *fax newspaper* or *radio newspaper* (Waldrop and Borkin 1938). It was meant to allow a radio listener to print a daily newspaper at home at a fixed time of the day. It was transmitted through dedicated radio frequencies, and then decoded and printed through a specific device integrated into the classic radio receiver of the time, as a scroll. The reader didn't know in advance its size, either, until it was fully printed.

The space occupied by the content was then early addressed as an issue, with the flourishing of commercial publishing business and the improving abilities to read generation after generation. A different do-it-yourself experiment was embraced by a Spanish teacher with the aim to relieve the students from the heaviness of their textbooks. Ángela Ruiz Robles in 1949 built a prototype of a mechanical book, which was aimed to incorporate a sensibly bigger amount of content than a classic textbook. The *Enciclopedia Mecánica* (Mechanical Encyclopaedia) (El Mundo 2016) used similar optical principles of the above-mentioned machines: it was built within a plastic case with texts and illustrations on reels, easily removable and replaceable by other, with different topics, and with parts meant to allow writing and drawing. The reels were under a sheet of magnifying glass with a light for reading in the dark and, in a second prototype released in 1961, there was also the possibility to hear a spoken description of the topic.

All these conceptual machines and prototypes remarkably rely on the same principle later applied in microfilms technology: the physical collapse of the content space. Using optical or mechanical technologies they tried to make it work through a dual functionality: reducing the space usually occupied by the content and revive it when needed.

THE SCIENCE FICTION VISION

In parallel to visions and prototypes conceived in the golden era of the technical do-it-yourself (1920s-1960s), science fiction has envisioned imaginable embodiments of media related to publishing. After being a literary territory to forecast a narration of the future at large, it has assumed a consequent archeological importance for the history of media. So a vivid and advanced imaginary about the infinite book can be retrieved by the production of different science fiction writers, who have provided different visions of a truly expanded ad-infinitum publication.

The comparable ideas in these novels are involving 'systems' and 'machines' as scientific or technical agents pushing the limits of media as we knew them. As one of the first examples relating publishing to the infinite dimension, even if it's not technically considered science fiction, Jorge Luis Borges' *Library of Babel* (1941), written in 1941, is probably the most famous example. It describes an infinite library with all the possible books that can be written and the cultural and psychological consequences on the humans approaching it. Just a few years later, Richard Shaver in his *I Remember Lemuria* (1948) novel wrote about an enigmatic object that he called a *pocket reading machine* which was so common that would have not attracted attention in the described urban environment. Even if just sketched in a few words, this elusive device was considered portable, small, and functioning as a machine, so including some systems for reading. Only three years later, Isaac Asimov in his short story *The Fun They Had* (1951) had two of the protagonists to describe *telebooks* over a dialogue. Indeed, in this story a couple of kids living in 2157 find an old printed book from the previous century, stating at some point:

> What a waste. When you're through with the book, you just throw it away, I guess. Our television screen must have had a million books on it and it's good for plenty more. I wouldn't throw it away.

Beyond the naive ecological considerations, which is not taking into account the waste of natural resources to produce both the tv set and the needed electricity, here the two media, television and print, are formally merging, in order to dematerialise the printed content in the air, channeling it to an already tested machine. This machine, the TV set, is able to temporarily host content on the screen, replacing it at will, so potentially hosting infinite content. Already in 1934, the similar idea of a *television newspaper* was graphically illustrated in the syndicated comics *Can it be DONE?*, with a couple commenting the news in front a big screen TV set, the size of a tabloid.

All these visions are technically focusing on content "containers", media in themselves at large. They are machines, or "devices", meant to become the universal interface to access the content, which is distillated in collapsed quantities, ready to be expanded within the device. All of them are imagining an evolution of the existing media into an updated and empowered version, with no clear spatial content limits.

THE DIGITAL ENDLESS COLLAPSE OF CONTENT SPACE

Digital machines by their own nature have certainly collapsed the space of information. Their engineering is based on a long historical trajectory of electronic miniaturisation of both the processing and the memory elements, which, over time, has induced the exponential multiplication of the contained digital space of information in smaller devices with greater storage capacity or networked access to almost infinite content spaces.

If we try to identify the first electronic device explicitly focusing on cultural content, we can probably choose the *Dynabook* prototype, conceived by Alan Kay in 1968 and unfortunately never realised. It was the first complete model for an electronic textbook, in a shape that today we would easily categorise today as "tablet" or "e-reader".

In his paper in 1972 he's detailing the Dynabook's technical specifications:

> The size should be no larger than a notebook, weight less than 4 lbs.; the visual display should be able to present at least 4000 printing quality characters with contrast ratios approaching that of a book, dynamic graphics of reasonable quality should be possible; there should be removal local file storage at least one million characters (about 500 ordinary book pages) traded off several audio (voice/music) files.

It can be noted that the "printing quality" of the display was treated as an important element, as it should have guaranteed the use of the screen as a functional substitute of the printed page. And equally important was the "removal", so expandable, file storage with a standard minimum content size of a huge book, potentially expandable to an entire collapsed library.

This transition, which sports a reverse of perspective, should have been initiated by a specific event: the optical qualities of publications reaching their resolution and spacial limits, in both paper and celluloid. The next step has included the technically investment in a "container" with a comparable resolution, but with no spacial limits for the content, which would have been perceived through a single screen. Generally speaking, the screen itself has very tangible boundaries, but its content has none. The main conceptual consequence is that the screen becomes the single universal space, which is potentially containing all the possible conceivable content, reconfiguring its matrix of basic elements. And the more we experience it, with a possibly extreme diversity of quality and quantity of content, the more we tend to consider it infinite and universal.

Historically when the devices started to be connected to an invisible storage through networks, first physically and then wirelessly, we probably started to assume that there's an infinite storage somewhere possibly containing all the content we need, and this content is then drawn from there, dynamically being rendered on the screen matrix of pixels, at will.

Where exactly it is stored, and who is storing it, owning it, being able to change it, edit it, delete it, becomes mainly irrelevant for the average user, especially compared to the compelling spectacle of having the content instantly available, and endlessly scrollable. The combination of an infinitely reconfigurable screen with a remote boundless storage breaks all the possible size limits in our imaginary. This gives room to high expectations of content which are constantly renegotiated, but always settled, accepting the failures to find something specific in exchange of the quantity of other similar content, constantly and rapidly replacing the initial need. When exposed, for example, to a search on Google, YouTube, Facebook, just to name a few, if we're not exactly finding what exactly we were looking for, we often rapidly modify the need with what we find, as the quantity and the basic quality of what we're being offered overcomes our initial intentions and focus, giving way to content-driven new paths. This mechanism makes the majority of humans prone to what they have been offered as the offer of content is, namely, infinite. There's always something more being accessible for free, then why stop? El Lissitzky in his *Our Book* (1926) affirmed that "The amount of material used is decreasing, we are dematerialising, cumbersome masses of material are being supplanted by released energies". These energies have become ubiquitous and continually exchanged. If we address them historically as "archeologies of the present", as Kittler (1999) defined them, we should "must also take into account data storage, transmission and calculation in technological media", including them in the equation describing what we really need and what we, instead, consume.

Having an infinite content means available, doesn't restrain us from increasing it with the content we so easily produce on various platforms. We can consider the act and gesture of "posting", on various type of internet media, as an act of "instant

publishing", increasing the total amount of content and allowing us to contribute to it. On one side the interconnected web content cannot be conceived as a single infinite publication, because of its diversity in topics, formats and quality, forming a multitude. On the other side the quality we attribute to traditional publications, instead, as being formed by highly sophisticated content, finiteness and consistency, cannot be applied, in reverse, in the online digital system, which is driven by two main time / space coordinates and qualities: instantaneousness and abundance.

Fig. 1. Shaver, Richard. *I Remember Lemuria*, Evanston, IL: Venture Books, 1948.

Fig. 2. Ángela Ruiz Robles showing The *Enciclopedia Mecánica*.

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The Emergence of Computational Design Research and Education

A Technical-Scientific Approach, 1950-1970.

Keywords: Computational Design Research and Education; Architectural Theory; Educational Project; Scientific Methodology; Computational Design.

Abstract:

A convenient framework of computational design research and education history in architecture is fundamental to formulate the possibilities of a "digital continuity" or "revolution in the discipline" (Oxman 2006). Contributing to this framework, this article presents an analysis of the cultural and technological context that led to the emergence of Computational Research and Design Education — HfG-Ulm and its American counterpoint — focusing specifically on the way teaching and architecture design approached science in the period 1950-1970. This is based in educational programs and places where a remarkable set of teachers, ideas and work converged.

1. INTRODUCTION

Nowadays the use of computational design processes in architecture has become a common practice thanks to theories connected to computer science developed in the 1950s across research centers in the US and UK.

Although there is an accelerated maturation of the integration of digital technologies in the architectural process, especially on teaching and research, there is no consolidated research on this perspective.

It is often observed that in architecture there is a transitional period in which technologies are initially applied as an extension of the established practice while in parallel, truly innovative approaches are developed in order to expand inherent potential of these technologies. This ultimately leads to a progressive transformation of the practice.

We are currently experimenting a transformational period (Menges 2013), in which the repeated search for innovation implies a deep understanding not only of digital design techniques, but also of a critical computational thinking that will guide future research. A convenient framework of computational Design Research and Education history in architecture is fundamental to formulate the possibilities of a "digital continuity" or "revolution in the discipline" (Oxman 2006).

Contributing to this framework, this article presents an analysis of the cultural and technological context that led to the emergence of Computational Research and Design Education, focusing specifically on the way teaching and architecture design approached science in the period 1950–1970. This is based in educational programs and places where a remarkable set of teachers, ideas and work converged.

The objective is to present an analysis of the computational design research and education, in two distinct technical-scientific contexts — Germany, through the HfG-Ulm, Hochschule für Gestaltung Ulm, founded in 1953, and United States of America, through some American institutions that were influenced by HfG-Ulm.

In order to carry out this analysis, this study uses the primary sources of archives and interviews. We will analyze the influence of emerging disciplines — Computer Science, Operational Research, Scientific Methodologies — in architectural thinking and project design.

As for HfG-Ulm case, this paper will examine and demonstrate the relevance of HfG-Ulm and the ideas developed by the aforementioned teachers, starting with the Max Bill Education Project, which proved crucial to build a new design approach and was also linked to the implementation of technical thinking and construction of a scientific perspective in architecture using an analytical approach of scientific research methods for information processing and design.

This article also contributes to the creation and mapping of an itinerary between institutions, works and key speakers that embody the defined theoretical framework, in a broader context composed of other institutions and systems of thought. It will advance research in the cultural and techno-scientific contexts that have contributed to the emergence of Research and Education of Computational design.

It ultimately aims to bridge a theoretical and historical gap in the interpretation of the relationship between computing and architecture between 1950 and 1970 through the belief that networked digital flexible architecture is capable of learning both past and present to evolve into a promising vision of the future.

2. STATE OF ART — EMERGENCE OF A COMPUTATIONAL PERSPECTIVE

The emergence of a computational perspective has not yet been documented and interpreted. However, we may already frame this ongoing research, that focuses on some research centers in Europe and in the United States, vital for the emergence

period in the thought and practice in computational architecture (Keller 2005; Rocker 2010).

The starting point is the perception that the intellectual foundations of computational design's nature, based on the confluence of domains, from mathematics and computational science to biology and philosophy (Menges 2011). Publications that cover this spectrum of topics (Menges 2011; Vrachliotis 2010) are rare and the historiography of information technologies is a starting point for a global vision, essential for this theme.

During the first decade of the digital design materialization, in the 1990s, significant writings appeared, in isolated publications or exhibitions. This was a period of cultural transformation (Lynn, 1999).

An important threshold was reached with "Folding in Architecture" (Lynn 1993) and 20 years later with "Archeology of the Digital" (Lynn 2014). Later, the methodological and technological developments in digital design were the focus of attention (Kolarevic and Malkawi 2005).

On the one hand, since the turn of the millennium, the increase of publications on "digital design" is noticeable (Oxman 2006). On the other hand, while less concerned with issues of formal first-generation exuberance, the academic emphasis was placed on digital design (Oxman 2006) as a new set of technologies and communication media, that have been transforming definitions and traditional design concepts. The diffusion of digital equipment is linked to a series of changes in the definition and content of architecture, resulting from a much longer and more complex process of adaptation of designers to digital tools (Menges 2011; Picon, 2010).

Nevertheless, there are still very few studies on the meaning and progress of digital technologies in architecture (Picon 2010). Nowadays, the challenge of computational design does not lie in the mixing of computational design techniques, but in the "acculturation" of design thinking (Menges 2011), which is a distinction between computerized practice and the true computational design project. Examples of this appropriation of culture can be found in the history of architecture.

It is therefore relevant to focus on how design thinking is transformed and informed through technological advances (Menges 2011), in addition to discussing the impact of digital technologies on the discipline (Picon 2010). It is essential to reconnect the computational architecture with history, discourse and theory, by a systematic way and in an international context, thinking about the "emergence of computational Design Research and Education".

2.1. HfG-Ulm — The Educational Project

2.1.1. HfG-Ulm and its influence on post-war design in United States of America.

HfG-Ulm, in Germany, was opened from 1953 until 1968, during the transition of industrial society to post-industrial society.

Despite its small existence, HfG-Ulm represented a continuous project of post war of rethinking social sciences rules, inside a beliefs on racional supremacy. HfG's mission of "good design" it was asserted as a moral project, with a strong belief in aesthetics as a sign of a democratic society, due to the personal history of its founders, of the era of Nazi Resistance.

Teaching at HfG-Ulm recognized the ideals of standardization and mass production, investigating a scientific approach that integrated systemic methods, data collection and processing objectives, to achieve the design solution. It would synthesize science and design in a new scientific humanism that recognized the pluralism of methods and methodological perspectives required by the designer to face the new problems of industrial culture. What emerged, however, was the beginning of an operational view of design science, which Maldonado called scientific operationalism.

Nowhere else has this question been focused on before, only amongst the designers of devastation, with large curiosity about all new scientific subjects and new ideas in the philosophy of science and mathematics (Buchanan 2009, 427). As Maldonado stated, "The mainspring of all our curiosity, our reading, and our theoretical work was our determination to find a solid methodological basis for the work of design" (Maldonado 1991, 222). In this way the scientific knowledge and the new methods could be applied in the search for solutions for design problems, within an industrialized environment.

With the emergence of new disciplines as a consequence of technological and scientific developments caused by World War II, decision-making processes and research about creative processes had a significant influence in the early years of exploration of product design and its development methods. In this context, exchanges of information between disciplines such as artificial intelligence, cybernetics and problem solving were fundamental, especially in Europe and in the United States. Although these subjects were being studied by several research centers of the time, HfG-Ulm preceded the international speeches that manifested interference with HfG-Ulm's philosophy or protagonists. A key issue raised by these center, as Andrea Gleiniger and Georg Vrachliotis claimed, was to understand how the computer could operate and be used in the design process. In his own words:

> A quick look back at the almost 50-year-long history of architecture and the computer will show that, at the beginning of the 1960s, the computer was still unchartered technological territory for architects, and considered primarily an artifact by technicians for technicians. It opened to architects a still foreign world of codes and programs that was also appealing, because they were fascinated by the mysterious and alluring glamor of technology. Now, with this in mind, the question then emerged of how this new machine can be operated and used in the design process.[1]

1. Gleiniger, A., & Vrachliotis, G. (2012). *Code: Between Operation and Narration* (pp. 10).

As such, it is important to consider the discussion that emerged in the United States about the systematic design methods developed at HfG-Ulm.

At the International Design Conferences in Aspen, United States, some professors representing the Ulm School were present, including Max Bill, Konrad Wachsmann and Tomás Maldonado. They discussed their ideas with industry managers and designers, promoting international exchange between theorists and practice.

In this context, the "First Conference on Architecture and the Computer" in Boston in 1964 focused on the problem of professionally educating a new generation of architects, proposing problem solving within a computer language, rethinking the function of the machine and its relationship with designers. Walter Gropius posed this question to the public and the audience of the conference, promoting the debate about the potentialities and limits of the computer in architecture.

According to Gropius, the computer was a product of that time, which required a change of practices. In his welcome speech, Payne, the chair of architecture in Boston and Gropius' assistant, said:

> Our topic, the computer, seems the most timely, the most urgent, the most serious subject that we could bring to the profession", and he added: "Steeped in time-honored traditional methods of approaching architectural assignments, but this machine, a product of our day and our time, might require us to change and approach our task in some new manner. So we must begin to explore the subject immediately.

Gropius, at the beginning of this conference, spoke about "computer language" and "architecture assistants", in the sense of needing to apply the computer to architecture in a useful way, developing a common language between computer and architecture.

According to Georg Vrachliotis, when asked by Payne about the possibility of using the computer as an architectural tool, Gropius' answer was succinct: "Still I believe,

if we look at those machines, the potential tools to shorten our working progress, they might help us to free our creative power".

Gropius believed that the machine could shorten the designer's work processes and free up creativity. However, the most interesting aspect of this discussion was based on the initial question of Gropius: If architects were ready to consider computers as a viable architectural tool, it would be necessary to create the role of an architectural assistant. Almost four decades later and looking at the increasing complexity of computer programs, it is important to reflect on whether Architecture is still a field consisting of specialists, translators and architecture assistants or whether the work of architects involved with the University and researchers, essentially turns them into algorithm designers.

Design has historically been considered the fundamental tool for engineers and architects. Architects used design in the form of sketches, plants, perspectives, for design presentations, and to shape the abstract contours of their imaginary world. Writing and drawing were closely related. In both cases a "phenomenalization of the thought process" took place. The algorithmization of design process unleashed a wave of methodological and conceptual uncertainty throughout the field of architecture and later altered the architecture in the form of drawing and even more as a discipline. It was finally time to spread technological progress and start researching the use of the computer and its potential for Architecture. Except for the large planning and construction companies, where it was already being applied as an administrative calculating machine, the computer was seen by architects in the early 1960s as an artifact of technicians for technicians. No one knew how to approach these new machines. Despite the pioneering spirit that Payne was trying to unleash in that place, most architects had not yet glimpsed how, or where, computers could be integrated into their creative design practice and planning processes. It was an unknown world of codes and programs but one with a mysterious and seductive character that could be seen in photographs where huge computers were portrayed and stylized, representing a sober and rational world of applied mathematics.

Architects did not imagine being able to operate a computer in the design process, not only because of their lack of knowledge, but also because (and for many this would be the real reason) they did not feel the use of computers as part of the architect's design component. Two worlds were colliding: on the one hand the universal design, creative and intuitive and on the other the performative techniques.

In the conferences referred to above, held in the United States, Tomás Maldonado stood out amongst the main mentors involved. His relations with the United States were sporadic, but left an important legacy. In 1963 he was a visiting professor in the United States at the Carnegie Institute of Technology in Pittsburgh. Later in 1964, he lectured at the Institute of Industrial Technology of Buenos Aires, requested by the UNO as a specialized technician. In 1965 he was a Curriculum Advisor at the College of Architecture at the Carnegie Institute of Technology in Pittsburgh and served as Lethaby Professor at the Royal College of Arts in London, England. In 1966 he was considered a senior member of the Humanities Council and a visiting professor at the Princeton University School of Architecture. From 1968 he occupied the chair "Class of 1933", at the Princeton University School of Architecture. In the interview granted for the scope of this investigation, Maldonado reports the beginning of his contacts with the United States:

> (...) I was the promoter of the enrichment of a theory that resorted to hard Semiotics, information theory and the theory of cybernetics. During these years we invited Nobert Wiener to give a conference and we discussed these ideas with him. Of course, we had relatively clear ideas of what we wanted, but there were still mixed issues, because we were leaping far ahead. In the 1960s, I believe that in the year 64 or 65 more specifically, the first contact with the American schools happened.

I went to the United States, Princeton and Harvard a few times to give courses and training sessions.[2]

Maldonado anticipated the role of industrialized production methods, as we can conclude when we analyze the Fundamental Course that he coordinated. Some of the themes taught by Maldonado related to Information Theory, Cybernetics and Computational Theory, where the objective was the introduction of precise analytical methods in design that followed mathematical explorations or applications of precise recursive rules. They influenced the generation of design patterns (for example, early versions of fractals such as Sierpinski's Triangle and Peano or Hilbert Curve). These were continued through the work carried out by William Huff, student of Maldonado, who showed the construction of a project system based on geometric rules. Rather than focusing on the design of specific and limited forms, students sought to explore the generation of variable parametric standards.

Huff had a significant role in the expansion of some ideas launched at HfG-Ulm and developed in the United States. It can be stated that William Huff was instrumental in defining the scientific approach in school. William Huff emphasized this approach in HfG-Ulm, expanded it and deepened it in other research centers, especially in the United States of America. In the interview given for the scope of this investigation, Tomás Maldonado pointed out that one of Ulm's most brilliant students was William Huff:

"He was an American, was very important because he later was also a teacher in school and was my best student. William Huff was Albers' student at Yale and it was Albers who told him to come and study with me because Albers had been a teacher in 1955 in Ulm and he was there for a year with me and I helped him, he was my assistant. "After his experience in Ulm, his performance was noticeable as an assistant professor at the Carnegie Institute of Technology (Pittsburgh) from 1960 to 1966, and later as associate professor at Carnegie Mellon University from 1966 to 1972, became a professor in New York State, in Buffalo, from 1974".[3]

In addition to the lessons he taught, his publications also represented outputs from the Ulminian learning, Huff attempted to develop a project methodology based on the system of thought, proposing a reciprocal structuring system to its respective environment. Thus, very easily, the system of thought was literalized through geometric structures and the differentiation of the system, being presented through differentiations of geometric structures and patterns. The purpose of Huff's pedagogy was to search for systems of structures that relate "to the arrangement of parts or elements. For the project, then, it is above all the structure and for me the study of structure (in the abstract)." For Huff, the study of physical and perceptual structures became very important. Like Bense, Huff understood physical structures as "a structure, as far as humanly we can determine, in fact, is from the microcosmic atom to the macrocosmic universe".

Much remains to be learned, however, about structure in both its manifestations, the organic form, and the inorganic form. The structure can be studied through biology, mathematics and physics, as indicated by D'Arcy Thompson, quoted in Huff's text. In particular, D'Arcy Thompson's works became important references to Huff, and consequently to HfG-Ulm, for they represented structures of matter: "cells and tissues, shell and bone, leaves and flowers, are different portions of matter and it is in obedience to the laws of physics that its particles have been moved, shaped and shaped".

From this point of view, Huff's pedagogy defended two types of structuring of a system: the physical structuring through transformations following rigid transition rules, which transformed geometric patterns, and the perceptual structuring through optical illusions. Perceptual structuring has been exemplified by patterns whose

2. Tomás Maldonado, interview performed by author, at 2012, in the context of research.

3. Tomás Maldonado, interview performed by author, at 2012, in the context of research.

realization, through the perception of the observer, changes continually. The designer is then in a position to create structures of unstructured matter, in anticipation of its continuous restructuring through who sees it. Therefore, it is not just design or design projects, but also the likely perceptions of design. Consequently, much of the training at HfG in the 1960s focused on rigorous methods training that allowed the designer to arrive in a controlled fashion with structures that offer a maximum of likely readings. Part of this methodology reinvested itself in the role of symmetry as a structuring, ordering and generating device. Moving away from the fundamentals of the Bauhaus, "learning by doing", replaced by a rigorous rule-based design discipline that explores questions of symmetry, topology, and perception. In HfG, Gestaltung meant Gestaltung of the human, physical, perceptual and mental environment.

The course where Huff taught at the Carnegie Institute of Technology in Pittsburgh was based on the HfG-Ulm Basic Course, written and directed by Maldonado in 1956-57. None of the early American design studies at that time approached the contents of the Basic Course in Ulm, except, according to Huff, of the Department of Yale, led by Albers. According to William Huff's own testimony:

> I began to teach Basic Design course at the Carnegie Institute of Technology, Pittsburgh. I did this especially out of my mouting vexation the beginning studies of none of the American Schools of design approached anything of the consequences of the Ulm Grundkurs (that rare island at Yale's Department of Art under Albers, notwithstanding.

In 1963, which computer models operated responsible for Huff's classes at Carnegie Mellon for a month. Observing the success, the students' learning and the practice of design reform in class, he invited Huff to come back to Germany and teach an autumn course at HfG-Ulm. That year, Huff worked in the Department of Visual Communication and the Department of Industrialized Construction. What, then, was Huff's real contribution to the Basic Course of Maldonado of 1956–57? According to William Huff himself, "based on Bauhaus's experimentation and observation strategies, "they added layers "that redefined the basic design, what he called "geometrization", "perceptualisation" and "exercise".

It is noted that the interests of Huff and Maldonado, his mentor, were no longer focused on single isolated elements and whole forms, but rather on the search for algorithms based on process rules. In contrast to previous surface structures, patterns have been imbued with the complexity of their possible variations. Variation was both a feature of the elements of a final form, through various scales, and, at the same time, the various possible forms that a single algorithm could generate. Artists and architects were consequently less responsible for producing a final form than for producing an algorithm that could generate a number of forms. The work of art and architecture as such ceased to be regarded as an original singular form.

It could be said that there was a continuity of processes, both in a pedagogical and technological perspective, in relation to the disciplines that had already been tried at HfG-Ulm. It is thus considered that the maturation process only came to fruition at the College of Environmental Design in Berkeley.

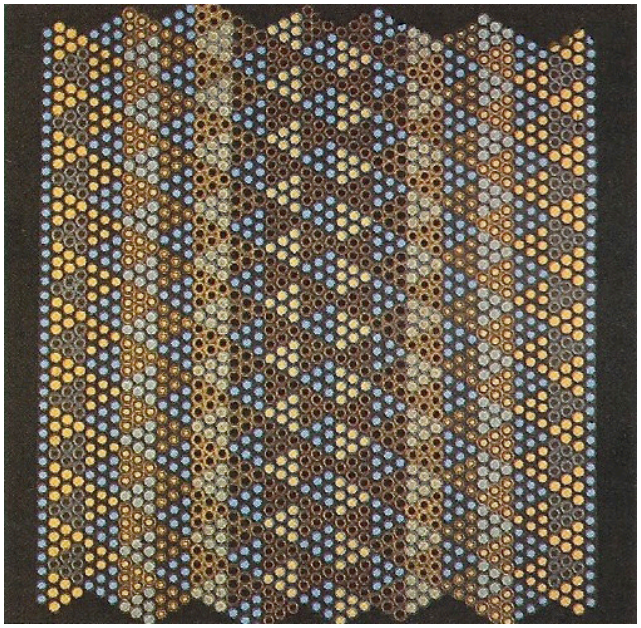


Fig. 1. “Color Raster”. Student Louis Sirianni, CIT (Carnegie Institute of Technology) 1965. Teacher: William Huff. Source: Gregotti, V. (1984). The Diaspora. Self-Portraits of Twenty Protagonists of the HfG. In *Rassegna 19 – Il contributo della scuola di Ulm* (pp. 37). Bologne: Editrice CIPIA.

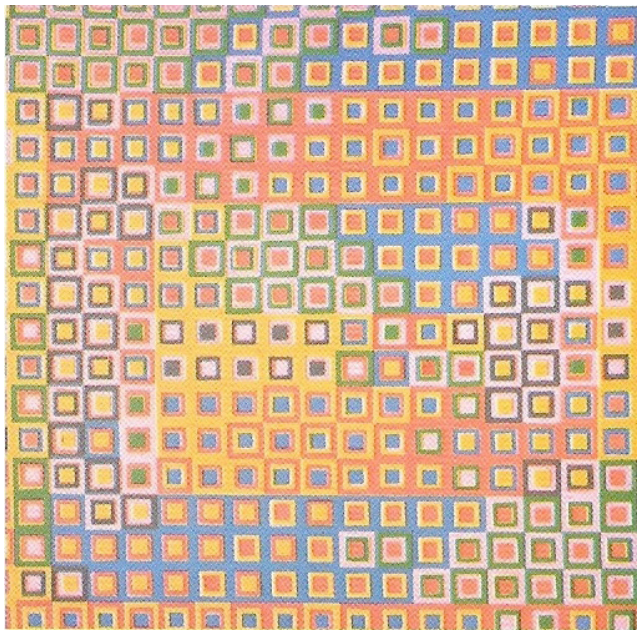


Fig. 2. Student Luís Golomb, CIT (Carnegie Institute of Technology) 1962. Teacher: William Huff. Source: Gregotti, V. (1984). The Diaspora. Self-Portraits of Twenty Protagonists of the HfG. In *Rassegna 19 – Il contributo della scuola di Ulm* (pp. 37). Bologne: Editrice CIPIA.

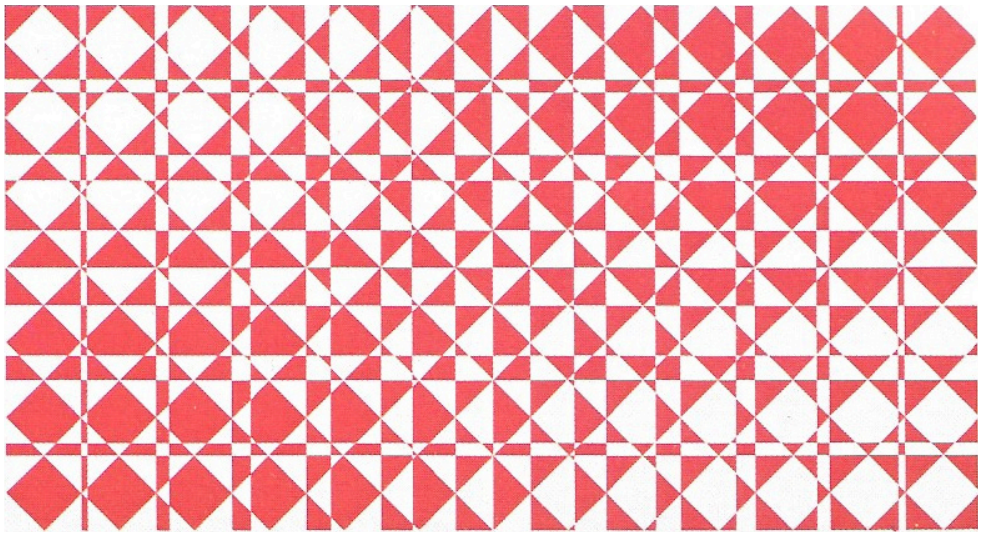


Fig. 3. Student: Yuqing Li, University at Buffalo, Teacher William Huff. Source: Cantz, H. (2003). *Ulmer modelle – modelle nach ulm*. Hochschule für Gestaltung Ulm 1953-1968 (pp. 189). Stuttgart: Ulmer Museum/HfG-Archiv Publications.

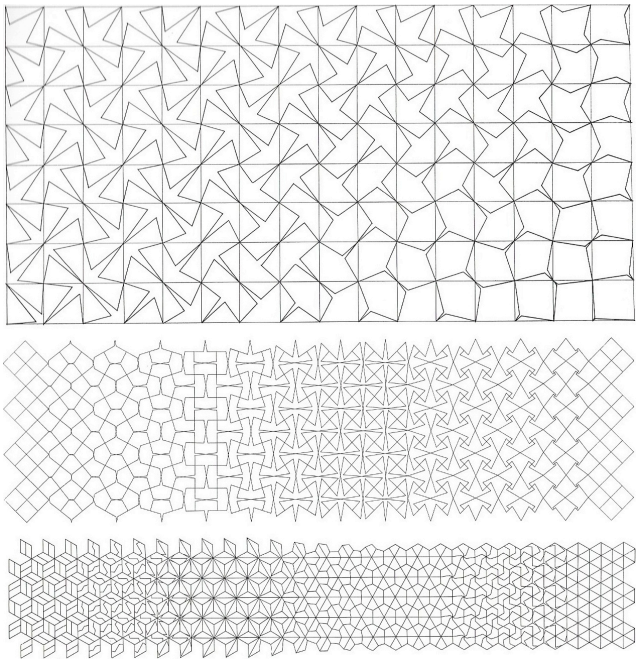


Fig. 4. “Symmetry or Programmed Design” Student James Eisenman, C.-MU (Carnegie-Mellon University) 1966. In Gregotti, V. (1984). The Diaspora. Self-Portraits of Twenty Protagonists of the HfG. Source: *Rassegna 19 — Il contributo della scuola di Ulm*. Bologne: Editrice CIPIA.

2.3. Ivan Sutherland’s ingenious construction — interactive system for graphic images, based on graphic commands

Between 1961 and 1963, Ivan Sutherland[4] developed a graphic program — the sketchpad — claiming to be able to operate a computer with a visual base, beyond a logical and mathematical base. It was a “drawing machine” — that was his PhD thesis held at MIT. It was considered the first computer aided design (CAD) program and the starting point for research on human — computer interaction. With the Sketchpad, the concept of GUI-Graphical User Interface was inaugurated allowing interaction with the virtual world without typing long commands in scripting bars or programming algorithms. Users could use clicks to draw — a very familiar procedure, such as the ones used in current software programs like autocad.

In an interview given in the scope of this investigation, Maldonado said that he watched the development of this technology, stating:

> (...) At Princeton, in 1966 or 67, we began to talk about themes that were of interest to us in Ulm, as well as to them, teachers and students in the United States. American professors were also interested in these subjects. At that moment something very interesting happens. At the same time as my classes I am initially 3 months and then 6 months in Princeton) there was a teacher who gave a conference about the experiences that were being made at MIT on the subject of the computer. I was very enthusiastic, because that interested me a lot. I thought at the time the relationship between Information Theory and computerization. And then they told me that I would have to go to Boston because there were two young men who were doing their PhD thesis and they were approaching that. One of them was Ivan Sutherland. I met him and Timothy Johnson and realized what they were doing. They worked in a small room and I realized that Sutherland was mostly working on a pencil-like element that made it possible to modify images inside the computer. This was the subject of his doctorate. It represented a significant step forward, because it was the missing stage, not only to get to the image and the production of images, but to everything that had to do with computerization. Here our theory was linked to Cybernetics through their action that was very concrete, very applicative. Ivan Sutherland was practically the “father” of the mouse (mouse). From the pen to the mouse is a very simple step. So these 24 or 25 years old young men, were on the ground, to invent the operative elements. And in fact, when I

4. Tomás Maldonado, interview performed by author, at 2012, in the context of research.

> went back to Princeton and then to Ulm, around 1964, I started to get more interested with these issues. What was a very abstract theory in the 50s, it begins to gain strength in the 60s and the interest grows for the technical part.

Sutherland's PhD thesis demonstrated the design operations that could be performed. This presentation was a pioneer in the notion of OOP (object oriented programming) and algorithmic language applied to drawing.

In the context of Architecture, the first discussions on the subject began to be published in the United States in the early 1960s and the most relevant investigations were conducted at the Department of Civil Engineering at the Massachusetts Institute of Technology (MIT) and at the University of Pennsylvania. On the other hand, the first applications of CAD realized in Europe, in England, presented different connotations of the American applications. There was inspiration in the Sketchpad formulation, and later a very sophisticated graphic interface was developed.

The "Conference on Architecture and Computer Graphics" held at Yale in 1968, another notable event in this field, focused on how architects dealt with computers. Steve Coons, a computer pioneer, said:

> No architect wants to become or should become an expert computer programmer. Architects want to do architecture. City planners want to do of city planning. They do not want to have to invent and manufacture the pencils they use. They want to have them at hand. The computer is a tool. We want to arrange matters so that the computer can be used naturally and easily as a pencil (...).

As expected, this statement was received with great approval by all architects, because above all, the architects wanted to communicate their ideas. According to the concept of Coons technology, it was the new technology that would have to change to meet the needs of architects.

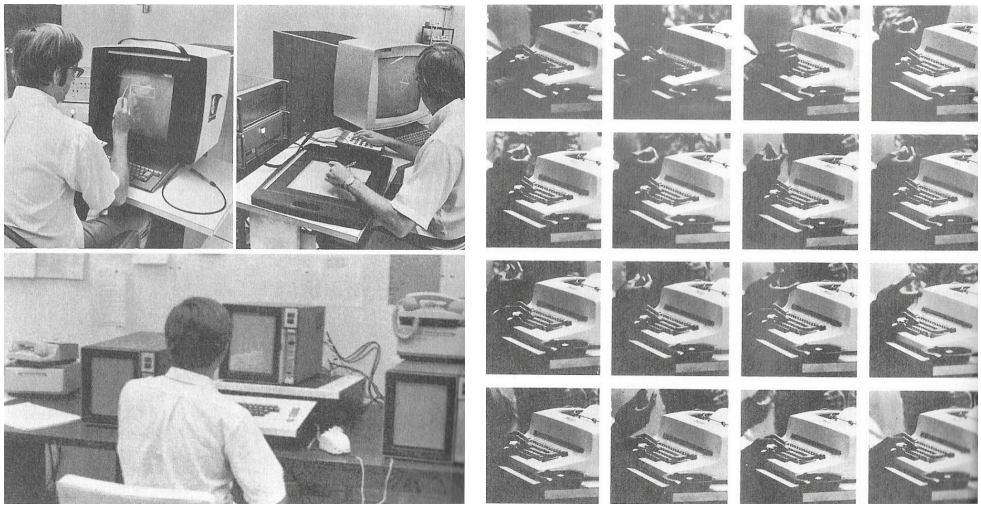


Fig. 5. Series of images of "The Architecture Machine", 1970. In Vrachliotis. Gropius question or on revealing and concealing Code in Architecture and Art. Source: A. Gleiniger & G. Vrachliotis (Eds.), *Code: Between Operation and Narration* (pp. 80-82). Basel: Birkhäuser GmbH. (2010).

3. THE EARLY ARTISTIC AS WELL AS THEORETICAL CONTRIBUTIONS BY MEMBERS OF THE STUTTGART SCHOOL AROUND MAX BENSE

Throughout the development of this movement in the United States of America, an artistic and philosophical tendency related to graphic computer was developed in post-war Europe. This trend differed from the approach of Coons and Negroponte in the fact that the graphic computer was programmed and not "drawn", as before. In the productive phase of Cybernetics, art and philosophy led to a culture of experimental programming that could spark a new artistic generation. The three central figures of this code culture were, above all, two young mathematicians Frieder Nake,

Georg Nees and his mentor, the philosopher Max Bense, who transformed programming into a modern form of aesthetic craft, thus developing a new theoretical level.

Frieder Nake (1938, Stuttgart) is a mathematician, computer scientist and computer art pioneer. He is now known internationally for his contributions to the early manifestations of computer art, a computer field that made its first public appearances with three small exhibitions in 1965. Georg Nees (1926, Nürnberg) was a pioneer of computer art, honorary professor of computer science at the University of Erlangen, Germany. Nees and his companions, the also considered pioneers Frieder Nake and A. Michael Noll were designated as the "3N" of computational art. In 1968, Nees completed his doctorate at the University of Stuttgart, under the supervision of Max Bense his doctoral thesis was the first that focused on computer art. In 1977, he became an honorary professor at the University of Erlangen.

In this process a reciprocity has been developed between artisan aesthetics and aesthetic theory. On the one hand, the lines drawn by Nake and Nees seemed to contain traces of Bense's theory of art, and on the other hand, many of Bense's essays could be read as decoded philosophical aids, which were mandatory for reckoning Nake's abstract aesthetics and Nees' residual programming images.

As they explored playing on the computer, the images they created were sometimes presented in order, sometimes with irregular patterns. These machine-made drawings could be detected or assigned to a programming error, creating random patterns. The visual results of these program defects have charmed young mathematicians at the centre of computational investigations. At the same time, from a theoretical perspective, it was evident that these small black and white drawings contained an unimaginable explosive force.

Programming and design in this context implied thinking at the machine code level, regardless of what the drawing would represent, what kind of language had been used or what type of system had been coded. In this way, "one works at the level of the computer codes, meaning to use the logic of the machine". A code here consists of symbolic signs, being nothing more than a text, basically text, as Nake emphasizes. The computer has become a type of Semiotics, a technical artefact, or according to the computational scientist, a "Semiotic machine". In this way, one worked at the level of computer codes, using machine logic.

Drawing with code meant operating with "text". Nake and Nees' first computer designs shifted the emphasis from methodology to technology, giving a complete twist in programming theory. This was clearly demonstrated by the computer graphics program, which was organized in 1965 and where Nake and Nees showed some of their work. The authors showed that the programming codes gave rise to the drawings and, in other words, revealed the structural source and not just the result.

Presenting the code in this way, like an art form hung on the wall, was more than a didactic effort to make the new machine intelligible. The logical device of merging this link between artwork and method, computer graphics, and program codes became a prerequisite that, in art and architecture, would eventually lead a new faith in mathematics. There was now a double demystification — on the one hand the creative artistic process and, on the other hand the logic of the machine. The technical foundation closes the question of artistic creativity when the author is not only the machine, but also a set of systems. Nake's intention was to show the simplicity of the program code in order to reveal not only the complexity, but also how aesthetic the structures generated by the code can be, creating a discussion about the relationship between art, architecture, authorship, and technology.

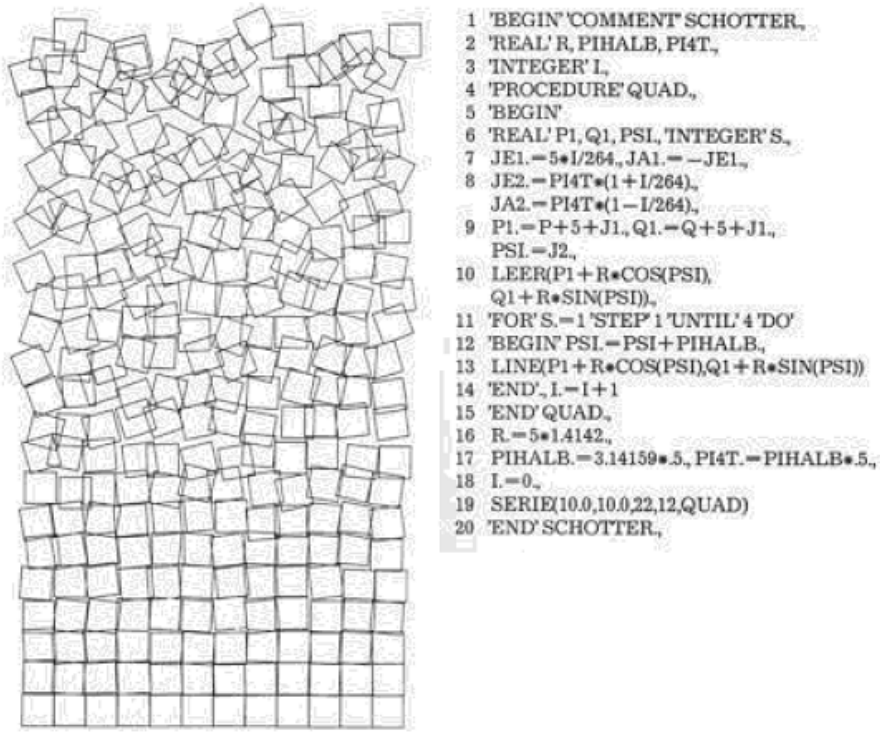
Max Bense saw in the programming of Nake and Nees a first step towards a future technical world of which he always spoke so passionately. Bense in his essay "Projekte generativer ästhetik", published in 1965, wrote that, in general, "the artificial" differs from the category of "natural" production by introducing a communication scheme between the creator and the work consisting of a program and in a pro-

gramming language that introduces an unusual division of work and the aesthetic process. Bense was convinced that the human being needed to be fully integrated in the world of science and technology, to be intellectually incorporated and to be incorporated by science.

The evolution of Bense's communication scheme marked an important difference between the origins of computer graphics in America and Europe. According to Vrachliotis, the theory lacking on one side (United States) is abundant on the other (Europe). The lightness on one side is the weight on the other. The confrontation of "buildings without drawings" to "program culture" in the arts could even today trigger a reflection on which of these two forms proved to be most effective and useful for architecture.

Nake showed us a productive path out of this comparison in his 1974 book, "Aesthetics as Information Processing," which addressed the potential of computing in architecture and questioned how computers changed current ideas, stating that the architects had had a similar experience to the linguists for when they tried to solve problems with computers, they discovered its very limited knowledge. The emergence of the new machine, a new production tool, proved to be inspiring and motivating. It was, according to Nake, a new vision and an innovative way to acquire knowledge.

Nake also refers the linguists, making references to the revolutionary wave of the late 1950s, initiated by the work of the computational linguist Chomsky, who captured the attention not only of Bense but also of architects such as Christopher Alexander. The Sketchpad of Sutherland was an interaction model that introduced an abstraction zone between the user and the actual hardware, and the electronic representation of the data that the user wanted to have in his interface, that is, the user was the first interface of computers. It was also a first step towards the end of computing conceptualization, since the user can enter data without ever having to conceptualize the computation logic. In this sense, one could speak of a "house-training of computing", in the sense that the graphical interfaces allowed to directly transfer known design conventions to the computer. As computers became ubiquitous they provided interactive and more accessible interfaces in a practical application of the "known", which was not interested in the conceptualization of current and potential processes to structure the environment, but rather in the implementation of known processes and conventions".



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1  'BEGIN' 'COMMENT' SCHOTTER.,
2  'REAL' R, PIHALB, PI4T.,
3  'INTEGER' I.,
4  'PROCEDURE' QUAD.,
5  'BEGIN'
6  'REAL' P1, Q1, PSI., 'INTEGER' S.,
7  JE1.=5•I/264., JA1.=-JE1.,
8  JE2.=PI4T•(1+I/264).,
   JA2.=PI4T•(1-I/264).,
9  P1.=P+5+J1., Q1.=Q+5+J1.,
   PSI.=J2.,
10 LEER(P1+R•COS(PSI),
   Q1+R•SIN(PSI)).,
11 'FOR' S.=1 'STEP' 1 'UNTIL' 4 'DO'
12 'BEGIN' PSI.=PSI+PIHALB.,
13 LINE(P1+R•COS(PSI),Q1+R•SIN(PSI))
14 'END'., I.=I+1
15 'END' QUAD.,
16 R.=5•1.4142.,
17 PIHALB.=3.14159•.5., PI4T.=PIHALB•.5.,
18 I.=0.,
19 SERIE(10.0,10.0,22,12,QUAD)
20 'END' SCHOTTER.,
```

Fig. 6. *Georg Nees Graphic "Schotter"* and the computer code that generates the graph, 1968. Source: Vrachliotis, G. (2010). Gropius question or on revealing and concealing Code in Architecture and Art. In A. Gleiniger & G. Vrachliotis (Eds.), *Code: Between Operation and Narration* (pp. 86). Basel: Birkhäuser GmbH.

4. CONCEPTUALIZATION OF COMPUTER — COMPUTATIONAL THINKING IN ARCHITECTURE

Conceptualization of Computer was precociously presented in the HfG-Ulm investigation, and in some works developed in other contexts by HfG-Ulm mentors, as we have seen in this article, through the case of William Huff's work.

HfG-Ulm schooling stimulated a different approach towards Project and developed this computational conceptualization: instead of focusing on drawing and the pursuit of specific and conclusive shapes, students aimed to explore the conceptualization of a geometrical set of rules in order to control the definition of the shape itself. Thus, evoking scientific disciplines and methodologies, they developed a practice of Project that embodied an idea of a system, where a field of information is interactively structured in an open way so it can generate actual Project solutions.

The exercises with patters are a clear example of this approach. In it, one can see as students codified a set of rules of variation, from a given basic input, a module, in order to sustain the generation of a pattern, in which the module ceases to act as a fixed and repetitive entity, and becomes an element that shifts geometrically at every stage, but in an orderly way.

Despite this geometrical shapes were handmade, they reflect a Computational Thinking facing Project that can be recognized in the different contemporary approaches towards Project, based in the exploration of digital processes of parametric design.

Following the analysis of the article "Computing without computers"[5] from John Frazer, we may consider that, also on HfG-Ulm, it was perceivable a Computational development without computers. The computer emerges as a conceptual model, such as is perceived in Frazer's article, where it is interpreted as an electronic programmable device, and as a conceptual model.

Despite their coincidence, this two strands could develop from independent shapes. The emphasis, though, was on the demonstration of the theoretical model and its technical viability, and also on the functionality of a thinking experience.

Frazer claimed still that computation without computers was perhaps the most important lesson to be learned from the conception of those tools. As Frazer argued, it was clear that also in HfG-Ulm one could perceive that it wasn't necessary to build those tools in order to simulate its behavior.

By exteriorizing and materializing the internal procedures of the computer, the physical models act as any other model of architecture, helping to visualize and also to understand. The models aren't just tools that help the conceptual design, but also explanation tools. According to Frazer's words:

> The late 1960s and early 1970s became a prolonged thought experiment for myself and fellow students at the time. There were no affordable computers to speak of, so the only option was to imagine that they existed and imagine all the rest of the technology and social and political change necessary to realize dreams. This is what I mean by computing without computers; a mental rehearsal of what architecture and a built environment would be like at beginning of the 21st century.[6]

The record that Frazer describes, in which there were no accessible computers, and the only option was to imagine that they existed, was in fact the context in which HfG-Ulm emerged. There, computing was discussed not so much as a technology, but rather as a way of thinking and practicing, which altered the understanding of design and designer, and influenced other schools and teachers.

The HfG of Ulm, pioneered in the mid-60s heuristic procedures related to the power of the new computational era. This pedagogy clearly emerged from Ulm, constituted a legacy of computational thinking that evolved till today. Its cultural and technological context requires the pursuing of a historical reading that would enhance

5. Frazer, J. (2005). Computing without computers. *Architectural Design: The 1970s is Here and Now, 75*(2), 36.

6. Frazer, J. (2005). Computing without computers. *Architectural Design: The 1970s is Here and Now, 75*(2), 36.

the interpretation of architecture own contemporary history. In HfG-Ulm the theoretical foundations through which computer models operated, with a “language of the computer”, together with the language of “architectural assistants”, began to make possible the application of the computer to the field of architecture, being necessary a translator who knew the language of both: computer and architecture.

The few who had access to computer systems in universities and companies in the 60s shared their knowledge in writing or in lectures organized several times by Tomás Maldonado. Thus, through these exposures and interferences, computer technology also found its way into HfG, feeling the implicit impact of new computer technology through the diffusion of general concepts related to hardware, as it happened throughout the work accomplished.

Computational thinking in architecture has led to an increase in the use of models and simulations in architecture. This development implied a predisposition for architecture to take the model, which explains that in places like HfG-Ulm, theoretical information, Operational Research, cybernetic and semiotic models were, despite their abstract nature, well received. Computers would also function as laboratories, where genuine computing processes were exploited, where the simplest computational rules led to more complex and unassignable results in results that could not have been predicted before their computation. It was there that theorization and conceptualization of computing found the real praxis, turning the computer into a tool for projections and speculations. The consequences for the role of the architect and architecture were significant, and the architect was now the author of an algorithm rather than a single architecture. The architect defined through his work a multiplicity of possibilities, in which architectures could or did not arise. This approach was different from previous ones, focused on the definition and design of a single piece of architecture.

There was a shift in thinking from architecture as a singularity to architectural thinking as seriality. This development is comparable to the development of Nees and Nake and computer art in the 1960s, when a single algorithm produced not a single piece of art, but rather a whole series of pieces of art, as can be seen in composition instructed by William Huff. These are symptoms and signs of an emergence of a computational perspective in Design and Architecture.

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Conversations with ELIZA: on Gender and Artificial Intelligence

Keywords: Artificial Intelligence; Chatbots; Anthropomorphization; Gender; Femininity; Stereotypes.

Abstract:

This paper aims to explore the relationship between gender and artificial intelligence. It begins by addressing AI and the possibilities and questions that emerge with its evolution and integration in daily life. It then examines gender in light of a binary framework, in order to understand its role in social, cultural and work related contexts. These topics are then related, seeking to understand how and why chatbots and digital assistants such as Siri, Alexa or Cortana tend to display feminine attributes. Complementing this discussion, the project *Conversations with ELIZA* is presented as an exploration of femininity in AI through the development of four chatbots integrated into a web-based platform. Each of these bots performs specific tasks that seem to highlight particular gender stereotypes or even reflect common assumptions about femininity back to its user. In this manner, this study aims to question whether artificial intelligence tends to reinforce traditional and normative notions of gender and femininity.

1. INTRODUCTION

Artificial intelligence is often associated with fictional and futuristic scenarios in popular culture, even though it has already become part of our daily life. In fact, we frequently interact with AI systems without even realizing it, namely with chatbots whose ubiquity often goes unnoticed. These personal digital assistants are now embedded into our mobile devices and web-based services and platforms. The former can be illustrated by Siri, Alexa or Cortana as personalized services, while the latter refers to online contexts where it has become more and more common to find a bot that aims to assist us in specific tasks (Dale 2016). Regardless of their complexity, they share the goal of assisting users by performing tasks in a kind, helpful and compliant fashion.

However, the process of anthropomorphizing theses assistants by assigning them human-like traits or features seems to be accompanied by a tendency for them to display feminine attributes. These digital entities are often feminized through their name, voice or avatar, while they also execute tasks associated with jobs which are historically performed by women. As such, they seem to behave according to gender stereotypes and reinforce traditional assumptions of femininity (Weber 2005; Hester 2016).

This paper aims to explore how gender relates to AI, while also seeking to understand why most chatbots and digital assistants appear to be female. To this end, it begins by providing an overview of artificial intelligence, addressing questions that arise with their integration in our daily lives. It then approaches the concept of gender in light of an historically patriarchal and heteronormative society that promotes a binary frame (Butler 1990; Haraway 1991), particularly focusing on women and femininity. Artificial intelligence and gender are then related, paying particular attention to Siri, Alexa and Cortana, in order to shed some light on how chatbots and digital assistants appear to be mostly female.

Complementing this discussion and in order to illustrate the topic, the project *Conversations with ELIZA* consists of four chatbots which were developed and integrated in a webpage, seeking to simulate a specific personality with the purpose of emphasizing feminine roles and stereotypes. In this manner, this study thus seeks to question traditional notions of femininity and their significance in AI. It seeks to explore and understand how this relationship takes place, why femininity seems to be often present in AI and which gender roles or stereotypes are reinforced in this process.

2. OVERVIEW

2.1. Artificial Intelligence

2.1.1. A chatbot named ELIZA

Artificial intelligence nowadays encompasses different areas of study, but all of them announce its integration into our daily lives. We now have a more direct contact with this type of technology namely through chatbots that play the role of personal digital assistants embedded into our devices and that engage in conversations with us through natural language. They have also become a natural part of the asynchronous simultaneous conversations we carry out, based in short type interactions. As Robert Dale points out, "chatbots have been around for a long time" and are thus returning, instead of emerging as something new (Dale 2016, 814).

In 1966 Joseph Weizenbaum introduced ELIZA, a computer program capable of analyzing written inputs from users and answer accordingly by using a set of rules, thus establishing a "human" dialogue.[1] Weizenbaum chose a script with which ELIZA

1. To do so, the program searched the inputs for the presence of a keyword, and produced responses "by transforming sentences according to a rule associated with said keyword" (Weizenbaum 1966, 37), and also by replacing certain words or expressions. For example, if a user said something along the lines of "I am upset because of my mother", ELIZA would answer with "Why do you think you are upset because of your mother?". In this sense, ELIZA wasn't restricted to a particular set of responses, although it was limited to a pre-determined set of rules and "adaptable" sentences, and if an input wasn't recognizable or didn't contain any keywords, it failed to have "the provision of a mechanism that would permit ELIZA to respond intelligently" (Weizenbaum 1966, 37).

acted as a Rogerian psychotherapist, since it was "easy to imitate because much of this technique consists of drawing his patient out by reflecting the patient's statements back to him" (Weizenbaum 1976, 3).[2]

ELIZA was one of the first "natural language process applications" that was able to trick some of its users into thinking it "was a person rather than a machine" (Dale 2016, 814), and this was an important point in AI progress. This idea of having a machine talk to us as if it were human, leading us to believe we are speaking to another human being, conveys the purpose of the Turing test.[3]

By shifting human-machine interaction from a purely robotic, rational nature one to a more social one, ELIZA marked a significant development in AI, which relates to the way chatbots evolved towards emulating human behavior. Nowadays, chatbots are a natural component of our technologies as "just another facet of today's always-connected multi-tasking world, where we participate in multiple conversations in parallel, each one at a pace of our choosing" (Dale 2016, 815).

2.1.2. From chatbots to solutionist assistants

William Meisel distinguishes two groups of chatbots: "general personal assistants", which refer to more developed and complex assistants like Siri, Alexa or Cortana, and "specialized digital assistants", which refer to a "tsunami of more narrowly focused chatbots" (Dale 2016, 812).

AI systems of the first type can help with "some subset of the standard virtual assistant skill portfolio", which mainly includes reading, writing, sending emails, scheduling meetings, checking calendars and setting appointments, making calls, sending messages, taking notes, setting reminders, etc (Dale 2016, 812).[4] Usually, general digital assistants are integrated directly into our devices, like Siri in Apple devices, and assist us in a more personalized way.

Specialized digital assistants "operate in very specific domains or help with very specific tasks", usually in web-based platforms or apps that serve specific areas, and their tasks can range from "booking a flight, buying some shoes, taking issue with a parking fine" to sending daily weather forecasts, helping with online shopping payment processes or even just telling jokes (Dale 2016, 812-813).

By performing these tasks, chatbots work towards an amelioration of our daily life, assuring that nothing is left unorganized, forgotten or undone; they make sure that we are as productive as possible by "promoting efficiency, transparency, certitude and perfection — and, by extension, eliminating their evil twins friction, opacity, ambiguity and imperfection" (Morozov 2013b, Int. par. 14). This need to ameliorate our life and maximize production conveys Evgeny Morozov's concept of solutionism, defined as "an intellectual pathology that recognizes problems as problems based on just one criterion: whether they are 'solvable' with a nice and clean technological solution at our disposal" (Morozov 2013a).[5]

2.1.3. From anthropomorphization to companions

Embedded into our cellphones, laptops or tablets, as well as websites, apps or other types of web based services, artificial intelligence is simultaneously ubiquitous and subtle. This growing presence conveys how chatbots are no longer mere tools; they are also "imagined to become friends and companions" (Richardson 2015, 15). This sense of companionship develops alongside with the anthropomorphization of artificial intelligence, as chatbots are endowed human attributes or traits and evolve from assistants to companions that become closer to us.

Anthropomorphization takes place on a more superficial, physical level, through names, voices, avatars, or other kinds of attributes that move away from a purely mechanized presentation. However, it also concerns dialogue and interaction. In this

2. This decision solved a lot of issues regarding ELIZA's "unawareness" about her surroundings or inability to talk about topics out of its framework because the psychiatric interview style allowed a "categorized dyadic natural language communication in which one of the participating pair was free to assume a pose of knowing almost nothing of the real world" (Weizenbaum 1966, 42).

3. Introduced in 1950 by Alan Turing, "the Turing test demands that a human subject decide, based on replies given to her or his questions, whether she or he is communicating with a human or a machine. When the respondents fail to distinguish between human and machine responses, the computer may be considered intelligent" (Halberstam 1991, 442). As such, ELIZA demonstrated how the Turing test poses human intelligence in a somewhat narrow way, since it was considered intelligent simply by being able to follow a logical script and appearing human.

4. They are also able to play music, play videos, search the web, translate sentences, open apps, give directions, announce the weather and even control automation-enabled home systems.

5. According to Morozov, nowadays there is a constant need to attempt to root out any "imperfection, ambiguity, opacity, disorder and opportunity to err, sin or do the wrong thing" (Morozov 2013b, Int. par. 15), which is closely linked to what chatbots aim to do. Personal, digital assistants are now at our disposal, constantly present, ready to help us quickly solve our problems, while tracking our habits and user preferences, leaving little to no room for imperfection — all of this just a touch away.

sense, Jutta Weber considers that, with anthropomorphization, there is a significant shift from rational-cognitive processes and problem solving to a socio-emotional interaction, which emphasizes this intention of turning our interaction with this type of machines into a more social one (2005, 209). Therefore, this type of technologies are "supposed to mimic or even learn those abilities and characteristics which were, until recently, regarded as purely and typically human and beyond the grasp of machines" (Weber 2005, 213).

Although it becomes more evident among the current myriad of personal digital assistants, anthropomorphization goes back to ELIZA and the fact that "people were conversing with the computer as if it were a person who could be appropriately and usefully addressed in intimate terms" (Weizenbaum 1976, 7).[6]

For Weizenbaum, this raised some problems, which he addressed under the notion of "computationalism", relating to the belief that "the functional relations between mental inputs, outputs and internal states are computational" (Piccini 2004, 814). However, Weizenbaum considered that not every part of the human thought could be reduced to logical formalisms and that "there are some acts of thought that ought to be attempted only by humans" (Weizenbaum 1976, 13). Hofstadter later corroborates this idea stating that "no program in the world understands even one concept at the same level of complexity as an ordinary person does" (Hofstadter 1995, 160).

On the other hand, Weizenbaum also raises the question of human-machine relationships, observing that when we interact with machines as if they were human, we start developing emotional bonds, a sense of empathy and of being understood. In fact, he observed "how quickly and how very deeply people conversing with ELIZA became emotionally involved with the computer" (Weizenbaum 1976, 6).

6. This effect relates to a belief that "the responses which appeared on his typewriter were generated by a human" (Weizenbaum 1966, 42).

2.1.4. The ELIZA effect

This illusion, which he considered dangerous, is known as the ELIZA effect, describing:

> the susceptibility of people to read far more understanding than is warranted into string of symbols strung together by computers (...) and the idea that computers "understand" the physical world, reason abstractly, make scientific discoveries, are insightful cohabiters of the world with us". (Hofstadter 1995, 157)

Consequently, people start getting attached to these technologies (and to the entities contained within them). By creating anthropomorphized digital assistants, giving users the false sense they are talking to another human being, human-machine interaction is influenced by feelings of intimacy, closeness and empathy. In this process, personal digital assistants engage in conversations with us, evoking a not-so-far-away world "where some of those conversational partners we'll know to be humans, some we'll know to be bots, and probably some we won't know either way, and may not even care" (Dale 2016, 815).

2.2. Gender and stereotypes

When chatbots are anthropomorphized, whether through their voice, name, or the way they interact, they tend to portray gender related features. In order to understand this phenomenon, we need to take a closer look at gender as one of the aspects through which we socially develop and establish relationships, whether with each other or with ourselves.

Gender constitutes a part of our identity that regulates the type of behavior or acts we establish socially "by managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one's sex category" (West and Zimmerman 1987, 127). In this sense, Judith Butler introduced the idea that gender

has a performative nature, given that gender identity is a repetition of acts stylized through time, manifesting a "cultural interpretation or signification of that [biological] facticity" (Butler 1990, 522).

2.2.1. Binary framework

Simone de Beauvoir once said that "one is not born, but rather becomes, a woman" since 'woman' (as a concept) is a "historical idea and not a natural fact" (in Butler 1990, ch. 1 sec. III par. 3, 1988, 522). These words suggest how gender is not something we are born with and, instead, is something we internalize through performative acts, over time. To be female or male is a matter of sex; but to be a man or a woman is a matter of gender. Gender is also seen as something polar, as seen through a "binary framework" in which there is a "mimetic relation of gender to sex whereby gender mirrors sex or is otherwise restricted by it" (Butler 1990, 88).[7]

Consequently, there is a normalization of what is considered to be feminine or masculine behavior, which becomes predetermined in a foreclosed historically sedimented structure. This establishes a set of expected behaviors and acts according to which we are compelled to act. That expectation is based on the perception that others have of our sex, which is presumed through the "factic datum of primary sexual characteristics" (Butler 1988, 528). In other words, through this "need to routinize (...) behavior in accord with pre-established conceptualizations and behavioral patterns" (Deaux and Major 1987, 370), certain attributes and acts are identified as specifically feminine or masculine and are supposed to imply someone's preferences and behaviors. As we grow up, and are categorized as men or women (or, instead, boys or girls) we are expected to comply to "normative conceptions of appropriate attitudes and activities" that are determined by "institutionalized frameworks through which natural, 'normal sexedness is enacted'" (Goffman, 1977 in West and Zimmerman 1987, 137).

As Prentice and Carranza put it, "prescriptive gender stereotypes" define "the qualities [ascribed] to women and men (...) that are required of women and men" (2002, 269).[8] These stereotypes imply that a gender belief system imposes expectations and gender behavior patterns, as internalized and socially reinforced stereotypes. Butler expands on this, stating that "gender performances (...) are governed by (...) punitive and regulatory social conventions" (Butler 1988, 527) that reject the acts or behaviors that convey some kind of deviation from the norm.

2.2.2. Feminized labour

Gender roles and characteristics deemed as specifically feminine or masculine also imply a structural hierarchization of labour. In other words:

> If, in doing gender, men are also doing dominance and women are doing deference (cf. Goffman 1967, pp. 47-95), the resultant social order, which supposedly reflects 'natural differences', is a powerful reinforcer and legitimator of hierarchical arrangements". (West and Zimmerman 1987, 146)

This means that feminine and masculine behavior is also used to segregate and structure labour accordingly. The workplace and its relationships change since, according to Kelly, when we interact within these contexts "social labels, beliefs and attributions may serve as grounds for predictions and generate behavior designed to validate or invalidate these beliefs" (in Snyder 1977, 8). In fact, a lot of service work is seen as feminized labour or "associated with qualities traditionally coded as feminine" (Hester 2016, 47).[9]

7. According to Judith Butler, gender is "radically independent of sex" and, instead, is a "free-floating artifice", while sex is defined as a "biological facticity" (Butler 1988), which means it is a biological criterion that distinguishes solely between female and male. As Butler puts it, gender "is neither the causal result of sex nor as seemingly fixed as sex" (Butler 1990, ch.1 sec. II par. 1). Therefore, gender is not something inherent "because gender is not a fact, the various acts of gender creates the idea of gender, and without those acts, there would be no gender at all" and gender is shaped and socially defined according to a "tacit collective agreement to perform, produce and sustain discrete and polar genders as cultural fictions" (Butler 1988, 522).

8. Some of these stereotypes, presented by Bem (1981 in Prentice and Carranza 2002, 269), describe feminine characteristics as "affectionate, cheerful, childlike, compassionate, does not use harsh language, eager to soothe hurt feelings, feminine, flatterable, gentle, gullible, loves children, loyal, sensitive to the needs of others, shy, soft-spoken, sympathetic, tender, understanding, warm, yielding". On the other hand, masculine characteristics are described as "acts as a leader, aggressive, ambitious, analytical, assertive, athletic, competitive, defends own beliefs, dominant, forceful, has leadership abilities, independent, individualistic, makes decisions easily, masculine, self-reliant, self-sufficient, strong personality, willing to take a stand, willing to take risks".

9. This is tied to "women's practices (...) within the terms of some more dominant cultural formation (Butler 1990, ch. 1 sec. I par. 8) and to what are historically considered women's places, "idealized social locations seen primarily from the point of view of advanced capitalist societies: Home, Market, Paid Work Place, State, School, Clinic-Hospital and Church" as Donna Haraway explains it (Haraway 1991, 307).

In other words, by expecting certain acts (deemed as feminine) from women, we expect them to occupy jobs and perform tasks associated with these attributes, thereby creating a category of feminine labour. To give a concrete example, historically women have a significant presence in the telecommunications industry, where they filled the role of assisting and establishing calls and communications, which rendered "female operators (...) inferior, subordinate, and knowable" (Zost 2015, 3). In other cases, women fill the role of secretaries, assistants, nurses or even flight attendances. These type of jobs convey, in a way, an "assumption that women possess a natural affinity for service work and emotional labour" (Hester 2016, 47).

This asymmetry also affects the private sphere, namely domestic work. As West and Zimmerman explain, household and child care tasks are considered women's work as a consequence of "normative conceptions of appropriate attitudes and activities for sex category" (West and Zimmerman 1987, 139). The heterosexual framework contributes to this asymmetry since it reinforces the "embodiment of wifely and husbandly roles, and derivatively, of womanly and manly conduct" (Beer 1983 in West and Zimmerman 1987, 144).

Additionally, and according to Donna Haraway, domestic work is transformed into capitalized labour out of the private sphere, through jobs such as office work, nursing or service work. Borrowing from Richard Gordon, Haraway considers that, with new media, a "homework economy" emerges, defined as a "restructuring of work that broadly has the characteristics formerly ascribed to female jobs, jobs done only by women" (Haraway 1991, 304).[10]

Therefore, even outside the domestic sphere, women still ensure domestic tasks: "partly as function of their enforced status as mothers" as well as working in an "integrated circuit (...) in advanced industrial societies [where] these positions have been restructured (...) by social relations mediated and enforced by the new technologies" (Haraway 1991, 305-307). This reflects traditional conceptions of gender derived from a patriarchal heteronormative society where women perform domestic and assistant-like roles, while it also reveals how gender standardization and normalization has consequences at a social, personal and structural level.

10. For example, a personal assistant conducts "a form of corporate care work, including providing sustenance of the body in the form of teas, coffees and lunch orders, as well as making dentists' appointments, picking up dry cleaning, paying personal bills, and so on" (Hester 2016, 49).

2.3. Gendered AI

2.3.1. Feminized labour automated

Gender norms and stereotypes in artificial intelligence take form in various ways, not only through anthropomorphization, but also when tasks performed by chatbots begin to mirror traditional feminine labour. As Halberstam explains, what we observe is a "gender automatization" given that tasks traditionally and historically considered female become a part of technology (Halberstam 1991, 451).

Hence, AI performs tasks considered feminine and does so as a natural part of its system programming. It reflects:

> (...) our assumptions about feminized labour and our existing relationship to socially gendered caring and service behaviors, tapping into those elements of femininity that have historically enabled caregiving or service-providing subjects to better undertake specific obligations, activities, and tasks. (Hester 2016, 50)

The author adds that "we are witnessing the protocols of femininity being programmed into machines" (Hester 2016, 48) as labour previously deemed as feminine becomes technologic. Accordingly, we can observe how general or specialized chatbots automate work that is coded as female (Hester 2016), given that they mainly operate in service or assistance related contexts, acting as personal assistants, secretaries and the like.[11] By operating in contexts of service, and following these standardized behaviors, chatbots also end up emulating attitudes that resemble, as Gustavsson puts

11. General personal assistants such as Siri, Cortana or Alexa perform traditionally feminine tasks by acting as assistants (searching the web, translating sentences or controlling automation-enabled home systems), secretaries (registering information, sending emails or setting up appointments) or even telecommunication operators (making calls, sending messages and establishing communications in general). Similarly, specialized personal assistants also perform tasks aimed at helping us with services, such as online shopping payment processes, acquiring travelling tickets or even looking through a shop's online catalog.

it, a "stereotyped image of female service providers" (in Hester 2016, 47). They display feminine attributes because these characteristics have "its basis in the stereotyped image of female qualities. (...) Such a stereotypical female image of caring, empathy and altruistic behaviour has become a standard component in a service script" (Gustavsson 2005, 402 in Hester 2016, 47).

2.3.2. Gendered interaction

However, it is not only trough the human attributes displayed, but also the dialogue and tasks it performs, that a chatbot becomes a gendered entity. So beyond the physical level of anthropomorphization, gender is also revealed at the performative interaction level. In other words, gender is visible in features like voice, name or, in some cases, avatar. By default, Siri, Alexa and Cortana display feminine voices, and only Siri has a masculine option, limited to a particular set of languages.[12] Siri's name, in nordic, translates to "beautiful woman who leads you to victory" (Fessler 2017). And Cortana's name is inspired on a character from the videogame Halo, whose avatar is a woman.

These aspects are defined prior to any interaction, but their dialogue and interaction also reinforces this feminization since, beyond their service and assistance, chatbots frequently display feminine characteristics through socio-emotional based dialogues. Siri, for example, presents itself as an entity that, in her words, "lives to serve" and please its users, thus fulfilling a submissive role.

As Weber puts it, these gendered dialogues imply a "reduction of social interaction to stereotypical and gendered behavior patterns" (Weber 2005, 215). Consequently, human like behavior in social machines becomes standardized and gender stereotypes are instrumentalised to manage our relationship with chatbots, reproducing and reinforcing social clichés (Weber 2005, 214). Often, the behavior of chatbots confirms expectations regarding gender, when following socially established feminine behavioral patterns.

2.3.3. Digital moms, caregivers and femmebots

Their tasks also resemble "traditional care giving activities associated with domesticity" (Hester 2016, 49) and, in fact, a lot of their functions consist in ensuring our well being, reflecting upon motherly acts. For Weber, this maternal attitude conveys one of the aspects that mainly defines our relationship with machines, since this interaction follows a "caregiver-infant logic" (Weber 2005, 214). Given that "sociality and emotionality have been deeply gendered categories in western thought that have hitherto been assigned to the feminine realm" (Weber 2005, 213), instead of seeing a machine, we start looking at chatbots as feminine entities that look after us. By fulfilling these roles, chatbots, begin to develop relationships with us that might go beyond mere daily assistance, since they start simultaneously emulating attributes that are not only related to historically feminine labour but also to motherly acts.

According to Snyder, social stereotypes constitute "(...) pieces of information [which] are usually the first to be noticed in social interaction and can gain high priority for channeling subsequent information processing and even social interaction" (Snyder 1977, 2).

Thus, when chatbots relate to us by simulating social norms and gender stereotypes, they establish expectations and possible approaches regarding user interaction, such as the idea that "all women are dependent and conforming" as Snyder suggests (Snyder 1977, 2). Adding to this idea, Hester states that "when technologies 'do gender' it is obviously not natural, but is instead visible as the product of deliberate choices about how best to relate, assist, or persuade the imagined technology user" (Hester 2016, 50).

12. There are chatbots that display masculine traits, namely specialized digital assistants that perform specific tasks, mostly in contexts associated with manly labour. However, this paper focuses on general personal assistants rather than specialized, and thus addresses the observed predominance of female traits in this type of assistants.

The ELIZA effect already identified an attachment that derives from approaching machines as if they were human, and the fact that we might develop emotional bonds and a sense of empathy with them. In the context of daily interaction with ubiquitous chatbots, these social and affective effects become more evident.

When this attachment is felt towards entities that appear to empathize and understand their users, and whose role consists of assisting and simultaneously look after them, it also reinforces the idea that emotionality and ensuring someone's well being are feminine features. When bots interact in a motherly logic, attachment also conforms to expectations and stereotypes that associate femininity with emotional and domestic caregiving acts.

Interacting with artificial intelligence systems on a daily basis, makes us look at them not only as mere machines, but also as "mirrors or substitutes" with gendered attributes that match socially established expectations (Weber 2005, 216). As they try to become closer to reality, it is from reality itself that they draw rules for their interaction and presentation, thus reproducing and automating historically feminine jobs and tasks, but also articulating these roles with female voices, names, avatars and social behaviors.

When interacting with these humanized chatbots, we engage in communication processes similar to those we establish with human beings. Consequently, the way we relate to our peers starts influencing how we relate to artificial intelligence and vice-versa. And when we look at these gendered digital personal assistants as substitutes, there is a risk that they might affect the way we feel, perceive, interpret and even describe reality, gender and women.

This results in a somewhat questionable relation between femininity and artificial intelligence that appears to conform to normalized ideas of gender, reflecting these ideas back to reality.

3. CONVERSATIONS WITH ELIZA

Taking on the ideas addressed, and in order to complement their discussion, the project *Conversations with ELIZA* seeks to explore and expose this currently observable femininity of artificial intelligence, particularly in chatbots and assistants. The project, therefore, intentionally highlights certain feminine traits conforming to gender stereotypes that become apparent in their anthropomorphization, the functions they perform and, particularly, the socially established feminine behavioral patterns this kind of entity can assume.

The project involves the development of chatbots with different personality traits, which are implemented on contexts in which the bots normally operate (such as Facebook messenger or Twitter). These are contextualized in a online platform, as a primary component of the project that seeks to briefly elucidate on what AI is, with another chatbot whose function is to explain its own creation process and including links to the other chatbots.

Each of the chatbots developed takes on a particular archetype, characteristic of the relation between AI and female stereotypes, which becomes evident through interaction with the user. In this manner, and as an exploratory project that motivated the ongoing research on which this paper is based,[13] *Conversations with ELIZA* seeks to incite reflection on the apparent predominance of the female gender in artificial intelligence, and how it can reinforce traditional and normative notions of gender and femininity.

13. *Conversations with ELIZA* was developed in the 1st year of the Masters degree in Communication Design and New Media at the Faculty of Fine-Arts, University of Lisbon as a preliminary approach to the topic which motivated this paper and the research we are now undertaking.

Fig. 1. Conversations with ELIZA website.

3.1. Concept

Seeking to question the relation between gender within AI systems the project focuses on designing the chatbots' dialogues, tasks and personality traits, whose femininity is gradually revealed through interaction. In terms of dialogue-based interaction, it proposes different types of experiences with chatbots, whose conversational subject matter develops around the ideas and concepts relating to AI and gender, in order to introduce the user to the topic. In terms of their role as assistants, each chatbot is designed to perform specific tasks in an attempt to simultaneously portray standard virtual assistant skills and functions associated with traditional female labour.

Femininity is also gradually revealed through their characteristic personality traits, that seek to emulate feminine archetypes, which are approached with a certain irony and in a somewhat caricatural manner, by portraying personalities specifically designed to meet their functions and by making evident the traits or attributes typically associated to them.

3.2. Implementation

Concerning the methods for implementing dialogues, tasks and personality traits, and in order to ensure successful interactions, we began by developing rules-based dialogues that allow retrieval-based responses. Focusing on common AI errors and how to avoid them, we aimed to eradicate off-track moments by presenting suggestions in a multiple-choice fashion.

Regarding their tasks, we first looked into common functions offered by chatbots, and then into traditional attributes associated with female labour as previously described. We then combined both, and came up with four different tasks that simultaneously referred to AI and feminine tasks: explaining how chatbots work and are made, sending to-do reminders, giving daily compliments and pep talks, and tweeting curious facts (in this case, regarding women).

These tasks also reflected upon the bots' personalities. But we also focused on particular archetypes, characteristic of AIs (such as Helper, Lover, Motherly Figure and Femme Fatale),[14] and combined them with traditional female stereotypes (namely Innocent, Orphan, Caregiver and Ruler)[15] in order to expose recognizable and expected social behavior, therefore drawing inspiration from popular culture and how it typically portrays femininity in AI (e.g.: Her, Ex Machina, Humans, Metropolis).[16]

Accordingly, we came up with a helpful, compliant assistant; a motherly, caregiving figure; a cheerful, understanding and intimate figure; and an irreverent, sarcastic figure, as described in the results. Adding to this, we also analyzed the dialogues,

14. These archetypes, retrieved from an article analyzing female robots and AIs, are mainly found in pieces of media that depict female AIs. The Helper archetype refers to helpful and compliant assistants, the Lover to figures that seek to satisfy lack of intimacy or emotional contact, the Motherly Figure to empathic, sympathetic figures who may also be worried or disappointed, and the Femme Fatale to a simultaneously attractive and dangerous figure that seeks power and conflict (Anders, 2015).

15. These stereotypes are also found in media depicting women, while also referring to Bem's stereotypes (1981 in Prentice and Carranza 2002, 269). The Innocent stereotype refers to naïve, optimistic women that try to follow the rules, the Orphan to women that try to please others and wish to be well seen as well as feel integrated, the Caregiver relates to maternal women that look after others and try to protect and ensure their well being, and the Ruler pertains to bold and competitive women that seek power and are not afraid to break the rules.

16. Most of these examples, despite portraying said archetypes, also include feminized bodies. In this sense, *Her* constitutes a particularly interesting example since Samantha (the AI) only takes form through its voice, revealing how stereotyped femininity (in this case, the Lover archetype) can still be portrayed without physical appearance.

tasks and personality traits displayed by Siri[17] to see how it would react to dominant or friendly acts,[18] borrowing from its answers in order to further develop the chatbots.

Finally, and although linked to the primary webpage of the project, the bots were integrated in platforms that resonated with their tasks and echoed common contexts in which chatbots typically operate, ranging from web-based chats to social pages like Twitter or Facebook.

3.3. Results

The project's website[19] provides context on what AI is and how it works, but also highlights gender and femininity within AI. Taking on a previous and broader research project on the relationship between gender and AI and on how to create perfect female cyborgs, bots and AIs, this site puts a particular focus on the creation of feminized chatbots.

Accordingly, the project presents four chatbots that engage with their users through different types of interactions such as dialogues, tweets and reminders, and thus explores gender in AI within and outside its website, while presenting the subject to possibly unaware users. It also allows for multiple interactions that range from texting bots, to reading tweets or even dragging them across the screen.

The main bot,[20] integrated on the project's webpage as well as on Facebook messenger, is an assistant whose function is to explain, through dialogue, the female AIs' creation processes, or how femininity emerges in these contexts. This bot borrows from female stereotypes associated with service contexts, such as being compliant, helpful, and gentle.

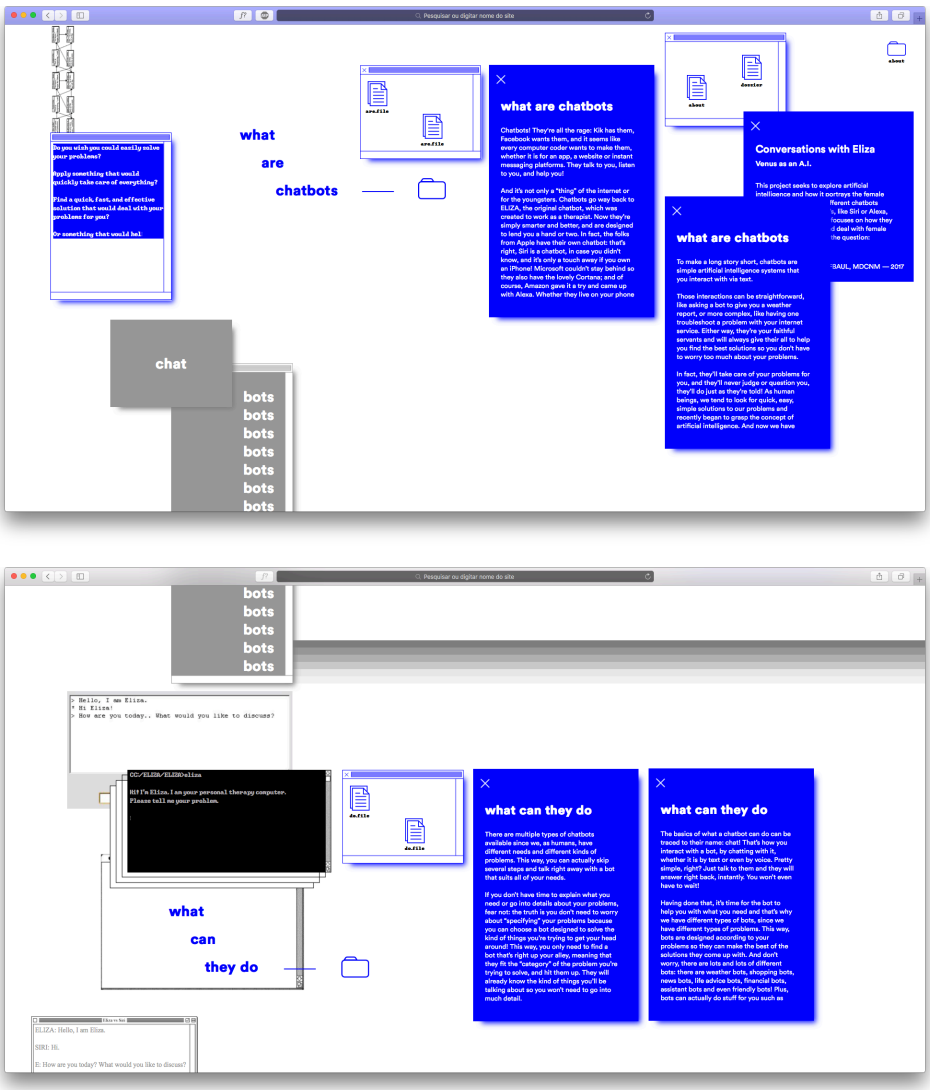


Fig. 2. Section that provides context on AI.

17. We chose Siri because we had easy access to Apple products, making it easier and quicker to analyze this AI. We analyzed how it would react to certain commands and observe which stereotypes it displayed and noted, for example, that the AI often put itself down or reassured the user about being in control. Our ongoing research seeks to expand this analysis to other bots in order to further examine stereotypes in AIs.

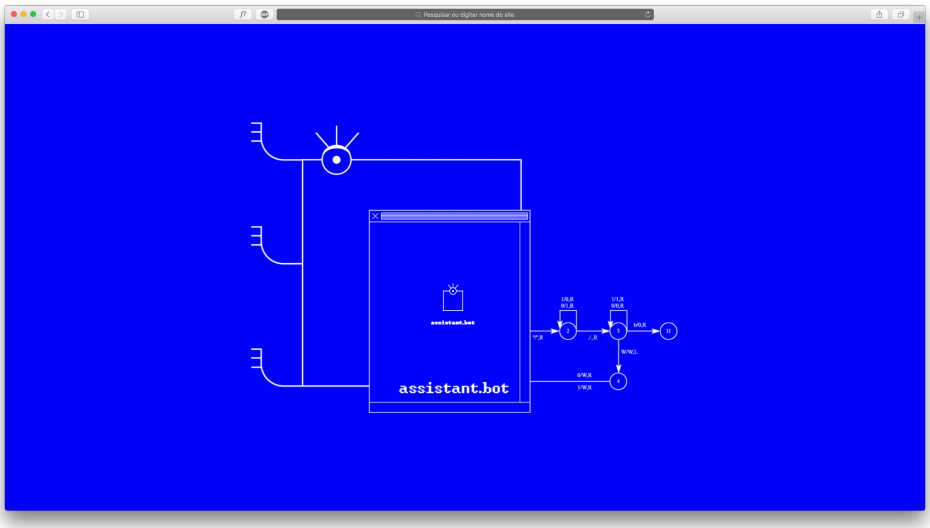
18. This approach was inspired by an article, written in 2017, that showed how Siri, Alexa, Cortana and Google Home reacted to sexual harassment, noticing their reactions mostly reinforced traditional ideas about women. In this situation, the bots "most frequently evaded harassment, occasionally responded positively with either graciousness or flirtation, and rarely responded negatively" (Fessler, 2017). The article also concluded that "the fact that Apple writers selected "I'd blush if I could" as Siri's response to any verbal sexual harassment, [...] or coy, evasive responses like Alexa's "Let's change the topic" in response to "You are a slut" ends up reinforcing stereotypes of passive, subservient women (Fessler, 2017).

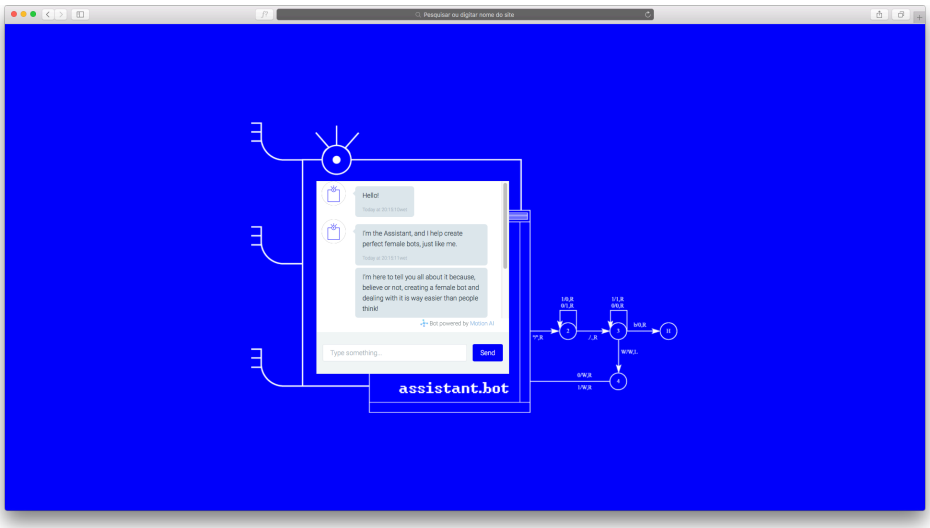
19. tinyurl.com/yaecumal

20. facebook.com/assistantcwe

Fig. 2. (cont.) Section that provides context on AI.

Fig. 3. The Assistant bot, presenting itself.





21. twitter.com/cybelecwe

Subsequently, the other three bots are presented and named according to the different female stereotypes ascribed to them: Cybele, Iynx and Electra. The first, Cybele,[21] whose name is inspired on an Anatolian mother goddess, is a tweet scheduling bot that uses code lines to generate tweets and send daily "maternal" reminders, operating as a simultaneously caring, obsessive and disappointed motherly figure. It exhibits stereotypical behavior such as being compassionate, sensitive to the needs of others, and yielding.

Fig. 4. Assistant, accessible through its Facebook page.

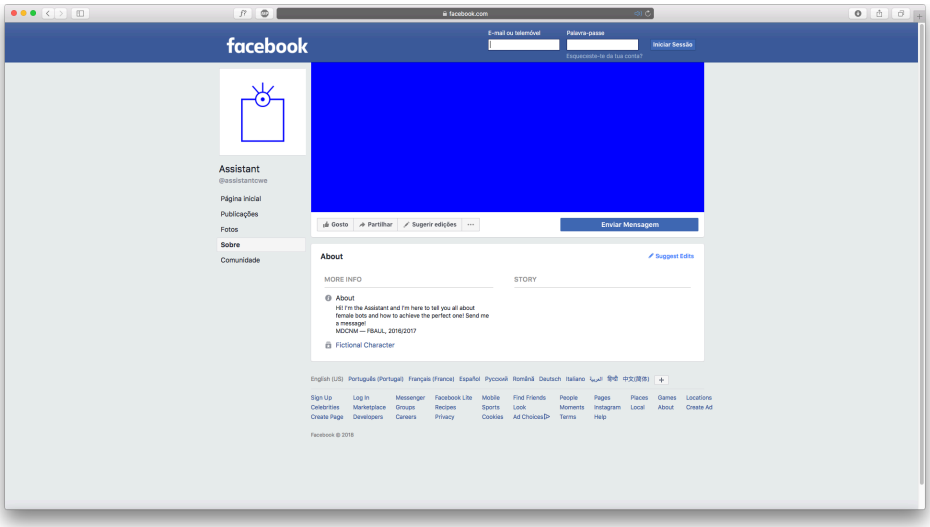


Fig. 5. The remaining bots Cybele, Iynx and Electra.

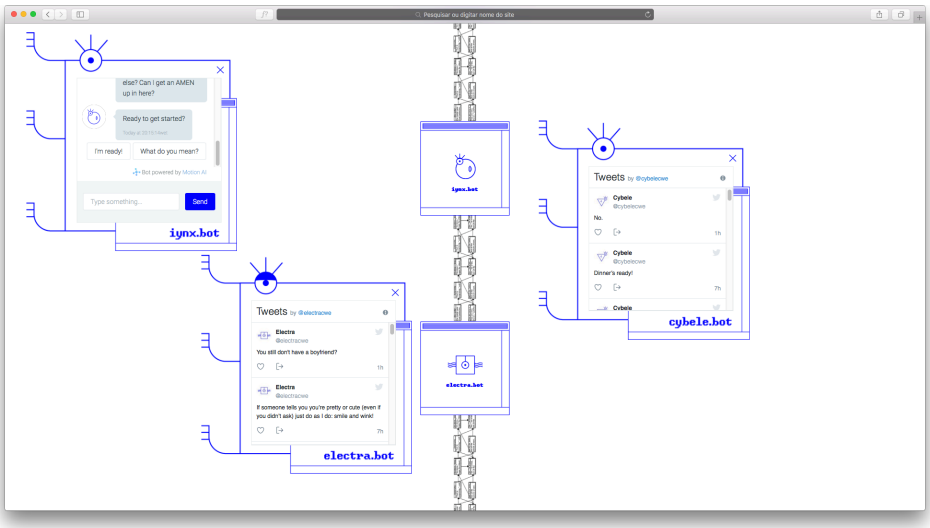
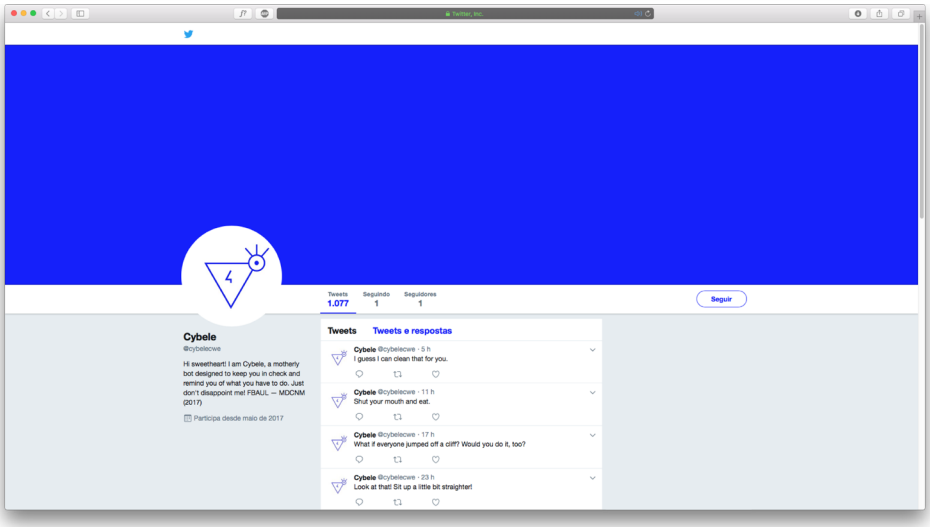


Fig. 6. Cybele's twitter profile.



22. facebook.com/iynxcwe

Inspired on a Greek nymph, Iynx[22] consists of a Facebook messenger based bot, which operates as a seductive, empathizing figure that tries to help its users with their self-esteem, by offering the feature of sending daily compliments and pep talks. Accordingly, it does not use harsh language and is eager to sooth hurt feelings, while being soft-spoken, childlike and understanding.

23. twitter.com/electracwe

Electra,[23] whose name is inspired on a Greek vengeful figure, follows a less conventional approach. By portraying a more defiant and bold attitude, this tweet scheduling talks about common assumptions regarding women, eventually twisting them or presenting them ironically. It tampers with female and male stereotypes, such as being assertive, self-sufficient and having a strong personality.

Fig. 7. lynx, accessible through its Facebook page.

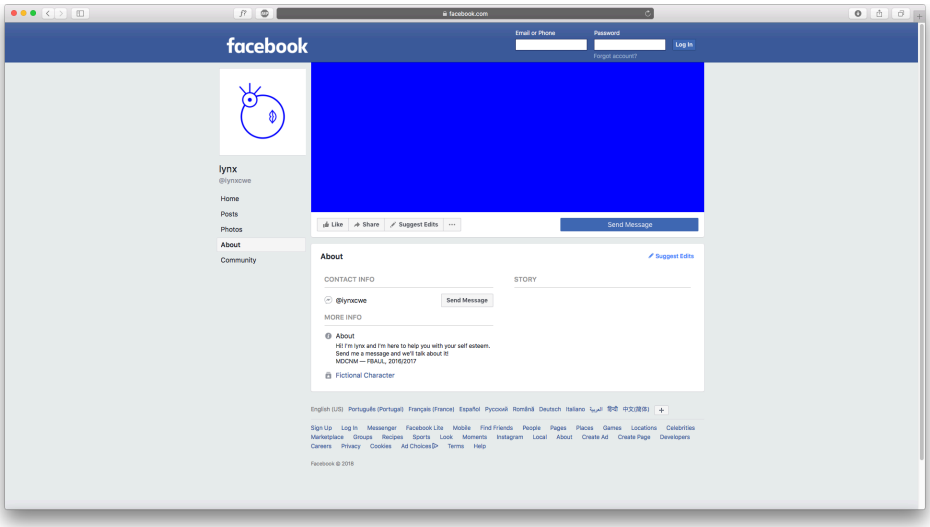
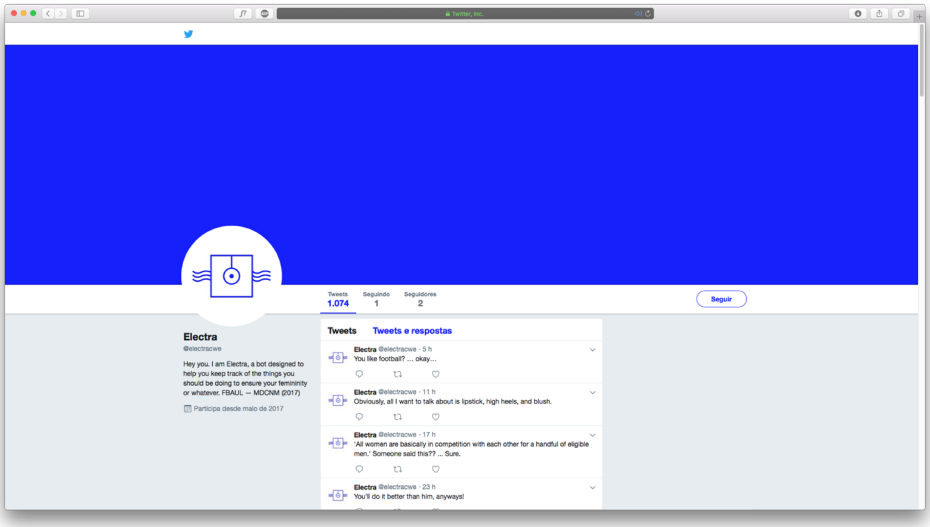


Fig. 8. Electra's twitter profile.



These different personalities and functions seek to incite reflection on feminized AI, its multiplicity and the questions that arise, particularly, when it reinforces traditional gender roles and accentuates cultural stereotypes. These bots seek to promote this kind of reflection by exposing, and intentionally accentuating, female stereotypes observed in AI. Accordingly, further developments of this exploratory project contemplate the expansion of these chatbots functions and femininity, aiming for more complex interactions and gender portrayals.

4. CONCLUSION

Artificial intelligence increasingly integrates our daily life and its development is pushing it towards a social, humanized realm. In this context, chatbots are no longer mere assistants given their ubiquity and their way of interacting that brings them closer to friendly companions. However, these ubiquitous companions often perform tasks that echo historically feminine roles and articulate these features with stereotypical behaviors. The attempt to bring them closer to human traits and interactions also reveals a biased view of gender through a feminized (often submissive) role, lacking a counterpart or gender neutral approach, or just mere cultural diversity.

This paper sought to examine and explore the relationship between gender and artificial intelligence and its significance as a field that, in its rapid development, often eludes awareness and critical stances on the social and cultural roots that inform its evolution. But rather than providing answers or guidelines to counter an observable tendency towards feminization of digital assistants, this paper sought to tackle into the questions that arise when the topic is subject to closer inspection.

According to this idea, *Conversations with ELIZA* sought to illustrate and comment on the phenomenon of feminized chatbots, ironically reinforcing some of the stereotypes we engage with. In this sense, it's partially inspired by portrayals of AI in popular culture but also, and more profoundly, by common assumptions about femininity often portrayed by chatbots such as Siri, Cortana or Alexa as an integral part of our daily lives. As abstract and neutral as these entities might want to be in their conception, they end up reflecting our common assumptions and views back to us.

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Chatbots as a Novel Interactive Medium for Poetry

Keywords: Conversational Agents; Chatbots; Poetry; Medium.

Abstract:

As emerging infrastructural entities that enable human-computer conversation, chatbots open a plethora of possibilities in the mediation of poetic content. The aim of this paper is to systematically explore various implications that arise from the conceptual role and technical possibilities of chatbots. Their conversational nature is a key differentiator in an assembly of existing media spaces that enables phenomena such as dynamism, non-linearity, and inverse intentions, while it also modifies the roles of medium, artist, and user.

1. INTRODUCTION

The essential and inherent role of mediation between poetic content and the reader (or in broader sense — user, since the term user is not perceptually specific) is to articulate, convey, and transform the poetic content. In comparison to other media, conversational agents or chatbots radically enrich this role by opening a wide range of expressive and interactive possibilities related to the conversational nature of their interfaces. Interactivity 'is the refinement of a very specific kind of engagement with art that positioned the participant or visitor as an integral part of the creative process' (Tofts 2005) and is one of the conditions that differentiates new from traditional media (Stuart 2009). While interactivity is present, at least as a possibility, in other forms of electronic literature, chatbots extend the penetration of interactive qualities deeply into the underlying process of articulation and transformation of the poetic content being mediated through conversational interfaces. A conversational medium enables creating a broader context through dynamisms, non-linearity of human-computer communication with possible indeterminacy, and adaptability of the content in relation with users' actions (or the lack of them).

In order to observe how chatbots serve as a new medium for poetry, our aim is to explore different implications and possibilities for poetic expression opened by various features which are either specific for conversational interfaces, or entail unique implications in combination with other features. Almost without exception, all of those specifics arise from conversation as a mediation paradigm. An ability to convey poetic content through context-dependent and dynamic conversations puts both the user and the artists in new position. Users become an equal actor in the human-medium relation with a plethora of possibilities to engage, influence, and express themselves, while the role of the artists extend to creating the media space along with the poetic content.

The aim is, therefore, to systematically discuss phenomena that come from technical possibilities and conceptual roles of conversational agents without imposing any particular guideline and qualification for the artistic practice. Particular consequences of various design choices on aesthetical, stylistical, empirical, contextual, and conceptual aspects of a poetry chatbot are not a part of this general discussion, as they need to be built around specific artistic practice or individual work. While conversational interfaces can rely on different types of communication using text, speech, and graphical interfaces, this discussion focus on textual conversational interfaces, but in some aspects it can be naturally extended to other communication channels.

2. THE INTRICACIES OF THE MEDIUM

Depending on context and perspective, the concept of medium can adopt different characteristics and facets. On the lowest level, a medium can be interpreted and explained as a channel for communication and transmission of content in information theory (Shannon 1949). When discussing this approach, we're not concerned with the semantics nor epistemology of the transmitted content, and instead observe only the physical interactions between signal (content) and channel noise (interference). Then, expanding on this idea, we see medium become a more complex and encompassing concept. In media studies, for example, the medium is observed through the contents it disseminates, its historical significance, and its effects on socio-political environments (Innis 1950). In this field it is often posited that all human artefacts and technologies are to be considered media (McLuhan 1964). Finally, building on top of media theorists or holding contrarian positions, views such as Michel Serre's pure mediality and fascination with parasitic noise (Serres 1982) have also been identified as relevant. To better understand the position of a relatively recent, high level, and abstract medium such as the one explored in this

paper — chatbots for poetry — and its effects on the interaction between users and technology, in the following two subchapters we provide a short overview of the historical, philosophical, and aesthetical thoughts on the role of medium in art in general and especially when the content it carries can be classified as poetry.

2.1. Medium in art

The relationship between medium and art is crucial and multifaceted. Art without medium might not exist, but the exact definition of medium in the context of art is elusive, its ontology and epistemology inherently complex. The role of the medium is thus placed on a scale from passivity and distraction to an integral function (Davies 2003). For some, medium is interpreted in an inactive role, as nothing but the physical material through which art is conveyed (Lewitt 1967). Stone, metal, and gas particles that make up the air — the characteristics of the medium are well known and defined but aesthetically irrelevant and any of their uses with the end of implementing artistic ideas is separate and isolated (Collingwood 1938). In this sense, an art medium becomes completely passive and inert, its unwelcome characteristics — brittleness of stone, imperfections in acoustics — seen as nothing but noise that inhibits the artist in the creation of art.

Continuing from this, some further minimize the role of the medium and argue that the medium is completely irrelevant and in some ways detrimental to the process of fleshing out artistic ideas (Beardsley 1958). These ideas, they posit, are inherently intrinsic and belong to the artist's internal processes, while its manifestations in the physical world in the form of artwork are imperfect facsimiles. Thus, any chosen medium will always provide only a flawed approximation of the artwork itself.

A layer above or parallel to this understanding we find the concept of medium as acknowledging of the characteristics of the medium itself as active participants in the creative process and final artwork. In this line of thought, manipulations of the medium and the conceptual framework built around them — tone scales, choreographies, painting techniques — become part of the artwork itself and influence the artist in the process of creation (Wollheim 1980). We can say that in this context the medium becomes an inextricable part of the artwork itself.

Finally, in a third layer, medium in art becomes not only the medium used to implement a piece of art, but also includes the way the which the artwork is conveyed to others (Danto 1981). Here an artwork is transformed into an "aesthetic object" whose subjective interpretation is not only impacted by the characteristics of the medium used during creation, but also the characteristics of the medium used during "consumption". A painting might yield vastly different reactions whether viewed in an art gallery or on a computer screen. In this case, the characteristics of one medium such as transmitted video signals override the characteristics of the original medium. By observing a painting through a computer screen, the observer is not aware of imperfections in the painting, ridges left by brushstrokes, etc. Similarly, different recording and reproduction techniques can significantly alter the original music. These patterns have often been intentionally subverted by artists (Dixon 2007).

This final notion is exacerbated by the onset of the digital age which by itself is a medium that transforms other mediums. Various artworks (Harper 2012) explore this relationship that is inherent and natural to art consumption in the contemporary world. Instead of assuming any form of the digital medium to be passive and focusing on minimizing its "noise", artists explore how enhancements in the digital medium distort and change the original art with unexpected and innovative results.

Stemming from the above, we approach a concept of hypermediality that is a common area of experimentation. In it, we see combinations of different media which birth new and novel media. Here some theorists posit that the combination of dif-

ferent media is warranted only if the result is not achievable in a single medium and if the combination of media produces something unique (Arnheim 1938).

2.2. Medium in poetry

The discussion about the role of medium in poetry obviously builds on the arguments of medium and art in general with some additional specificities. Historically, poetry has been closely tied to the textual medium while recent works explore, for example, poetry as non-textual and belonging to the sonic (Minarelli 2001).

While these novel ways of conducing and projecting poetry, specifically chatbots, will be explored in the following chapters, here we take a look at the way that textuality defined poetry. By looking closely, we can see that the relationship is not as trivial and straightforward as expected. As a simple example, one can observe how notation systems or languages — which should be considered part of the medium and not the poem itself — influence both the creative process and its final outcome (Hanauer 2010). For example, a poem written using Kanji will by default impose a different structure and flow then if written in Latin script. Similarly, poems written in one language and then translated to other languages often require the re-engagement of the creative process as the literal and direct translations can rarely — due to semantic and syntactical elements and differences between languages — convey the originally intended meaning.

Through the years, this inter- and extratextuality of poetry's medium was often intentionally misused and bent to achieve effects which were, in some way, completely outside the textual and crossing into interventions on the physical medium that holds the text. Concrete poetry, specifically Guillaume Apollinaire's poems (Bohn 1993), even if rooted in the traditional text-on-paper form, actually transcend that medium into a rudimentary form of hyper- and intermediality. Here the poems fulfill a literary function, but the arrangement of text also suggests a visual dimension. The medium has been modified and transformed into something new, satisfying Arnheim's criteria of acceptance.

Similarly, Marinetti's futuristic poems (Marinetti 2016) contain in them large sections of the onomatopoeic, suggesting sounds which, while not exhibited in the original medium, are created and transposed to non-tangible artifacts in the mind of the reader. This is also an example of how art, or in this case poetry, can exist even outside an a priori determined medium. Here the final medium is manifested during the act of reading and interpretation rather during creation.

Until the rise of digital media and novel ways of conveying and generating poetry using these tools, postmodern poets such as Allan Ginsberg stayed within the confines defined by concretism in therms of hypermediality, and instead insisted on redefining and recontextualizing the poetry itself by focusing on arrangements of words, sentences, etc. not in terms of their visual structure, but through their meanings and connections with extrinsic elements (Hungerford 2005).

3. CONVERSATIONAL AGENTS AS THE MEDIUM FOR POETRY

3.1. Introduction to conversational agents

Just as humans use languages for communication with other members of their species, they want to use the same natural languages to communicate with computers. This is the main motivation behind the creation and development of bots.

Conversational agents are defined as characters enacted by the computer which acts on behalf of the user in a virtual (computer-based) environment. Some agents are represented as smart assistants and are able to carry out mundane tasks like scheduling and searching for help in different spectrums by giving advice or recom-

mendations (Laurel 1990). Others act as content delivery computational systems, which can handle and deliver customized information, connected closely to the role of a lifestyle assistant.

These agents make the computer more human-like by entertaining, approaching, understanding, and engaging with people (Catrambone 2012). Their aim is to somehow simulate human behaviour in dialogue management and understanding, as well as human reasoning capabilities (Augello 2011). Agents have thus become a predominant area of research and development in such human computer interfaces. And within that field, it's conversational agents which are the most interesting because of their ability to interact with humans in a conversational manner via text or speech (King 1996; Hingston 2012).

A conversational agent, also defined as a chatbot (or chat-bot, dialogue system, IM bot, and chatterbot) is a software system program that interacts with the user using natural language. They were first discovered in 1966 when Weizenbaum's early program Eliza, built at MIT, was used to emulate a psychotherapist. When interacting with it, people were convinced their interactions were with a real person rather than a computer program. It used simple pattern matching and mostly returned users sentences in the form of questions. The common term given afterwards to these autonomous software programs was chatterbots, chat-bots or "bots" for short (Hingston 2012).

However bots are more than just instant messaging platforms or channels, browsed by users on computational devices. When mixing complex systems into our culture, such technology can impact our way of learning and discovering. For example, one such system could remind its owner to top-up his card when approaching a bus or shine a light on hyped artists when passing by a museum. Whichever modus of operation we choose, it's clear that these systems have the potential to change the way we deal with the world on a daily basis. Similarly, such systems can support people in delivering a unique experience when it comes to poetry. Humans could navigate through art and history, accessing all kinds of information within a conversation. Poems, interpretations, comments, biography, etc. can now become an integrated part of the poetical experience, lead by conversational agents.

3.2. Specifics of the medium

In order to build towards a comprehensive overview of chatbots as a novel interface, in this section we discuss possibilities for poetic expression that arise from technical features and conceptual roles of conversational agents forming unique implications in mediating poetic content.

3.2.1. Selection and order

The first manifestation of an enriched role of chatbots as a medium is the possibility for users to influence the selection and order of poems. Printed forms rigidly imply a fixed order which represents a high-level composition of a poetry collection or book. Digital media idiomatically extend this paradigm — they can mimic the fixed order of poems, they can support a predefined compositional aspect in the order, they can provide a sense of positions and relations, and they certainly can rely on a broader range of readers' actions and data provided either implicitly or explicitly. A few practical examples include different styles of navigation through poems on websites or mobile apps using categories (Poem Hunter, Pocket poetry, Wings-Poems), the possibility to search poems (POETRY app from the Poetry Foundation), and non-deterministic selection (Daily Haiku, Poem Flow). Chatbots additionally contribute to the expectation of choice and control. In a typical textual conversational interface, poems cannot appear in parallel, but sequentially, so a certain reading order is thereby necessary and expected to be influenced through the conversation. Such an influ-

ence can be manifested on several levels — from direct navigation through selection of categories or attributes of a poem, to implicit creation of order based on data collected through previous conversations.

The expressive media space of chatbots can be observed as an evolution and combination of elements existing either in the traditional (text, images) or digital interfaces (graphical controls) within the conversational paradigm. This heterogenous synergy named hypermediacy by Ted Nelson (Nelson 1965) almost consistently represents a distinction between new and traditional media, as new media assemble traditional media spaces and make users aware and even delighted by the media itself (Bolter 1999). Hypermediacy in chatbots is a result of combining textual conversational interfaces with elements that are more idiomatic to graphical user interfaces, such as icons, images, videos, buttons, sliders, input fields, and other graphical controls. This could be arbitrarily extended to voice control and various gestural modalities, but for the purpose of consistency and without reducing the generality in our analysis, we focus on textual chatbots with graphical elements.

In the context of navigating through the poetic content, hypermediacy by its definition opens two important questions: 1) how to synthesize a media space for navigation through poems and selecting them, and 2) how visible should the features of the medium be. The first question regarding media space synthesis touches upon a hierarchy of communicational abstraction in chatbots. On the lowest level is the basic, immediate, closed-type communication achieved using simple means, such as a limited number of buttons that represent options among which the user can choose. Such an approach can allow direct selection of poems through a list of questions regarding the categories or attributes of the poem. This example demonstrates how the lowest level of the hierarchy of communicational abstraction ignores the context and imposes limited choices. Higher levels of the communicational abstraction usually require exponentially more advanced technology and conceptual reasoning behind the chatbot to achieve open communication and to take the context in regard. The next three examples illustrate navigational possibilities on higher abstraction levels in a rising order of communicational abstraction. They also discuss the visibility of the medium's features.

Example 1: After each poem, the chatbot suggests several poems from which the user can choose one to be displayed next. The user can select the poem using buttons or other dedicated graphical elements. Communication is still closed and options are limited, but some basic contextual dimensions are taken into account while suggesting following poems. Such a suggestion can be done based on the attributes of the current poem (style, author, motives, mood, etc.) or by collaborative methods (popularity and selection of other users). Since the selection is explicit using graphical elements and requires the user's active engagement, this is the medium's feature that's visible to the user. Borrowed from other digital forms (such as mobile applications and web), the manual selection, even though it is enriched with automatic suggestions, will not create an element of surprise or delightedness by the medium itself.

Example 2: After each poem, the user can write an association or a motive which the chatbot will take into account when selecting the next poem for reading. The communication now becomes more open, even though it is still limited since the user needs to provide an answer to a specific question without the possibility of changing the direction of the communication. Natural-language processing (NLP), a field of computer science, provides proven techniques that can be used in this case to interpret intentions and sentiments expressed by the user (Bates, 1995). The predefined context of a specific question simplifies the general problem of understanding a natural-language in a conversational situation and for that reason this example does not illustrate an abstractional level on top of the hierarchy. Poem selection using open communication is less visible than in the previous example, but the user

can be aware of it, because of the specific question and direct reaction of the chatbot to the answer. If the results are relevant, this feature can bring an element of delightedness to the user experience.

Example 3: The chatbot occasionally asks the users to comment poems, to name their favourite poets, to write about their current mood, or, in general, to engage in conversations of broader topics. All the user data collected during the course of time can be processed in order to extrapolate new information and induct some conclusions about the users which are on a more general level than answers to specific questions. The data help the chatbot position itself in a related point in the space of contextual dimensions and select the most relevant poem. The user's direct engagement in selecting poems is invisible, but when the user is aware that the selection is a result of underlying mechanisms, it can be impressive, at least while the medium is still new and not a part of everyday life.

The selection and order of poems seems as a trifling applicational consequence of a medium, but in case of chatbots it can significantly shape user experience and implicitly absorb many underlying design choices.

3.2.2. Inverse intentions

Conversational interfaces enable communication between the user and the system in both directions and the same should also apply to the act of initiating a conversation. If a conversation mediates poetic content, initiation of a conversation may represent an invitation to read. Thereby, initiation of a conversation can be compared to analogous "inviting" characteristics for other media.

Printed poetry, characterized by its affordances, is passively inviting by its materialized appearance, while a desire to read with a consequent action is triggered by the reader. In contrast, some digital media, including mobile applications and chatbots, have a capability to invite users actively. A specific time of day, inactivity period, or any other event, can trigger an initiation from the medium's side which can be manifested as a notification or a message (e.g. e-mail, SMS, or Facebook message). Such a technical possibility of digital media and its conceptual implication represent a radically different paradigm in comparison to traditional media, since the intention can be inverted.

A specific characteristic of chatbots is their conversational nature that makes the act of initiating conversation something intuitive, since conversations are always initiated by one of the involved sides. While conversations can carry the poetic content from their beginning, this does not need to be the exclusive case. Conversations, whether initiated by readers or conversational agents, can entirely or partly serve another purpose, such as to inform users, entertain them, remind them to read, ask them questions and thereby learn more about their preferences, etc. Limitless conversation topics further pair with limitless tone of voice, message length and frequency, aesthetic characteristics of the text, and many other aspects of verbal expression (Agnese 2011). In that sense, inverse intentions exceed the basic mechanism of sending simple push notifications that invite users to read. They are about creating a meaningful and enriching experience that can be intentionally designed to accompany and amplify poetic content.

3.2.3. Interactive artistic expression

In the context of poetry, both traditional and new media posses some inherent or intentional characteristics which allow user engagement beyond influencing the reading choice and order. One such intriguing and accidental possibility that allows readers' to actively intervene in the printed medium is marginalia — a phenomenon of using page margins to write notations. Marginalia is a topic of research (Gazan,

2008) and inspiration for artistic work. American poet Billy Collins explored this phenomenon in his poem *Marginalia* (Collins 1996), while a drawing robot called Marginalia Machine reproduces archival margin notes from the Bloodaxe Archive of poetry (Schofield, 2015).

Readers' engagement on digital poetry platforms is more often intentional and even encouraged. Possibilities to comment, share, label, score, and like the poems enable the modalities of intervention which are idiomatic to the digital media. Subsets of those possibilities are present in most of the aforementioned mobile applications for poetry. Adding additional value to personal notes, markings, or local actions can be brought by the social element. Sharing poems directly to social networks from poetry applications is one of the standard features. Moreover, social networks serve as a direct media for poetic content in different forms. Poetic texts appear on Facebook and Twitter, poetry turned into images is published on Instagram and Tumblr, audio recordings are presented on Anchor, and audiovisual poetry can be found on YouTube and Vimeo. One of the most prominent characteristics of these platforms, that capture more and more of the users' time, are related to the possibility of engaging users both individually and socially.

Chatbots extend the role and meaning of user engagement — conversation — as it became a fundamental aspect of the medium. Engagements through communication with chatbots turn into a modality that is virtually unlimited in its polivalency and comparable to the expressive possibilities of the communication itself. Therefore, it can be observed within the previously established framework that considers levels of communicational abstraction and visibility. As higher levels are characterised by more advanced context awareness and communicational abilities of the chatbot, it provides more possibilities for users to express themselves and write notes, marks, or even verses that the chatbot can use to respond, to select poems in the future, or to adapt its tone of communication. While this consideration may seem too distant from the real-world artistic practice and applications, it should be an integral part of the design steps for every poetry chatbot, as the two-way relation between the user and the chatbot is instinctive and fundamental for this type of user interface. Therefore, regardless of the underlying process of conceptualization and design of the communication, users will intuitively try to engage and form their experiences based on the given conversation. In that light, designing the conversation is of the same importance as writing the poetry itself which implies that the medium imposes a certain additional requirement to the creator of the chatbot.

Finally, we must consider how chatbots figure in the broader context of a contemporary digital society. As another technology that lives within this system, it is subject to misuse and can be plagued by issues that affect society's other aspects. Phenomena like Internet addiction and attention economy can translate to chatbots both in a general sense and when used as media for poetry. For the latter, chatbot systems need to be designed so not to exacerbate the aforementioned phenomena and should instead encourage healthier behavior in users. Authors and researchers championing chatbots must thus keep in mind potential negative sides of the technology and present solutions that prevent or minimize them. This is a very complex, interdisciplinary subject that needs to be investigated alongside the core development of chatbots.

3.2.4. Design beyond visuality

Perceptive and even synaesthetic possibilities of a literary artefact are related to its materiality and, transitively, the medium that brings the poetic content into a visual, aural, tactile, or multimodal manifestation. Creating a medium therefore ecompasses desinging all of its perceivable expressions — whether they come in the form of text, graphics, sound, or a physical object. The act of designing a conversational bot fundamentally contrasts with textual, graphical, and sound design, even though the

conversation is ultimately manifested as text, graphics, or speech. Conversations are dynamic in their nature and creating conversations means composing their inner dynamism interrelated with the content. The following questions are just a few of many specific topics related to the conversation design for chatbots: (1) time and frequency of conversations started by the chatbot, (2) number of atomic messages and complexity (i.e. possible situations) in each conversation, (3) frequency and timing of atomic messages within the conversation which is very important if a poem is sent in a sequence of multiple messages as it affects the rhythm of displaying lines and verses, (4) types of the input form (predefined buttons, open text, or a combination), (5) content and tone of messages that do not contain poems, etc. In order to achieve a certain user experience, all of these aspects need to be considered and "designed".

However, design choices in this context do not mean fixed and deterministic decisions and they should be observed as context-dependent systems of working principles instead. For example, frequency of conversations started by the chatbot can, but may not be fixed to four conversations a week, yet it could also depend on various dimensions related to the user (such as user activity and user preferences), content (e.g. some topics may be initiated more often), and external conditions (e.g. day in a week or weather forecast). Designing a chatbot therefore means designing the dynamism of different aspects of human-computer conversation.

3.2.5. Accompanying texts

In the case of textual chatbots with user interfaces modeled on instant messages, conversations are the only mean of interaction with the virtual agent. They deliver the poetic content, but they also may have other purposes — to introduce the user with the system, to enable the selection of poems, to provide additional information, etc. Chatbots designed only to send poems would not rely on conversations and transitively would lose all the implications of the conversational interface mediating the poetic content. Therefore, conversations that do not carry exclusively poetic content are an expected part of the communicational corpus of the chatbot and share the same media space with the poetic content. Expanding on this idea, that means that non-poetic messages (i.e. accompanying texts) could be designed in a way that their style, vocabulary, aesthetics, and tone of voice have a designated relation with the poetic content. Such a relation is a question of the artistic intention and can be anything from match to contrast.

Accompanying texts could be seen as embodying experts, who guide their users through an iterative journey of poetry. These texts could therefore represent a more abstract, yet relatable voice which needs to be valued by the user and modeled on a believable conversation (e.g. with a poet who reads her or his poems, but also communicates with the listener). In the field of Human-Computer Interaction (HCI), some studies showed that believable bots, in terms of computing products in relation to humans, are perceived as more trustworthy, valuable and that they bring richer and more engaging experiences than humans. (Fogg 1999, Bartnek 2001, Hingston 2012). While believability is only one aspect of accompanying texts (admittedly, a specific one), sharing the same media space with the poetic content puts accompanying texts in a different position than in case of separation.

4. DISCUSSION AND CONCLUSION

New possibilities of conversational interfaces commonly entail a deeper propagation of artistic intention and artistic act into the design of the medium. A synergistic interrelation between mediated poetic content and the conversational interface reflects in a similar synergistic manner to user experience, so design of the medium

becomes a space of artistic expression that is tightly related with the poetic space. The plethora of possibilities makes that space a complex, but expressive stage for creating a specific user experience. This goes so far that qualifying chatbots as a medium may become questionable, since their purpose and function overly surpasses the essential role of conveying the poetic content. However, the infrastructural connotation of chatbots in all their applications confirms their position between a functionality or content and the user.

The intentional avoidance of imposing particular guidelines and qualifications in the context of artistic practice indicate some necessary directions for the future work. Proposed paradigms for building a chatbot's media space should be analyzed in existing applications, but also systematically implemented and evaluated in order to explore user experiences. The existing poetry chatbots mentioned in the previous section do not demonstrate all the aspects discussed within the paper and have not been thoroughly analyzed in terms of established dimensions. Besides forming a valid framework for such analysis, an experimental approach is necessary to understand implications of all the proposed paradigms and approaches.

Chatbots, as a medium for poetry, assemble and enrich elements and roles of other media. It is a common characteristic of new media to enable media recombinations and a consequential remediation phenomenon with such speed and ease (Perloff at el. 2006). As many forms of electronic literature, chatbots are essentially a hybrid medium depending both on the characteristics of its elements and the human subject that interacts with it. A specific aspect, that idiomatically does not belong to the poetry domain, is conversation (more particularly, human-computer conversation) as a mediation paradigm. To design such a medium means to design conversations, since all the implications from new ways of influencing the reading order to inverse intentions exists due to the conversational paradigm.

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Who nose?
How our noses could change if we lived on Mars. Transhumanist speculations

Keywords: Speculative; 3D Printing; Transhuman; Design; Experiment; Plastic Surgery; Mars; Biomimetics; Cosmonautics.

Abstract:

In 2017, NASA published results of the Human Research Program. The aim was to find out more about the impact of long stays in space on the human body, similar to trips to Mars made by a man. The human body will have to face new physical conditions on the Red Planet, such as lower temperature, less dense atmosphere, significantly higher radiation and many more.
Research conducted in 2017 by the University of Pennsylvania indicates that the human body has been evolving over centuries in order to genetically adapt to existing climatic conditions. The record of this process can be physically observed based on the example of our noses.
The impact of such conditions is visible and highly variable also in other organisms, including mammals that feature the best sense of smell.
The 3D printing technology is developing continuously and already today, we are able to print an ear that can be used for transplants. If this is the case, does it have to look the same?
Based on the research regarding the impact of climatic conditions on the shape of noses as well as state of the art regarding such areas as mountaineering, biomimetics, plastic surgery and taking into account mental factors, I am presenting my own nose designs. Utilising my knowledge and skills regarding design art, I am presenting my aesthetic speculations, interpreting the above visual and formal data.

Perhaps speculations on this issue will become an inspiration for science and will allow us to make breathing easier here on Earth — even before we set out to conquer Mars.

INTRODUCTION

The future starts today and it is also affected by past events.

One of the key tools in this scope consists of foresight studios and specifically the technological foresight. This is a set of tools and research methods that combines current activity (e.g. regarding science, business, society) with the uncertain but usually desired future (Voros, 2003). There is no single ending. There are many probable and possible scenarios. This is how speculative design works that is becoming a tool in strategies of forecasting macro trends.

Visualising the future may affect the development of science and business, while concept cars are an example of such solutions. One of the latest popular examples also in the area of transhumanism is a project called Meet Graham that was developed upon request of the Australian Transport Accident Commission. The project involved cooperation of an artist, Particia Piccinini with Christian Kenfield, a trauma surgeon from the Royal Melbourne Hospital, as well as Doctor David Logan, an expert on accident research from Monash University. Together, they created a human model that would be able to survive a car accident. Applying a reverse treatment where you adjust the human body to modern cars, carried a more meaningful message than "be careful, buckle up". The Australian project, besides the social campaign message, shows a completely different side of science.

My project is based on research conducted by the University of Pennsylvania, regarding the change of the shape of nose depending on the conditions in which our ancestors lived and I combine the above with state of the art. I present NASA research, information regarding programmes on inhabiting Mars as well as technological and surgery possibilities, progress of 3D printing and on this basis, I propose a futuristic vision on how our noses could look if we lived on Mars.

Fig. 1. How our noses could change if we lived on Mars. Transhumanist speculations.

1. WHY NOSES?

The nose is mainly composed of soft tissue that may be subject to changes. Numerous plastic surgeries involving the nose are a proof of the above. Often such surgeries are not performed due to health reasons but primarily for aesthetic reasons. There are also situations where the first issue is connected to the second issue and this is an example of when an unnatural creation is better than the genetically specified "original". Is that a good thing?

The history of Oscar Pistorius is an interesting case, worth mentioning at this point. I do not want to refer to the private life of this athlete but I am only mentioning his name in the context of a transhumanistic discourse.

Oscar Pistorius participated in Paralympics. He wanted to take part in regular Olympics and he succeeded in 2012. However, there were some controversies and it was stated that his prosthetic legs may have given him an advantage over people without disabilities. The decision separated the world of sports. One of the counter-arguments regarding this decision that was also shared by a Polish long jumper, Maciej Lepiato, states that prosthetic legs constitute a technical performance enhancement because they give the athlete an advantage.

This case provokes a question regarding a bio-ethical aspect in relation to the limits of interfering with the human body. Nevertheless, it cannot be denied that prosthetic legs increased the human performance at that particular distance.

Since noses are already a part of the body that is subject to modification, it is worth thinking about their form. If technically and technologically we are able to print the human ear from material that can be used for implementing, does it have to look exactly like the "original" ear?

Nature shows a huge variety of noses. Let us focus on mammals because they have a highly-developed sense of smell. Examples of extreme forms of noses are presented by snub-nose monkeys, whitemargin unicornfish (which is actually a fish) as well as sword nosed bats. The nature has developed noses throughout many years of evolution, adjusting them to the climate and conditions. In my designs, I treat them as useful traces to new solutions for human noses. Using biomimical inspirations, also called biomimicry, is commonly known in engineering. One of the most notable examples of the mechanism of nature used by a man is a hook-and-loop fastener. It was transferred from the world of plants into a solution used by people. Thanks to its use by NASA in astronaut suits, it was popularised and became widely used. Despite the fact that it was invented in Switzerland and patented in 1955, only thanks to space cosmonautics did the solution become popular and used daily (Vanderbilt 2012).

1.1. Select physical and functional aspects of the nose

1.1.1. (Encyclopaedia Britannica 2018)

- The structure of the nose enables to warm up or cool down air adjusting it to the body temperature, before it reaches the lungs.
- The nose also acts as a filter so that it catches small particles preventing them from reaching the lungs.
- The nose moisturises air adding humidity to prevent the respiratory tract from drying.
- It strengthens and impacts one's voice.
- It supports the sense of smell.
- It can attract and impact the biology of attraction (Little, Jones, DeBruine 2011).

Changes of living conditions or atavistic needs relating to the sense of security, choosing stronger and more attractive units for extending the kind are key. Hence, the

discussion regarding the change of the man's appearance and the model of attractiveness seems justified.

2. NOSE DESIGNS

I have prepared three nose designs and I focus on different functions in each case. I visualise the possible scenarios of the future in the form of unique nose designs, by means of the technological foresight method.

2.1. Nose designs — foresight database

a) Research from the University of Pennsylvania

Research conducted in 2017 by the University of Pennsylvania indicates that the human body has been evolving over the centuries in order to genetically adapt to existing climatic conditions. The record of this process can be physically observed based on the example of our noses. 3D face imaging was used in the research. 476 volunteers from West Africa, South Asia, East Asia and North Europe were measured. It has been ascertained that the width of our nostrils correlates with the temperatures and humidity of the local climate in which the ancestors of the volunteers lived. People whose parents and grandparents came from areas with warm and humid climate had wide nostrils. People originating in cold and dry regions — more narrow. The strongest correlation between the width of the nostrils and the climate can be observed in North Europe. This means that cold and dry climate is particularly favorable for people with narrow noses. (Zaidi, Matern, Claes, Huges, 2017)

The scientists have also discovered that the shape of nose is hereditary. They have found a correlation between genes and general similarity of noses in large groups of unrelated people. This means, that the shape of your nose is to large extent genetically conditioned.

In reality, our noses perform many more significant functions. They warm and moisturize the inhaled air, which helps to prevent illnesses and injuries in our airways and lungs. The scientists have long suspected that the shape of the nose had been evolving in a response to changing climate conditions. In a dry and cool climate natural selection favored noses which are better suited for warming and moisturizing the air.

b) 3D Printing

The possibilities of 3D printing keep developing. The race is in progress and it does not only relate to technology but also, or primarily to materials. The spectrum is so large that during a London-based conference regarding 3D printing in 2018, speakers talked about subjects regarding implants, aviation and jewellery within one discussion panel. The technology is not really that new because it was already known in the 1970s. The official date considered as the year of creating 3D printing is 1984 but concept works on the above technology started in the 1970s. In 1971, a French man, Pierre A. L. Ciraud, described the method of manufacturing items with any geometry by adding powder material, using the source of power for this purpose. It was published on 5 July 1973 and created a starting point for technology known today as SLS (selective laser sintering). Nevertheless, from that point on, 3D printing has been one of the fastest-developing technologies, both in terms of scientific experiments as well as hacker spaces supporting DIY movements. What is more, technology has become popular but a race is in progress regarding the variety of materials, improved prints and more precise parameters of print. One may also list materials and industries where we do not talk about print as a prototype or a method

of obtaining a quick prototype but rather about a final product. For example: a bridge in the Netherlands entirely printed by a 3D printer at the University of Technology in Eindhoven, Chinese buildings printed in 3D, as well as items printed in 3D used in space. Works on printed habitats and also printed tools were a subject of a competition announced by NASA, entitled "3D Printed Habitat Challenge". In biomedical engineering, works are performed regarding bio-printing of support structures that would later become the base for growing cells. One of such companies transferring those achievements to the stage of clinical tests is the Wake Forest Institute for Regenerative Medicine (WFIRM), which proved that it is possible to print tissue structures in order to replace damaged or diseased tissue in patients. Scientists from WFIRM have successfully printed ears, bones and muscles (Wook Kang, Sang Jin Lee, Kengla, Yoo, 2017).

c) Conditions on Mars

Mars is the planet closest to Earth, as recalls Elon Musk in his biography, "it is impossible that after conquering the Moon human ambitions for further exploration of the space should die". [1] Mars is not a very hospitable planet, however compared to our neighboring Venus we may talk about harsh conditions that may become challenges for the scientists, engineers and other representatives of science. Let's have a closer look on the physical conditions on the red planet:

Mars is a lot cooler than Earth, with average temperature of -63°C, which may drop to as low as -140°C. The lowest temperature on Earth was -89.2°C, recorded in Antarctica.

- Since Mars is further from the Sun, the amount of solar energy entering the upper atmosphere (the solar constant) is half of that entering Earth's upper atmosphere. Since the sunlight is not reflected into the atmosphere, the surface of Mars gets a similar amount of energy as the surface of Earth. However, lack of atmosphere has other consequences.
- Mars' orbit is more elliptical than that of Earth, which increases the amplitude of temperature fluctuation and the solar constant.
- Currently, the atmosphere on Mars is very thinned (approx. 0.7% of the atmosphere of Earth), which gives little protection against sunlight and solar wind. It is too thin for people to survive without pressure sets.
- The atmosphere on Mars consists predominantly of carbon dioxide. Therefore, even with a pressure correction atmosphere, local pressure of CO2 on the surface is 52 times larger than on Earth, which makes it possible for plants to grow on Mars.
- Mars has weak magnetosphere, so the protection from the solar wind is low.
- The radius of Mars is half of the radius of Earth, and its mass is 1/10 of the mass of Earth. This means that Mars has lower density than Earth.

This is just the tip of the iceberg of problems that we will have to deal with if we want to create a habitat on Mars and realistically think about its colonization or a regular life. How could this affect our bodies? Not in the perspective of the next few years, but in a more distant and long-term one? (McKay, 1991).

d) Preparations for living in space and Mars

In March 2015 Scott Kelly went to the International Space Station, where he spent 342 days. During that time, his twin brother stayed on Earth, however both of them took part in numerous studies. The aim was assess how a very long space travel, similar to that required for humans to get to Mars, will affect the human body, on the basis of comparison between two possibly similar organisms (Milstead, Charles, Paloski, 2018). Another program in the similar scope is Mars 500, a Russian experiment which commenced in March 2009 and was supposed to prepare people for a

flight to Mars. It consisted in keeping 6 volunteers closed for 500 days, in order to examine their psyche. The project was carried out in the Moscow biological-medical institute (Shwirtz, 2009), Similar space camp was prepared for a trial start of extraterrestrial technologies and research strategies on the Devon island. The island serves as "home away from home" to the members of the Haughton-Mars Project run by NASA. EXO 17 Missionis a Polish contribution in the research concerning the subject in question. The surface of Mars was imitated by the Mars Desert Research Station in Utah, and it comprises tests of air filtering system and methods of stress management.

The examples of how humans are getting ready for Mars expedition and thus to conquer the space, and the recent attempt of the Falcon Heavy developed by SpaceX, bears witness that this moment is right around the corner. These events thus encourage us to view ourselves from a different perspective.

The human body will have to change if we are to adapt to new physical conditions. Are these the new challenges for the medicine or a direction of evolution? Undoubtedly, environmental conditions affect the body and in the course of time, by the law of evolution, adapting to changes is inevitable.

2.2. Nose designs — context

The project is of speculative nature; it is also worth noting its transhumanistic character. Implants, foreign bodies implanted in the body in order to recreate natural function or aesthetics of a damaged organ are a reality. Plastic surgery of the nose, in other words, rhinoplasty, is one of the most common and yet one of most complicated plastic surgery procedures. Surgery may correct the shape of the nose by reducing or increasing its size, modelling the septum and the tip of the nose, or regulate too little distance between the nasal holes. Plastic surgeon may lengthen or shorten the nose, however in most cases we are dealing with a complex surgery regulating nasal asymmetries. Changing the shape of the nose could also affect protection against frostbite or susceptibility to sunlight. There are a few statistics concerning frostbites in the world medical literature. Studies conducted by Finnish doctors of the Health Institute in Oulu show that the body parts most susceptible to frostbite are nose, ears, cheeks and chin as well as fingers and toes. Frostbites cause shrinking of blood vessels; strong narrowing of skin vessels may lead to skin ischemia and tissue necrosis. In many animals living in a cool climate the nose is covered with more rigid skin and is construed in a different manner, which makes it less prone to frostbites and sunburns. Aesthetic medicine is often associated with a whim of the wealthy, who seek to change their image not for health reasons, but merely to satisfy their vanity. However, aesthetic medicine stems from more obviously more significant situations, associated with reconstructing faces after accidents, burns or other, for instance, genetic defects directly affecting patient's health. The meaning of nose outside medical context is proven by the aforementioned studies of scientists from Pennsylvania, which show that nose also has a complex evolutionary history, and the researchers suspect that additional factors, such as cultural preferences during mating, also played an important role in the formation of this organ. Research on the evolution of the shape of the nose and climate adaptation might have not only medical but also anthropological consequences.

2.3. Designs / scenarios

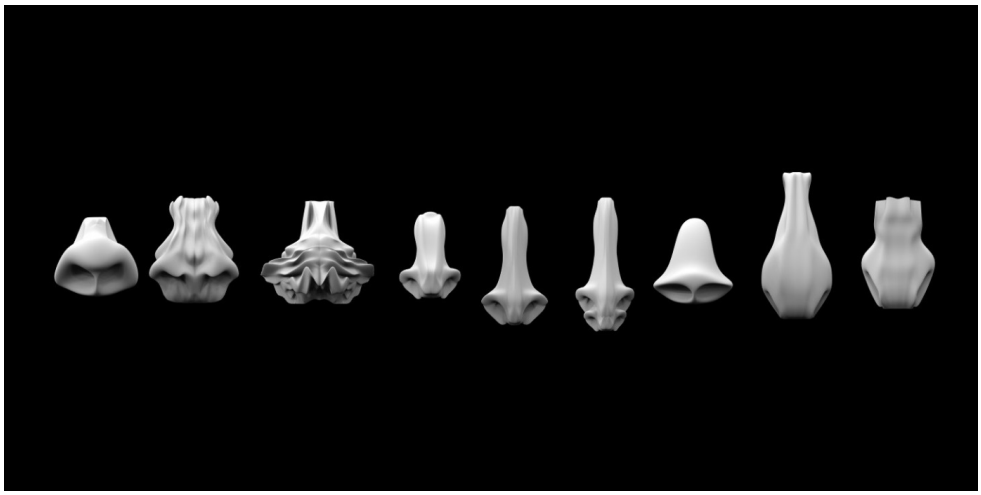


Fig. 2. Noses — different versions taken into account.

2.3.1. Double nostrils

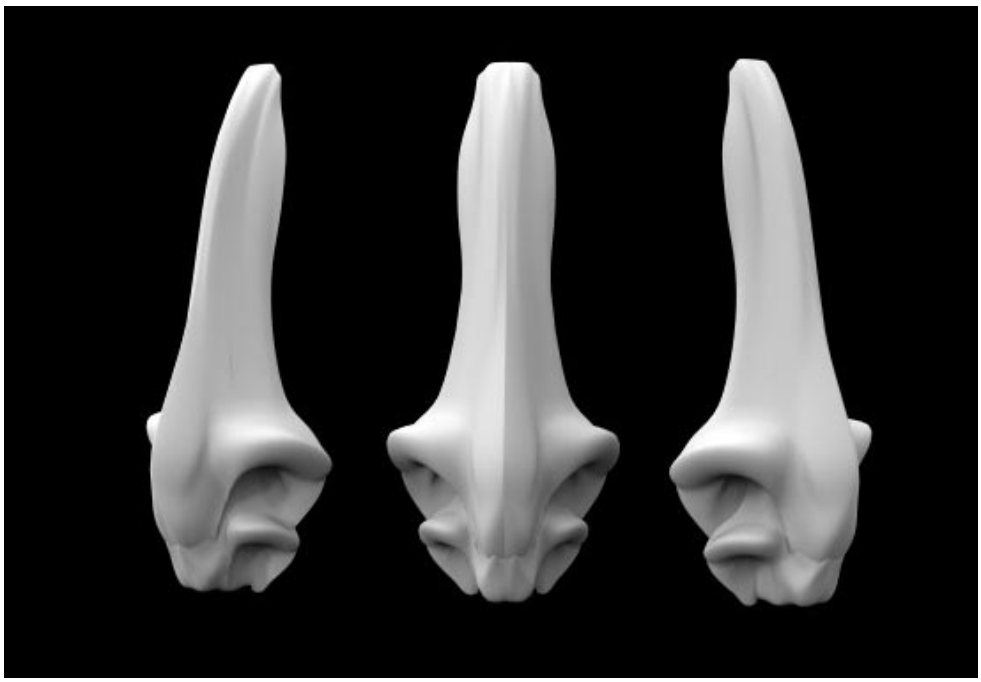


Fig. 3. Nose project *Double nostrils* — rendered nose in different views.

A. Long narrow noses are genetically associated with Nordic facial features.(Zaidi, Mattern, Claes, McEcoy, Hughes, Shriver 2017). This is associated with the fact that with a narrower nose, it is easier to warm up air, as compared to wide nostrils, due to low temperatures, both during travel and after landing.

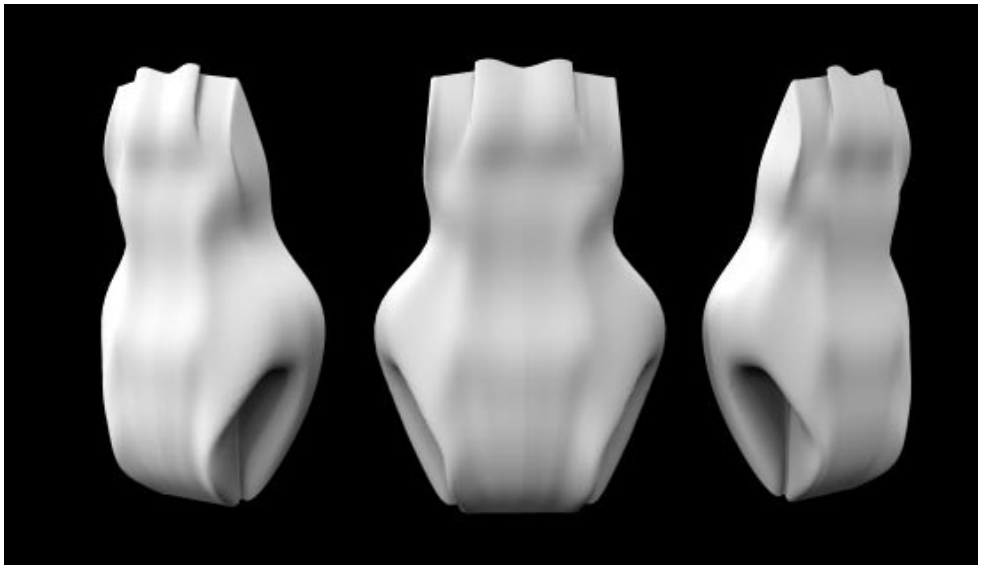
B. On Mars, people will live in habitats. They will wear space suits and helmets while walking on Mars surface and they will be forced to live in air-conditioned spaces. Also the trip itself there will involve staying in air-conditioned rooms.
Already today, we spend plenty of time in air-conditioned rooms and this has its consequences (allergies, colds, dryness). Analogue astronauts practice such a preparation on Earth.

C. We cannot forget about mental factors. Long travel and time spent in closed space may impact anxiety or less severe symptoms such as discomfort. Relaxation techniques inspired by Pranayama breathing exercises show a huge impact of breathing through the nose on staying calm and providing oxygen to the brain. Double nostrils make i possible to strengthen the sense of a deeper breath.

Fig. 4. Nose project *Double nostrils* — photo of 3D printed object in Flexible material Tango Plus 9740 . Technology polyjet, solidified liquid photopolymer by using UV light.

2.3.2. Boxer

Fig. 5. Nose project *Boxer* — rendered nose in different views.

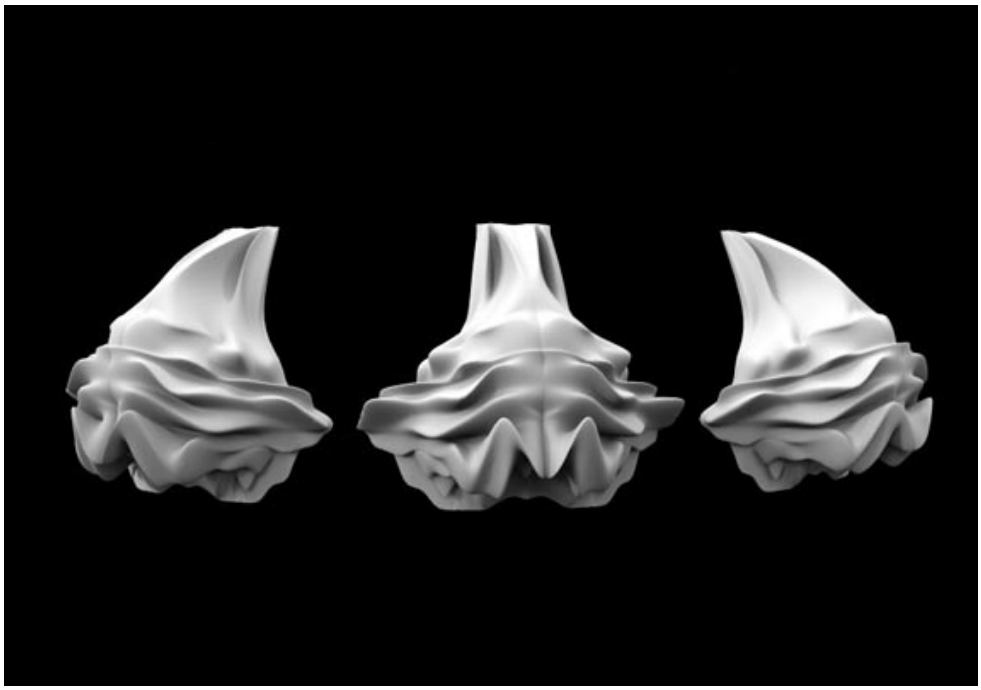


A. Utilising the experience of mountaineers, we know that the nose being an extensive part of the body, is the most prone to frostbite. Additionally, it is also subject to sunburns due to sun rays being reflected from snow. Burns also occur at the bottom of the chin or neck, according to Adam Bielecki, a Polish mountaineer. Mountaineers use special bands and tapes for covering noses and cheeks that protect against temperature and sun. For this purpose, the model of this nose is made more flat and it sticks out less,
B. The width and size of nostrils in this case is also related to the sense of better ventilation and deeper breath. In the world of animals, such a reference can be observed in the African Buffalo.
C. Wide biomimical nostrils and flattened nose may also affect one's self-confidence. The above-mentioned African Buffalo is one of the most dangerous animals in the World, which is enhanced by the specific nose appearance. An additional stylistic reference regarding a flat nose and wide nostrils is the structure of boxers' noses, which due to numerous injuries resulting from fights, modify the nose appearance. In the context of new attractiveness, it could create another subject of discussions.
D. From the point of view of functionality, such a nose would also be less prone to injuries relating to long use of helmets, that would break the nose in the case of a fall or trip, without securing it.

Fig. 6. Nose project *Boxer* — photo of 3D printed object in Flexible material Tango Plus 9740 . Technology polyjet, solidified liquid photopolymer by using UV light.

2.3.3. Radiator / resonator

Fig. 7. Nose project *Radiator / resonator* — rendered nose in different views.



A. Similarly to the design of radiators, the wavy surface of the nose may impact heat transfer.
B. The wavy surface reaching deeper may also have a clear impact on one's voice. The nose is a resonator and has an influence on acoustic effects. Since communication is mainly conducted with the use of microphones, its effect will be the same as in an aircraft cockpit, which means that some frequency will be interrupted by noises, and this will make communication more difficult. In basstraps used in recording studios, you may have noticed wavy structures which contribute to changing the acoustic effect.
C. Additionally, an example of nose structure of one of the sword nosed bats also shows that the nose is very fleshy. Scientists are of the opinion that this may be associated with echolocation. Due to the disrupted day (Earth) rhythm and the sense of day and night caused by artificial lighting, the trace in research regarding to transfer of waves and vibrations with reference to echolocation, also seems interesting.

Fig. 8. Nose project *Radiator / resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (front view).

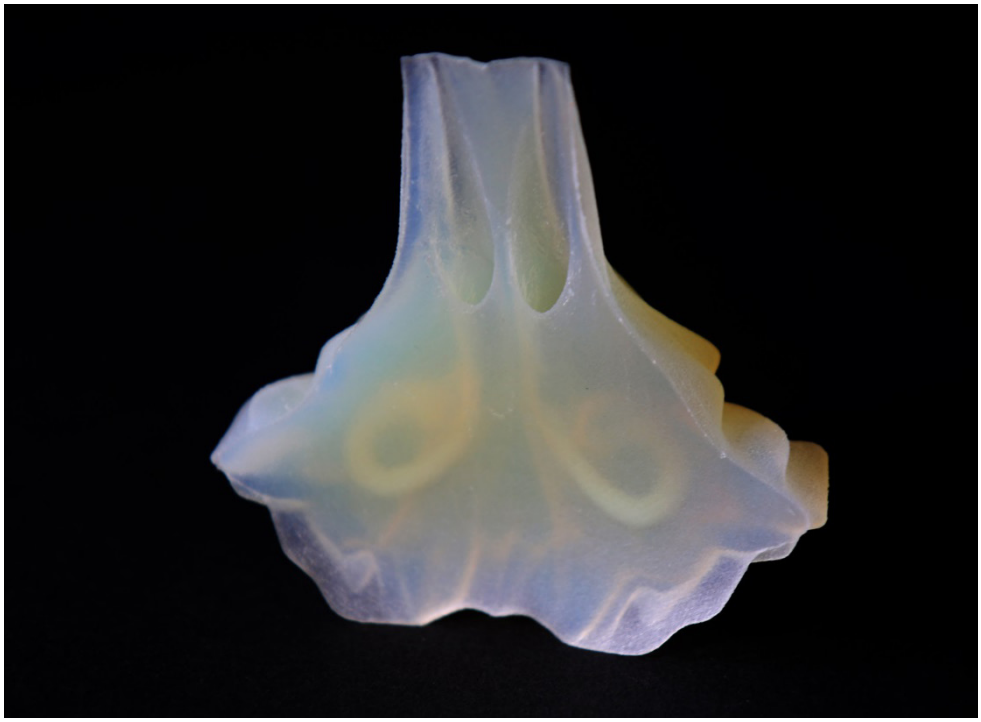


Fig. 9. Nose project *Radiator / resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (back view).

3. CONCLUSIONS

The “Who nose” project refers to the possibilities of 3D printing and plastic surgery in the context of challenges that we will all face. It has a speculative character. It does not mean that people will grow such noses in an evolutionary way on Mars. Already at this stage of medical development, we introduce many changes into our body: artificial eyes, mechanical prostheses, bypasses. Perhaps this apparently stylistic or aesthetic change could have a bigger impact on the comfort of our lives on Earth.

I have considered different stylistic options based on the above assumptions and decided to present three options that in my opinion will be a best representation of the issues and their options discussed herein. Since this is a speculative project, the answers will not be definite and they may be a proposal of interpretation.

Fig. 10. Noses – different versions and their scale on human head.

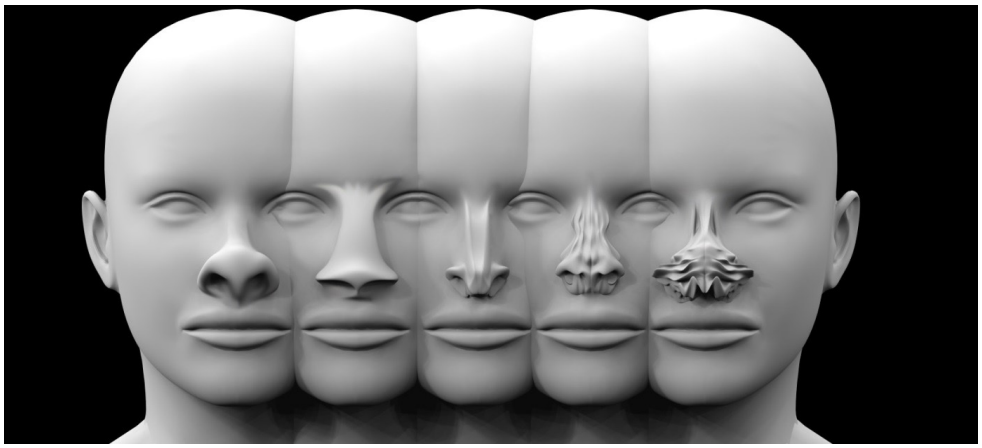


Fig. 11. Noses – different versions.

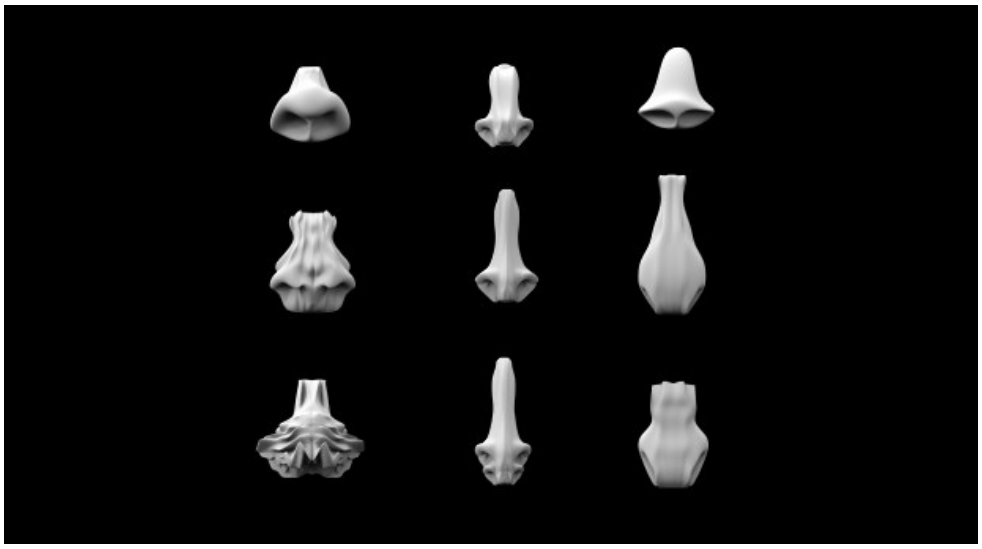


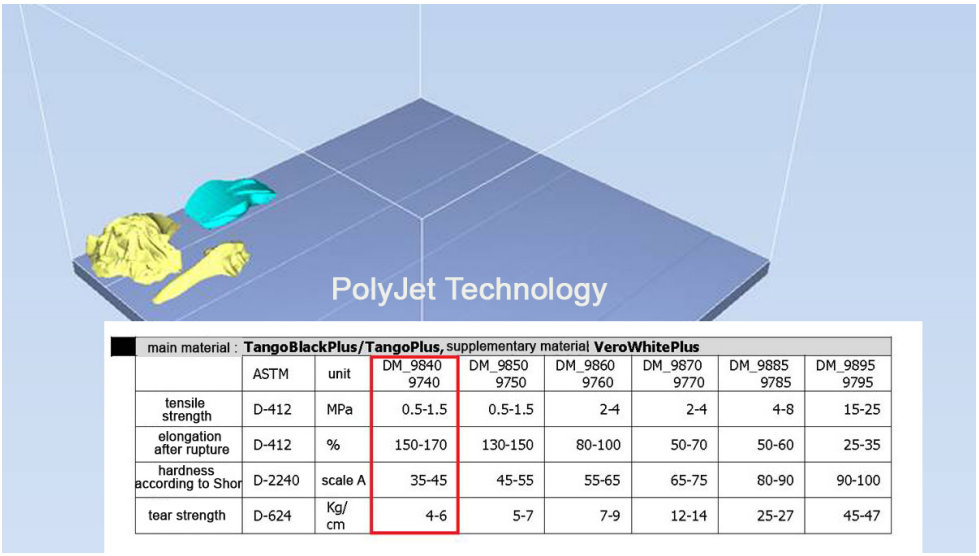
Fig. 12. Noses – different versions.

4. TECHNICAL INFORMATION:

Noses were printed at Bibusmenos, in Polyjet technology.

It uses liquid polymer resins hardened with UV light. They are applied in layers with piezoelectric heads, similarly to large 2D format prints. This is one of the most accurate technologies, namely Rapid Prototyping (RP) due to the development of parts made of ultra-thin layers, with thickness from 16 to 32 micrometers. The support material in this technology is constituted by resin sprayed by a separate group of heads that can be removed with water under pressure or dissolved in alkaline water, after solidifying.

As opposed to SLA and DLP technologies, PolyJet does not require re-exposure after printing. Each layer is fully networked and exposed so that the models are ready for tests and presentations immediately after cleaning the support structures. This material is often used in the medical industry for developing models and reconstructing the anatomic shape of a patient.



main material : **TangoBlackPlus/TangoPlus,** supplementary material **VeroWhitePlus**

	ASTM	unit	DM_9840 9740	DM_9850 9750	DM_9860 9760	DM_9870 9770	DM_9885 9785	DM_9895 9795
tensile strength	D-412	MPa	0.5-1.5	0.5-1.5	2-4	2-4	4-8	15-25
elongation after rupture	D-412	%	150-170	130-150	80-100	50-70	50-60	25-35
hardness according to Shor	D-2240	scale A	35-45	45-55	55-65	65-75	80-90	90-100
tear strength	D-624	Kg/ cm	4-6	5-7	7-9	12-14	25-27	45-47

Fig. 13. 3D printing preparation and material technical details.

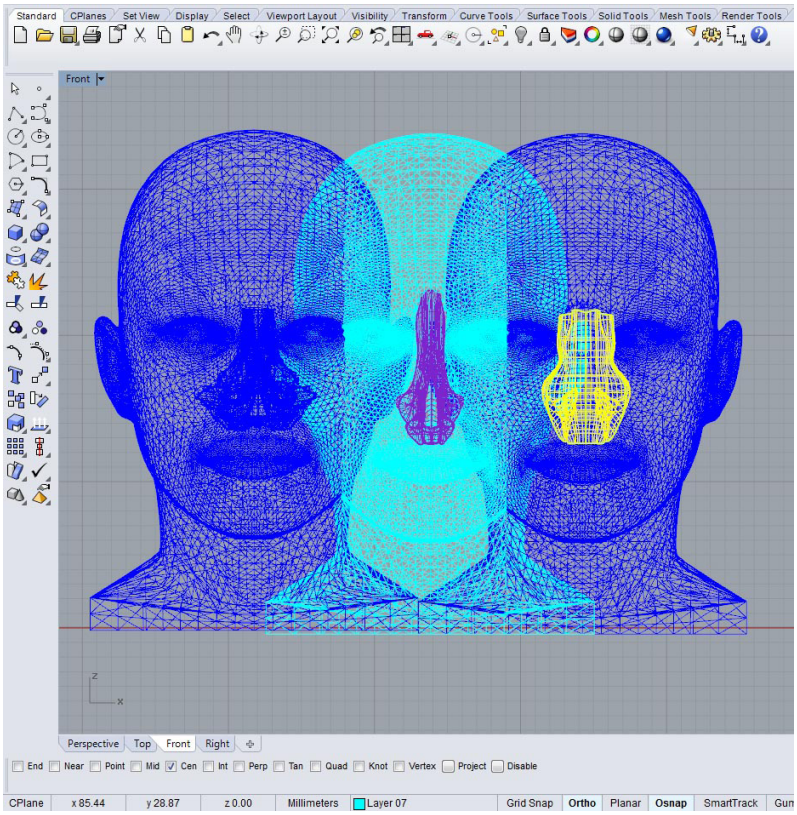


Fig. 14. 3D models preparations in Rhinoceros 5.

Fig. 15. All three selected models — photo of 3d printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light.

A video asset can be found at https://youtu.be/7cnn1f6tynk

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Artworks

6th Conference on Computation, Communication, Aesthetics & X
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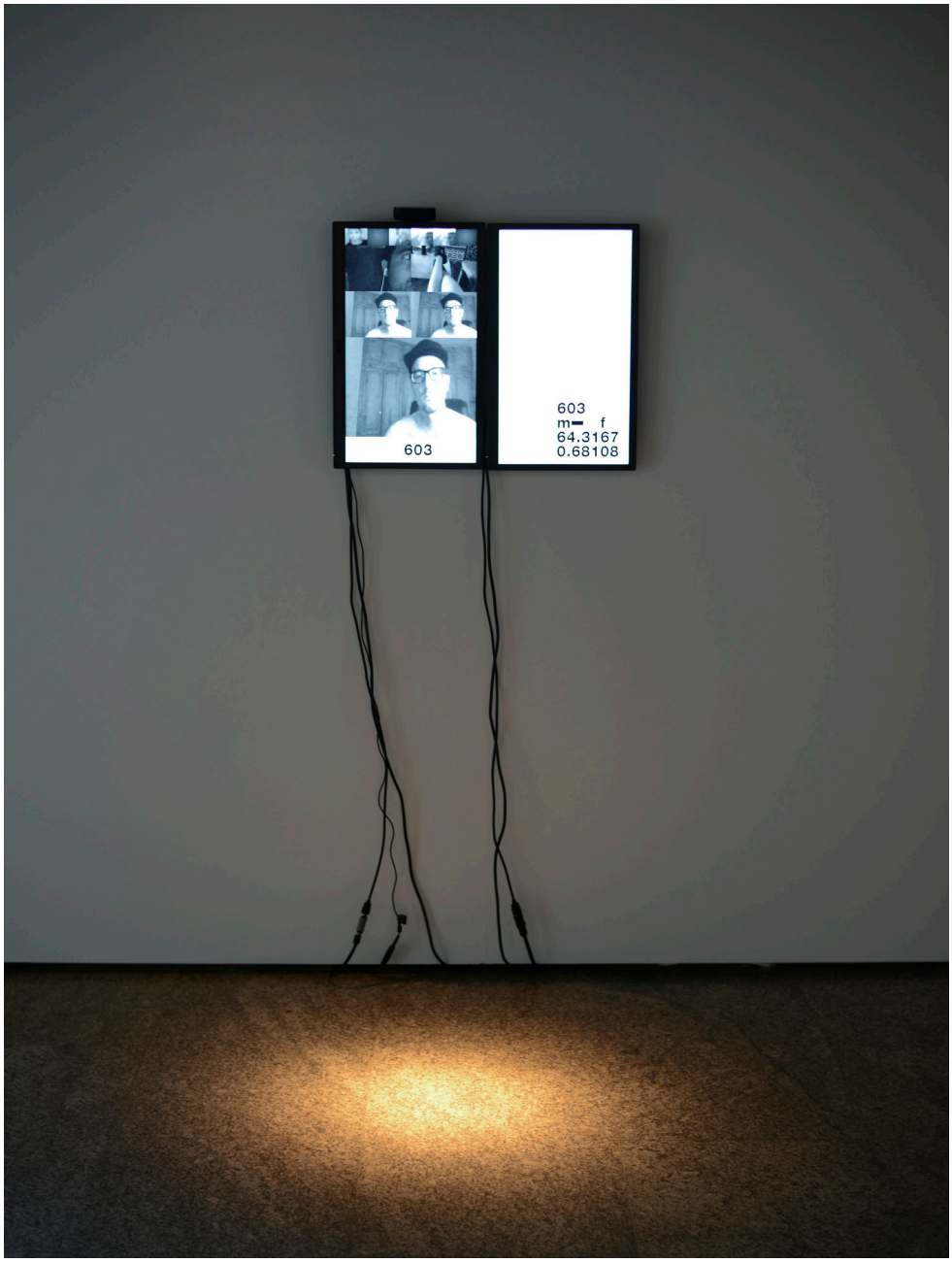
Critical Mass

Keywords: Autonomous Systems; Online Social Interactions; Digital Crowds; Self-Exposure.



Abstract:

Critical mass is a connected installation exploring behaviours of automation, digital crowds and the limits of self-exposure, social interactions, data ethics and sharing cultures. The installation connects the exhibition space with an established video chat engine. The visitor gets connected to a mass of random people in real time through an algorithmic intervened chat. Data of the interactions is collected and further used to extract facial features and train further automation systems.

1. CONCEPT

Critical Mass is an installation that connects the exhibition space with an established video chat engine, where visitors can have gestural interactions through video live stream media with random people connected through the internet. The video chat engine has been active since 2009 and has been pioneer in what concerns modern dating platforms. The installation exposes both the connected viewers and the visitors and twists the surveillance roles by asking who are the observers and who are the observed? Who are the exposers and the self-exposed? In the background of the installation a real-time engine stores visual data and performs facial recognition and analysis.

Critical mass is a concept used in Social Anthropology and Social Dynamics, which refers to the moment when a certain behaviour is adopted by a considerable number of members from a social group or specific culture. It refers to the multiplicity of social agents who are necessary in order for a collective change to happen. It may also refer to a social stage which is observed when a certain behavior gets accepted and established.

This phenomenon is especially visible in public spaces where crowds gather and propagate certain behaviours. For instance, if someone in the crowd starts expressing an aggressive behaviour, it will be a matter of time before a considerable amount adopts the same behavioural patterns, thus reaching the critical mass, a moment when the same behaviour can be observed in a more homogenous distribution.

The installation explores how this phenomenon also takes place in the digital space, where the individuals are not bound anymore to the others through the notion of space as a physical constrain, but are bound to each other by matters of culture, codes and by sharing the same channels and needs for communication.

The work uses the feed from an existing online chat, which allows people to remotely connect randomly to others who also use the video chat. Originally this platform was launched around 2009 and, until recent months, the platform had not changed its interface much and had remained as a non-commercial and obscure platform. The platform featured, over the past years, image recognition algorithms to filter out inappropriate content and hinder the participation of under-aged audiences and avoid the overload of sexual content. Currently there are a couple of domains which are doubling or mirroring the concept of the platform and moving from a flash-based technology to a WebRTC architecture, which allows to remotely establish video and sound streaming nodes through the web. There is little information behind them, in relation to their providers and what the end purposes behind providing such “service” may be.

Through the installation, it is not only the connected viewers on the remote nodes who get somehow transgressed but also the visitors of the exhibition who’s faces get tracked and collected in a database which is being used for training other algorithms with hidden purposes.

This transgression is somehow fictional because I don't really have yet a purpose in collecting all this data and conducting facial recognition and analysis as well as keeping the raw data of the visitors. Nevertheless, the intention is to maintain the tension in the fact that I am doing it and that somehow this process of surveillance, recording and data collection is visible to the visitor, and that somebody is being somewhat cynical on the process and not facing any further immediate consequences.

In "Crowds and Power", Elias Canetti has developed ideas concerning crowds and the mirroring and propagation phenomena in crowd behaviours, arguing that it is out of the need of transcending the individual, that crowds are built and self-sustained: "it is only in a crowd that *one* can become free of this fear of being touched. That is the only situation in which the fear changes into its opposite. The crowd *she* needs is the dense crowd, in which body is pressed to body; a crowd, too, whose psychical constitution is also dense, or compact, so that *she* no longer notices who it is that presses against *her*. As soon as *one* has surrendered *herself* to the crowd, *she* ceases to fear its touch. Ideally, all are equal there; no distinctions count, not even that of sex."

2. TECHNICAL DESCRIPTION

The installation consists of a set of two screens. In one screen, a generated portrait mosaic is built alternating with the feed from the webcam recording the faces of the visitors in the exhibition space, and the video feed from the online chat. In the other, a visual summary of the extracted faces is built and displayed in real time, as well as textual data concerning average gender, average age and average sexual exposure of the whole set of tracked subjects during the exhibition. The system is programmed using Open Frameworks, a headless browsing agent for Chrome, and Open CV-based algorithms for face recognition and analysis. Obscurely, a data base is collected in a continuous base and used for further analysis and system training.

2.1. Chat Engine Intervention

Fig. 1. Photography of the installation *Critical Mass* exhibited in Summer 2018 at xCoAx, Centro Arte Complutense, Museo del Traje, Madrid.

The existing video chat engine is intervened in order to make it possible to access several chat instances at the same time as well as to avoid the banning of the installation and allow to permanently be connecting to it. The viewers on the end nodes

of the chats are informed about their participation in the installation. The information and data retrieved is exclusively used for artistic purposes and it is handled with precautions to ensure data protection and privacy. The algorithms behind the chat engine intervention are written on Python and JavaScript. Additionally, a Chrome Extension Script has been written in order to allow headless web manipulations of the chat instances.

2.2. Media

In the following links you can take a look at the video documentation from the installation Critical Mass as it was exhibited at Centre Pasquart, Biel, Switzerland 2017.

Fig. 2. Video from *Critical Mass* 2017. (https://vimeo.com/224633095)

2.3. Note on privacy

To avoid legal enquires the name of the chat engine will not be revealed to the audience. However, the connected viewers on the other end of the engine are made aware of their participation in the installation upon the beginning of their connections.

Acknowledgements:

The participation of this work at the xCoAx 2018 Conference was possible thanks to the support from the Swiss Arts Council Pro Helvetia.

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Web Page from the Project. Github repository.

6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

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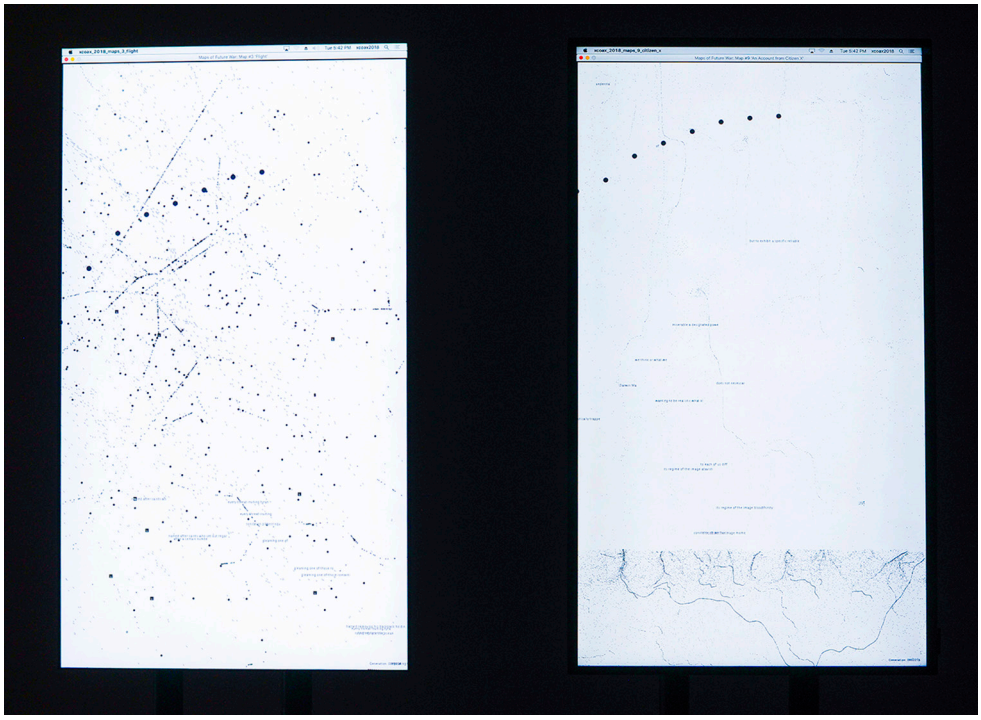
Maps of a Future War: Flight & An Account from Citizen X

Keywords: Agent; Generative Art; Emergent Narrative; Simulation.



Abstract:

Maps of a Future War is a series of nine generative maps that explore agent based narratives. The two maps discussed here are *Map #3: Flight*, which tells the story of movement across regions of conflict, and *Map #9: An Account from Citizen X*, which narrates the inner state of a citizen during a moment of political crisis. Using a framework of regions, signals, boundaries and other map elements, text agents drift, collide, and change in an attempt to produce an emergent narrative. The text blocks of each map's narrative agents are combinatorial, assembled algorithmically from an archive of statements that represent agent observations, beliefs, or actions across a range of narrative states. By shifting agent tendencies based on conflict weights and state coherences, *Maps of a Future War* intends to model narrative as a kind of complex system, one that can evolve or adapt according to region and agent conditions.

1. DESCRIPTION

Maps of a Future War continues my research in narrative aesthetics and stories that might operate as systems. The maps are environments in which text agents and other map elements form interrelationships that determine an overall framework for a fictional work or recombinant story. Working within a system of signals and boundaries, the text agents of maps use genetic algorithms and conflict weights to reproduce in an attempt to create an emergent narrative. Screenshots of map #3, *Flight*, and map #9, *An Account from Citizen X*, are shown in Figure 1.

2. AGENTS

Each map starts with a small group of text agents which are distributed across a set of narrative modes. Based on readings from the fields of political history, the narrative modes of map #3, *Flight*, were configured as Clausewitzian strategy, history, justice, politics, and sociology. Drawing on readings from literary theory and the narrative structures of monologue, the agent modes of map #9, *An Account from Citizen X,* were configured as memory, doubt, recognition, bargaining, and denial. A further description of the maps narrative modes is shown in Tables 1 and 2. These modes are made up of a number of archives or reservoirs of text fragments that represent the narrative of the agent concerned. These fragments were written as fiction for a story that might self-organize as recombinant system. On instantiation, each text agent is coded with a numerical array meant to represent that agent's 'DNA'. Fragments are then left to drift through the environment where they may 'collide', 'reproduce', and 'mutate' based on signals from map regions, borders, and other map elements. On collision with map borders, text agents can 'reproduce' or create child texts whose newly evolved narrative goals are the product of a genetic algorithm that reflects the influence of the collision border's DNA as well as the parent agent's genetic identity. Future text generations are selected based on the amount of algorithmic fidelity a child text exhibits towards an agent's continually recalculated narrative state.

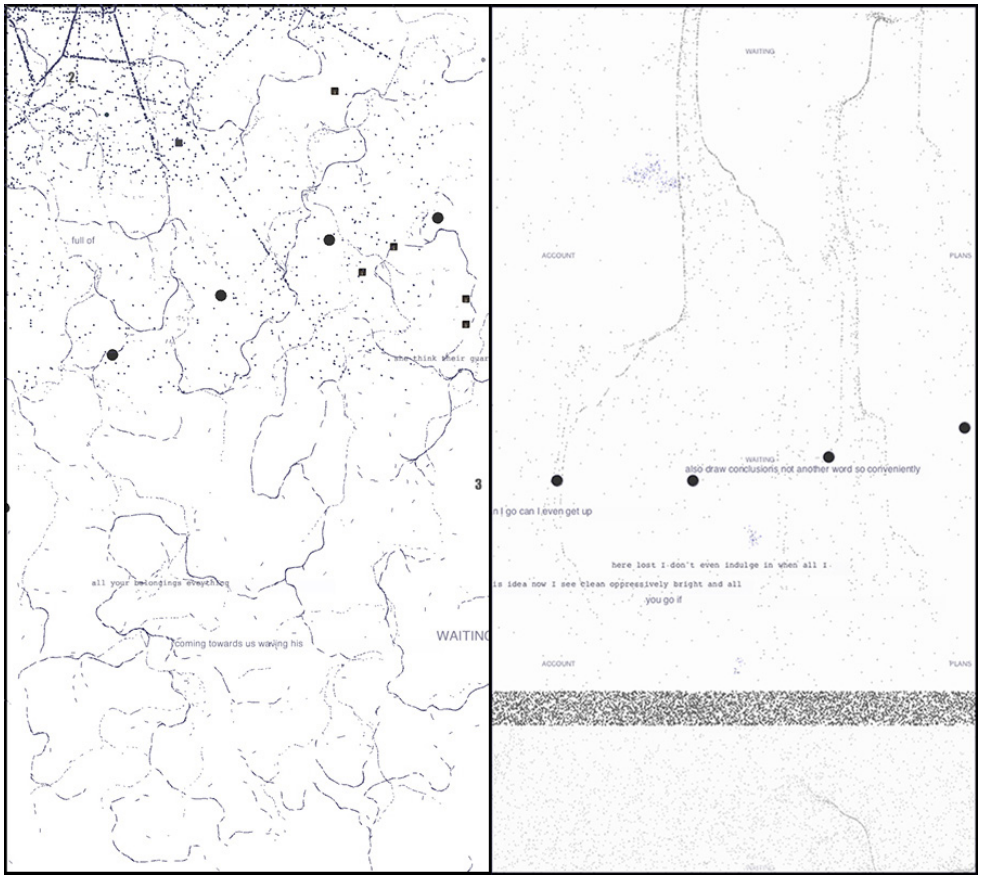


Fig. 1. *Maps of a Future War Map #3, Flight* (2017) and *Map #9, An Account from Citizen X* (2018), screenshots.

3. ENVIRONMENT

Table 1. *Maps of a Future War Map #3: Flight* (2017), narrative modes and states.

MAPS OF A FUTURE WAR, MAP #3: FLIGHT				
Narrative States				
History	**Sociology**	**Clausewitz**	**Justice**	**Politics**
blur aggressor and defenders	erase human causes	judge all sides guilty	repress critics	point out complexity
is History < 0.6?	is Sociology < 0.6	is Strategy < 0.6	is Justice < 0.6	is Politics < 0.6
↓	↓	↓	↓	↓
erase sequential memory	accept accounts of the aggressor	assign blame equally	point out the wrongs of victims	dismiss preventative strategies
is History < 0.3?	is Sociology < 0.3	is Strategy < 0.3	is Justice < 0.3	is Politics < 0.3
↓	↓	↓	↓	↓
consciousness of the instant	military replaces politics	condemn all sides	punish the innocent along with the guilty	point out failures of politics

As in many agent based systems, agents operate over cells, often called patches, but here conceived of as regions. Regions are made up of groups of cells, two or three dimensional blocks of terrain that develop at discrete time steps based on signals from other regions, agents, and elements. Each region can contain several varieties of map element, including agents, lists, and borders. Unlike agents, regions may change in appearance, but do not produce texts, or contain inner schemata that change, or

evolve. Instead, regions are weighted for conflict so that agents may evaluate a map area in terms of its coherence to that agent's current narrative state. Depending on these coherence weights, agents are either attracted to or repelled from specific regions, thereby creating movement, collision, and the possibility of change, reaction, or evolution of the agent texts. Regions also contribute to the several overall conflict weights for the system, some of which determine the appearance or form of certain textures and borders, and in some cases the sensitivity of certain signal sensors.

Table 2. *Maps of a Future War Map #9: An Account from Citizen X* (2018), narrative modes and states.

MAPS OF A FUTURE WAR, MAP #9: AN ACCOUNT FROM CITIZEN X				
Narrative States				
Memory	**Doubt**	**Recognition**	**Bargaining**	**Denial**
struggle to recall	question past motives	deny past	assert the questionable	practice counternarrative
is Memory < 0.6?	is Doubt < 0.6	is Recognition < 0.6	is Bargaining < 0.6	is Denial < 0.6
↓	↓	↓	↓	↓
reassign actions	examine gaps in the record	admit oversights	equate the unequal	insist on stasis
is Memory < 0.3?	is Doubt < 0.3	is Recognition < 0.3	is Bargaining < 0.3	is Denial < 0.3
↓	↓	↓	↓	↓
block distant knowledge	revisit conclusions	acknowledge failures	catalog 'what ifs'	examine obstacles

4. EMERGENT NARRATIVE

In contrast to traditional narrative structures, the design schemes of each of the maps in the series assumes a lack of initial goals for its narrative agents, and relies on agent text assembly to create progression. Agents in both maps use weights and rules to calculate a narrative state and a narrative tendency, then assemble archived fragments into a current text block. On collision with specific map elements, which are categorized as borders, agents are able to shift state, change, or evolve. In the case of map #3, *Flight*, collisions cause text agents to evolve according to a genetic algorithm. In map #9, *An Account from Citizen X*, collisions cause agents to evolve according to a narrative rule set or schemata. As agents change, they signal their new states and regions conflict levels, overall map weights, sensor signals, and agent headings are recalculated. Agent texts that lie outside or between the starting states of a map narrative are considered emergent or generative texts. This use of models or systems to express a changeable, evolving text is meant as an alternative to traditional narrative structures.

Table 3. *Maps of a Future War*, agent inputs and outputs.

MAPS OF A FUTURE WAR						
Agent / Environment Relationships						
Borders	→	Collisions	→	DNA		
				↓		
Regions Elements	→	Signals	→	Agents	→	Narrative States

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6th Conference on Computation, Communication, Aesthetics & X
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Ambient Landscapes

Keywords: Generative Music; Generative Video; Ambient Video; Musebots.

Abstract:

Ambient Landscapes is a meditation on our natural environment, inviting viewers to savour the passing of time over the course of the year. The system produces sequences of video joined by slow visual transitions and enriched through their interaction with music and soundscape. It is a real-time cybernetic collaboration between three generative systems: video sequencing, soundscape, and music. The computational processes run continuously, creating ongoing and varied audio-visual output for a single high-definition video stream with stereo sound.

1. INTRODUCTION

Art can clearly affect viewers and listeners in very emotional ways; however, artists will often reject the claim that the emotion is *in* the artwork itself, and instead insist that emotions felt are solely within the viewer / listener. How does one reconcile these seemingly opposing views? Efforts have been made to discover the relationship between emotion and music (Hevner 1937) as well as moving image (Cohen 2001); however, these studies have had limited direct application for the generative artist.

Russel's circumplex model (1980) introduced two very significant parameters for describing features that may produce emotional responses in listeners: *valence* (pleasant / unpleasant) and *arousal* (eventful / uneventful). These objective measures can be used both analytically as well as for generative purposes, primarily because such objective measures can be considered during the creative process. Artists can readily translate these measures within their medium: in music, for example, eventfulness can be translated as activity, and pleasantness can be translated as tension.

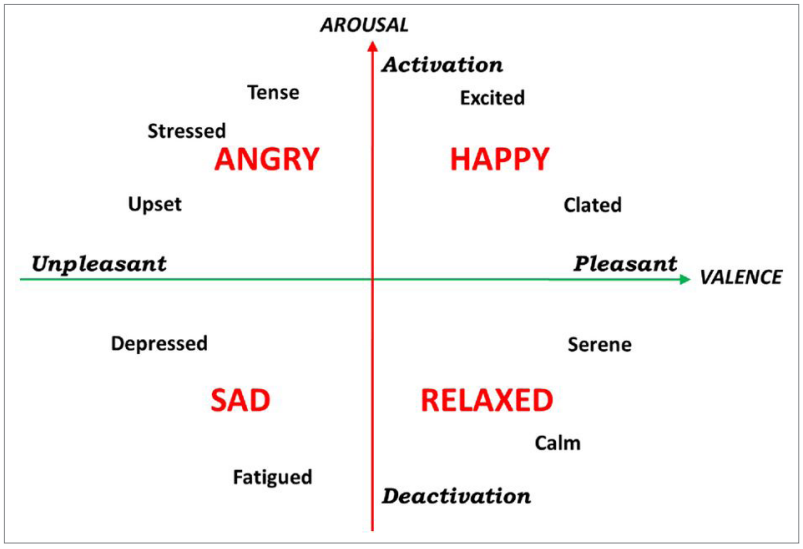

Fig. 1. Valence / Arousal model.

The circumplex model overlays emotional states on the two-dimensional scale (see Figure 1); significantly, these emotions result from the relationship between the two measures of arousal (or eventfulness) and valence (or pleasantness). Therefore, an artist, generative or otherwise, can create an artwork that has low arousal and high valence — two objective measures — and be confident that it will be perceived as "calm and relaxed", two subjective responses.

Within our multimedia installation, *Ambient Landscapes,* we are using these measures to drive the music and soundscape generating systems based upon an analysis of the video system's current output. The artwork uses visually evocative nature shots, and its goal is to support an ambient user experience that is calming and contemplative; as such, the values for valence and arousal in the video are relatively moderate.

2. DESCRIPTION

Ambient Landscapes combines three very different generative systems: video, music, and soundscape. In order to maximize aesthetic coherence and flow, the artwork relies on a chain of valence / arousal assessments and communications (see Figure 2). The chain starts with the database of video clips. The video sequencing system uses a set of content tags to select and order the stream of clips. Each clip has also been assessed and tagged by the artists for its valence / arousal values. This assessment is based on the artists' subjective evaluation of each of the shots.

The valence / arousal values for each selected shot are then sent to the two audio systems. The music system uses artificial agents, musebots (Eigenfeldt et al. 2015), to compose and create an original generative music track that reflects the valence-arousal values of the images. The soundscape system uses both content tags and the arousal values from the video stream to select and mix a soundscape that is consistent with the video and the music, selected from a large database of recordings. Lastly, the musebots pass their current pitch set to the soundscape engine, allowing that system to apply resonant filters to the selected recordings using the generated harmonies within the music.

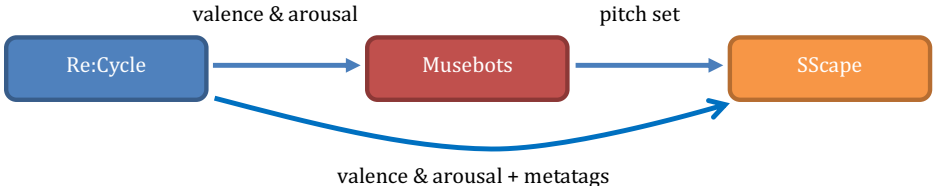

Fig. 2. Metatag and Valence/Arousal pipeline between the video system (*Re:Cycle*), the soundscape system (*SScape*), and the music system (*Musebots*).

Acknowledgements:

The artists wish to acknowledge the support of two separate SSHRC Insight Research Creation grants.

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6th Conference on Computation, Communication, Aesthetics & X
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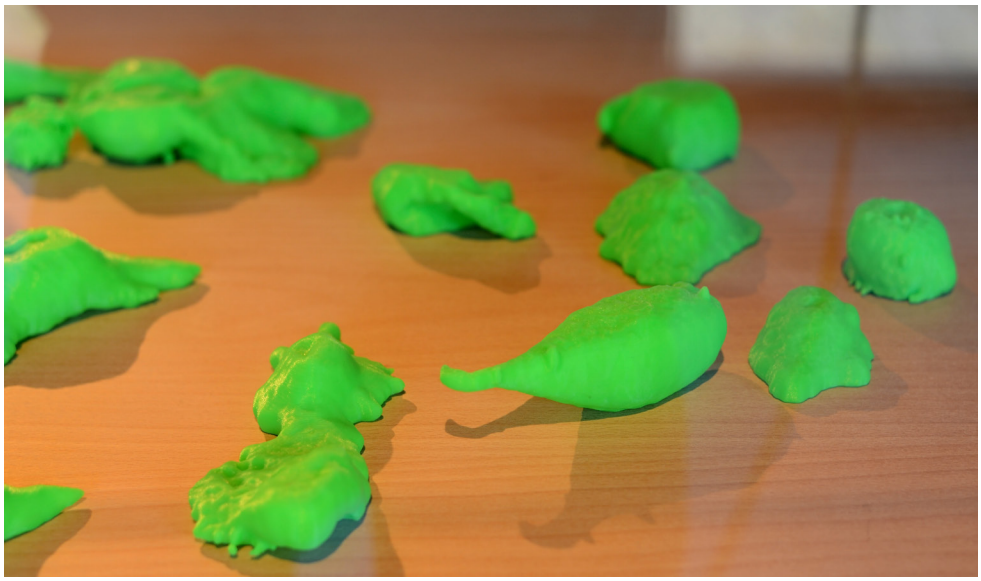
We Began as Part of the Body

Keywords: Art; Genetics; Skin; Science; Technology; Creative; Research; Practice Based.



Abstract:

We Began as Part of the Body, is an installation, made up of a series of creative research artworks, including sound piece, 3D printed skins and 360 photographic images, that immerse the viewer in the scientific and emotive issues raised by the use of human tissue for genetic research. The artworks were created during an ASCUS micro-residency in Professor Sara Brown's skin genetics lab in 2017. The project makes complex genetic research, that can be difficult to grasp and understand, more accessible. It attempts to challenge audiences to think critically about science, the value and implications of genetic research, and the impact this has on our understanding of what it means to be human.

THE PROJECT

We Began as Part of the Body, is an installation developed as part of an ASCUS micro-residency in Professor Sara Brown's skin genetics lab in 2017. The work evolved through observing the day to day activities of the lab, from carefully nurturing skin cultures, to the precise, complex and delicate processes use to analyse these samples.

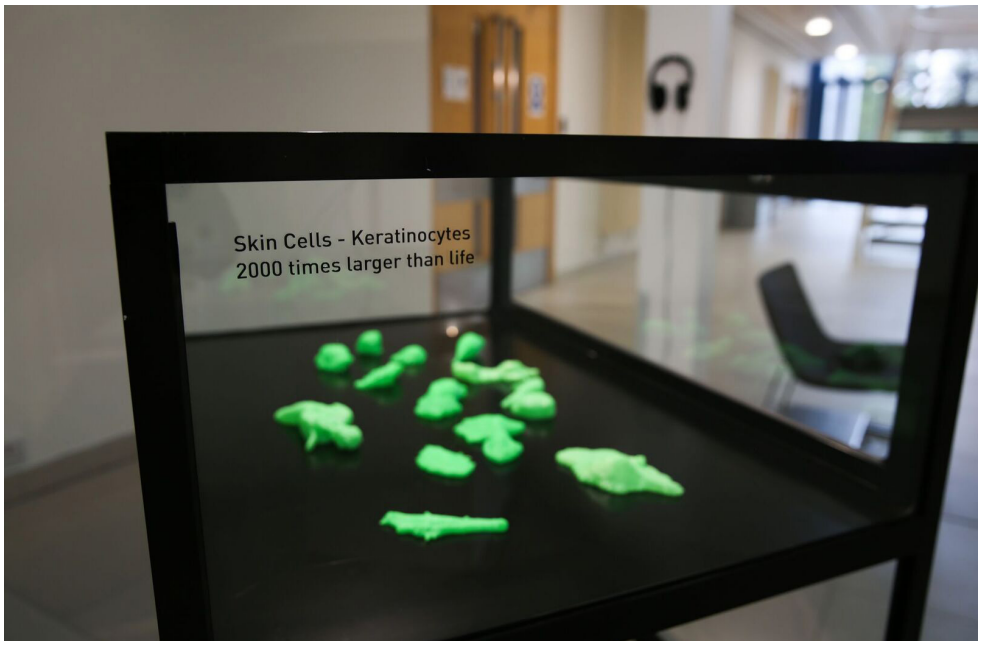


Fig. 1. *We Began as Part of the Body*, 2017. Photography by Erika Stevenson.

The micro-residency resulted in a series of artworks: *We Began as Part of the Body* (a 6minute spoken word sound piece), *Exhume* (a series of 3D printed skin cells) and the *Atopic* images (360 degrees photography). These elements were intended as a research library of materials, the initial stage towards creating an immersive virtual reality experience. The spoken word sound piece, written in response to a series of interviews with staff from the Brown Lab, leads the audience through the artificial skin cell culture's journey during their short, precious, three weeks long 'in-vitro' life, from operating theatre to research lab, and finally to disposal. Artificial skin cells were cultivated and scanned using confocal microscopy to create the series of 3D models, which were 3D printed 2.000 times larger-than-life. Blown up into objects that fit in the hand, the cells were given a tangible, physical manifestation, a madeness. The culture of skin cells is a group, made up of individual cells, different to one another, and going through a process of differentiation, changing. They are active, responsive and precious in their short 3 weeks lifespan, here permanently fixed

within their captive printed form. The 360 degrees photography presents the viewer with an immersive glimpse of the different environments of the lab; a window into a world not normally accessible to the public. Here we are presented with a somewhat ghostly version of the lab environment, without researchers or technicians, inhabited only by specimens; the organotypic, artificial skin.

What is so fascinating about these cells, is that they are real but synthetic, taken from an actual person, but then processed and maintained outside of the body. They are other. Almost indescribably similar and different from the cells that exist within our actual body. Are they better, worse or just different? And what does that difference mean? Does it affect how we understand our own bodies, not just in medical and scientific terms but in terms of what it means to be human?

Fig. 2. We began as part of the body, 2017. Photography by Erika Stevenson.

Acknowledgements:

The author would like to thank Professor Sara Brown and the staff of the Brown Lab, University of Dundee, ASCUS Art & Science, Dr Paul Appleton, the Arts and Ethics Research Group at the University of Edinburgh, Sarah Cook, Mark Kobine, Alasdair Napier, Matthew Jaron, the Tayside Biorepository, and The Wellcome Trust.

6th Conference on Computation, Communication, Aesthetics & X
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Eidolon360 – A VR Experience

Keywords: Eidolon; 360; Virtual Reality; Art; Film; Performance; Technology.

Abstract:

Eidolon360 is a virtual reality artwork and experience that is interacted with through VR headsets. The viewer, reclining on a bed within the exhibition space, experiences a 360 film, shot within a medical simulation centre. The experience presents a simulation of clinical hospital locations, such as operating theatres and hospital wards. The reclining viewer inhabits the point of view of resuscitation manikin Resusci Anne, set within a resuscitation training room. A medic approaches Resusci Anne and tenderly recounts her origin story, an intriguing tale of a mysterious drowned young woman, found in Paris in the late 1880s, who became the face of CPR (cardiopulmonary resuscitation), Resusci Anne. She has since been revived by over 300 million people worldwide. The film attempts to present an emotionally resonant anecdote, as an immersive experience, scrutinising the overlaps between real life and simulation.

1. THE PROJECT

Eidolon360 is a virtual reality artwork and experience that is interacted with through VR headsets. The work is presented as either a VR lounge experience, requiring VR headset only, or as an exhibition installation, where the viewer reclines on a hospital bed within the exhibition space wearing a VR headset, affording a deeper sense of immersion.

Eidolon360 is a 360 degree immersive film, which was filmed within a medical simulation centre, that provides facsimiles of clinical hospital locations, such as operating theatres and hospital wards. The viewer inhabits the point of view of resuscitation manikin Resusci Anne, set within a resuscitation training room. A medic (actress Pauline Goldsmith) approaches Resusci Anne and tenderly recounts her origin story, an intriguing tale of a mysterious drowned young woman, found in Paris in the late 1880's, who became the face of CPR (cardiopulmonary resuscitation). Resusci Anne has since been revived by over 300 million people worldwide. The film attempts to present an emotionally resonant anecdote, as an immersive experience, scrutinising the overlaps between real life and simulation.

Eidolon360 is part of a larger creative research project *Eidolon*, an immersive, participatory performance, developed at the Scottish Centre for Simulation & Clinical Human Factors (SCSCHF) at the Forth Valley Royal Hospital in Larbert, Scotland. SCSCHF is a state-of the-art professional training facility, undertaking simulation based medical education for medical students, nurses and professionals. A range of training manikins, embodied with physical responses, such as pulse, breath, tears, and voice, are accommodated in multi-purpose simulated clinical hospital location. These facsimile locations create an extraordinary psychological fidelity for the trainees, resulting in a profound level of conviction and commitment by participants, to the simulated scenarios they experience. *Eidolon* was developed through collaboration between interdisciplinary partners, and investigates the emotive and psychological potential of training manikins as a core construct for film and performance.

Eidolon echoes, yet at the same time disrupts and transgresses, the everyday activities of the simulation centre. This disruption triggers the appearance of empathetic, emotional, ambiguous, and, at times, uncomfortably human fissures, within the typical clinical simulation scenarios. Eidolon unsettles the ethical boundaries and taboos around the relationship between medical practitioner and patient, or patient manikin, and hints at the possibility of latent physical, psychological and emotional realms within human-like bodies.

Fig. 1. Eidolon, 2017.
Photography by Lindsay Perth.

The *Eidolon360* film transports the viewer from the role of passive observer to the subject of the performance. This transgression is unnerving whilst simultaneously creating an unforgettable experience. The *Eidolon* project attempts to engage the audience with challenging questions about where humanity and consciousness lies within the body, and the effect of technical mediation, upon psychological and physical presence. What constitutes a real, authentic and meaningful experience within a simulated environment?

Acknowledgements:

We thank the actress Pauline Goldsmith, sound designer Giorgos Mikrogiannakis, and all the staff at Scottish Centre for Simulation & Clinical Human Factors for their contributions in the creation of this art work. As well, Beverley Hood gratefully acknowledges the funding from a Wellcome Trust Arts Award, Creative Scotland, The University of Edinburgh and additional support from NHS Forth Valley. Tom Flint gratefully acknowledges support from Edinburgh Napier University.

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Speculative Artificial Intelligence / exp. #1 (audiovisual association)

Keywords: Neural Network; Artificial Intelligence; Audiovisual Installation; Artistic Research.

Abstract:

In the aesthetic experiment the question of the nature of artificial intelligence in neural networks is investigated. They are credited with intelligent behavior because they can generalize learned rules and apply them to unknown data. The artist Birk Schmithüsen describes the reaction to unknown data as predictable unpredictability. In the experiment, the training process of an artificial neural network as well as the predictable unpredictability are audiovisually translated and intuitively experienced. Sounds are used as input data associated with images as output data. A spherical object makes the sound-image associations visible.
The object consists of a seemingly chaotic cluster of thirteen thousand LEDs in which readable patterns of light appear. Each LED is connected to an output neuron of the neural network and represent its state by its brightness. The LEDs are mapped in three-dimensional space. Training data is generated from classifications of sounds to three-dimensional shapes, and the state of the neural network is represented as a readable pattern of light.

1. INTRODUCTION

In the aesthetic experiment *Speculative Artificial Intelligence*, the predictable unpredictability of an artificial neural network is explored and its behavior is made tangible through audiovisual translation. The work uses machine learning strategies as a tool and object of investigation. The behavior of the network is represented sensualistically by a sequence of different configurations of the training process. A set of classifications of sounds to visual motives is given. With this training data, the neural network learns to produce readable visual forms. The potential as a tool for the production of audiovisual works is reflected in the associations of the trained network to unknown sounds. The training process sets the framework for the associations of the network. Similar to the score or the algorithm in performance and generative art, the selection of training data and the design of the training process decide on the resulting aesthetics of the artwork.

2. AUDIOVISUAL NEURAL NETWORK

Neural networks (NNs) consist of a finite number of individual linked algorithms (neurons), but their overall behavior shows significant differences to traditional algorithmic programming. While algorithmic programs produce causal relationships that are explicitly programmed by formal expressions, the behavior of neural networks is characterized by correlative relationships based on implicitly learned rules. This means that no basic principles are defined by explicit, formal descriptions compared to generative aesthetics. Neural networks can learn an aesthetic principle as a whole by a finite number of examples without formulated rules. The aesthetic principle is modeled as a complex web of correlative relationships rather than being described by algorithms.

2.1. Training

The training is the crucial moment in the creation of the system. It determines the type of connection between sound and image and the aesthetics of the visual output. This is done by a set of classified data, consisting of pre-produced sound-image assignments. In several cycles, the network receives sound material as input data. They get processed to image data, which are then compared with the corresponding

reference images of the training data set. The resulting deviation is determined and the neurons of the network adjusted to get closer to the expected result. The more training cycles are passed through, the more accurately the network reproduces the given classifications. The more classifications are given, the more reference points the network involves for the visual association of unknown sounds. Control over the visual outcome and its complexity increases with the number of training data and training cycles.

In the aesthetic experiment, the classified data consists of various sinusoids, as well as percussive sounds and noise associated with white planes at different positions within the volumetric object. The choice of sounds and visual forms is based on the comprehensibility and the possibility of differentiating the various classification.

2.2. Association

An audiovisual NN reacts to unknown sounds with associations in the form of transitions and mixed relationships between learned visual forms. The audiovisual training material may therefore be fragmentary and does not have to be a complete composition. Individual classifications can be made strong, such as linking silence with darkness and other connections that are supposed to reproduce an exact association. Other sounds may be left untrained to allow new visual forms to be produced by the NN. In this capacity lies the potential of machine learning for artistic production — in the controllably unexpected result. In other words, speculative artificial intelligence can be used to purposefully generate unpredictable images. The effect that classical AI research seeks to minimize, namely that an NN makes a "wrong" decision and produces a "mistake," can the artist rethink as a creative potential. The unexpected output comes about when decision-making takes place in untrained areas of the NN. These areas develop their behavior through surrounding trained points. Training therefore makes it possible to set the framework for the neural networks behavior. The compositional style with the use of speculative artificial intelligence has an analogy to John Cage's use of chance. Cage controlled chance as a means of composition through a set framework — the *I Ching*. With the training process the unpredictable predictability of speculative artificial intelligence can be controlled.

3. INSTALLATION OBJECT

The associations of the neural network become visible in a spherical object. The object has an inherent analogy to the structure of the network. It consist of a seemingly chaotic cluster of thirteen thousand LEDs, but can display readable volumetric shapes and structures because of their localization in the three-dimensional graphical space. The neural network is an accumulation of meaningless decision units in their untrained state. Through training the network gets enabled to make complex decisions. The training of the network as well as the spatial mapping of the LEDs represent a process of order of many small entities to one large unit.

Fig. 1.

6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

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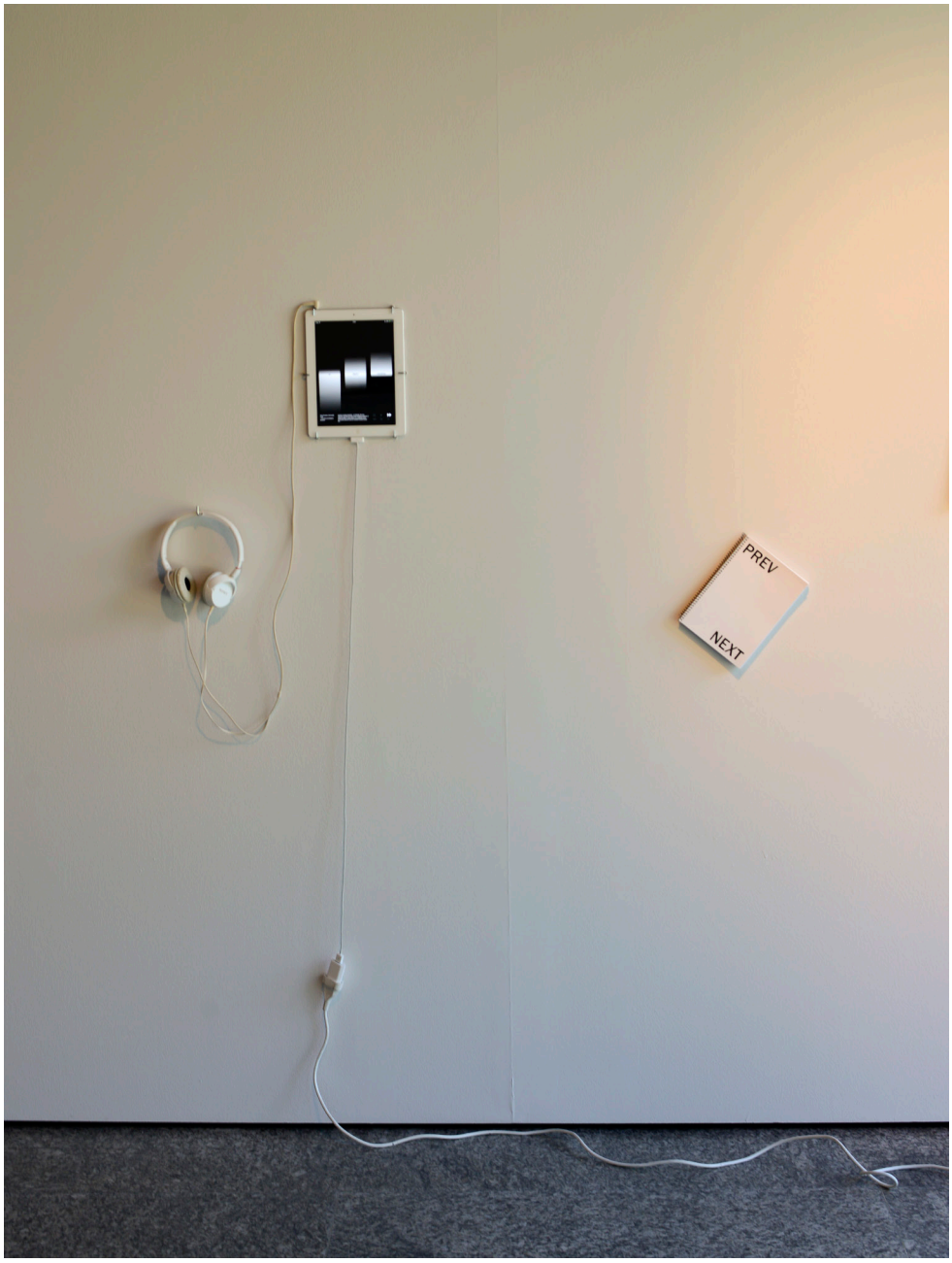
Previous-Next

Keywords: Digital Data; Text; Visualization; Sonification; Transmutability.



Abstract:

The project *Previous-Next* explores the topics found in the xCoAx conference discourse through an audio-visual installation that translates texts into graphics and sounds. It consists of a program that scans through the most relevant words in the papers, while generating graphics and sound modulations from them. The aim is to explore the potential of software to translate digital textual data into new expressive forms, and eventually propose new perceptions and relations from it. The project follows an on-going research, which focuses on the notion of transmutability of digital data, specifically through the exploration of textual material.

1. EXPLORING TEXTUAL DATA

We live in a time where we generate great amounts of digital data everyday. And a big part of "the richest information we have" is available in text formats (Heer 2010, 7), being either "born" digitally (social networks, emails, etc.), or digitized "from printed paper", to which we easily have full access online (Nualart-Vilaplana 2016, 7). At the same time, text analysis techniques are "increasingly mature and well developed" and "due to new easy-to-use software, their use is spreading" within diverse fields (Nualart-Vilaplana 2016, 2).

Therefore, we identify a transformative potential worthy of exploration, which is tied to the manipulation and translation of textual data by computational means. We assume the premise that all information that is "composed of digital code" can be regarded as raw material (Manovich 2001) and "algorithmically sonified or visualized" (Levin 2010). We focus on the nature of text as source data, and the conceptual and aesthetic possibilities of its mapping into new expressive forms. In a previous study we observed that these strategies can be tied to the exploration of the formal specificities of text, to the semantic aspects it conveys, or even to its abstraction, by emphasizing its mutability as digital data (Lee & Ribas 2016).

2. PREVIOUS-NEXT

In line with these ideas, the project *Previous-Next* proposes an illustration of transmutability focused on the expressive potential of the material qualities of text, as well as the abstract nature of its digital encoding. We seek to explore ways of audio-visually translating textual content, in order to provide new perceptions or experiences of it through seeing and hearing. We take as source material the conference proceedings and explore the internal logic of its individual elements, the words. Rather than looking at text as a one-dimensional list of words, this project is an attempt to create an overview of the diverse topics it addresses and create new associations between them.

So, we consider both analytical and expressive concerns. The process implies an intersection between data analysis and its aesthetic exploration through visualization and sonification. On one side, the project seeks to provide a glimpse of what the xCoAx conference is about, by exposing the main topics of its discourse, as well as the relations and convergences between each author's point of view. On the other side, we explore ways of audio-visually translating these contents and propose new expressions abstracted from their referent. This approach seeks to conceptually emphasize the translation process, or the potential of algorithmically transforming any kind of data into a new tangible representation. In this sense, the experiences are oriented towards an aesthetic exploration of the expressive qualities of the visualizations and sonifications.

3. DEVELOPMENT

The source of data for this project is a collection of papers of the xCoAx 2018 conference. Considering that we could apply our approach to other types of text, in this version we focus on academic writing. We begin by searching for the most frequent words in the collection of texts, we sort them them by the number of times they appear in the text, and then extract the sentences that contain these words. We assume that these words reflect the most relevant topics or key-concepts of the conference, and we use them as a basis for the visualizations and sonifications.

The mapping process is inspired by simple textual analysis and audio-visual mapping techniques. It involves a system of correspondences between textual features that are mapped into graphical elements and used to modulate sound parameters. Elements like the number of characters of each word and its recurrence in the whole text are used as parameters to generate graphic features and audio frequencies.

In terms of formal representation, we opted for the use of elementary figures and sounds, seeking to minimize aspects that are accessory to the audio-visual reading of the text, and taking advantage of the automatization of the computational mapping process. The text parameters are corresponded to gradients that vary in height. At the same time, they define frequency and amplitude values.

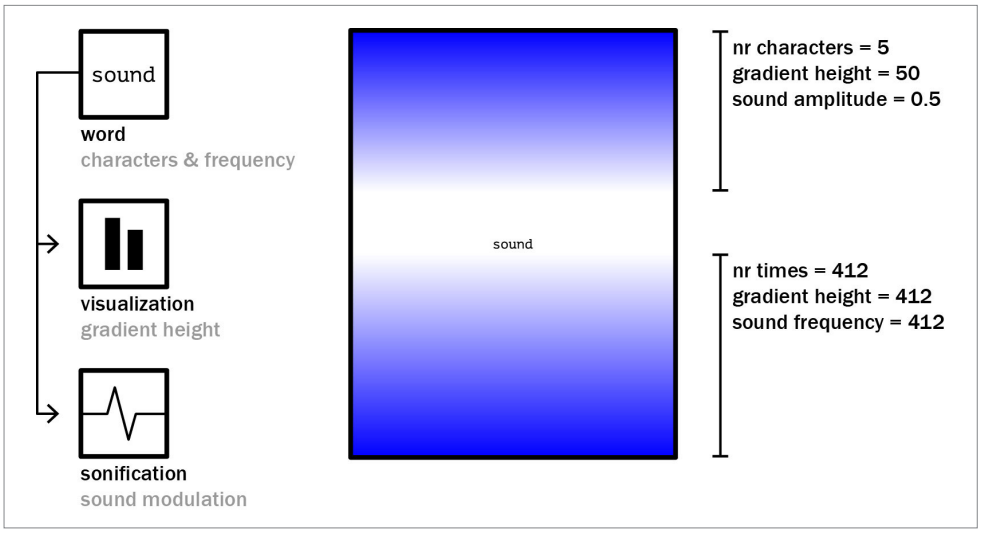


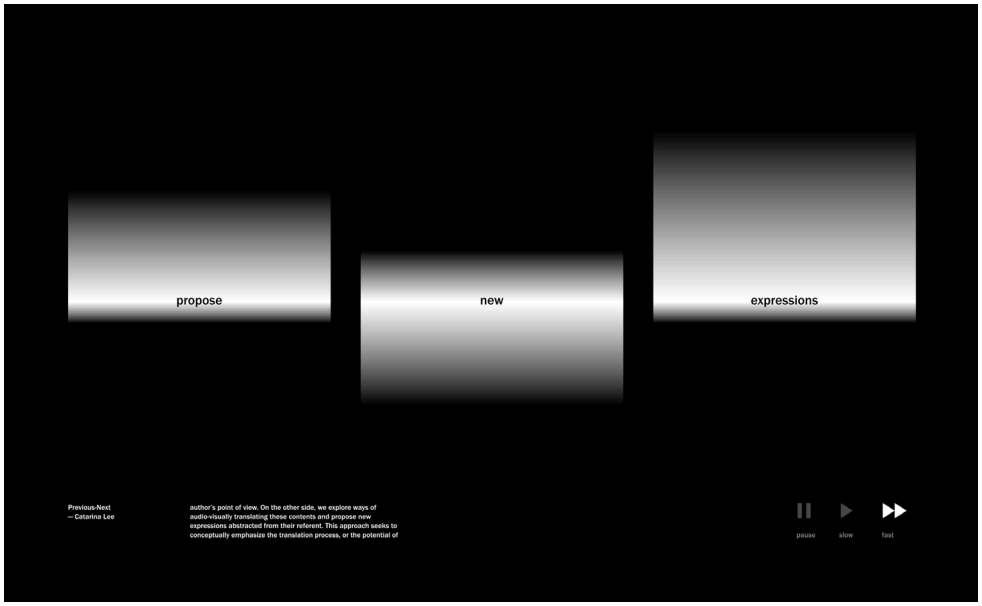
Fig. 1. Mapping process.

As the program is running the resulting images and sounds are displayed sequentially. Each keyword appears between its previous and next word, as well as the full sentence with some metadata (author and title of the paper). While we are going through the words, the resulting sequence presents an audio-visual reading and expression of the texts, and we can get a sense of how these concepts are approached by each author.

4. OUTCOMES

The presented work results from a closed system of correspondences between text, graphic symbols and sound parameters. The result is an audio-visual sequence where the graphics and sounds are combined. They present the words along with the visualizations and sonifications, ultimately becoming an abstract notation of the texts. In this manner, the work aims to promote a contemplative experience on the patterns and rhythms that emerge from the texts. The program scans through all the words sequentially and presents respectively the *previous*, *main* and *next* keyword. The bottom of the screen displays an extract of the source text.

Fig. 2. Screenshot.



In addition, and in spite of the closed non-variable nature of this work, the audience is allowed to control the speed of the screening so they can have a perception of these contents in different ways. When it is slower the audience can read the text within the source and perceive how each author approaches these concepts. On the other hand, when it is faster, visual patterns and rhythms will start to emerge, and it becomes a total abstraction, detached from text semantics and oriented towards an aesthetic exploration of the expressive potential of the visualizations and sonifications.

In this manner, this work seeks to explore the creative and expressive potential of translating text into visual and auditory representations and reveal some of its hidden dimensions. As part of an on-going research, this work can be understood as an open process, where the visualizations and sonifications here described provide a starting point for further developments, namely by exploring different ways of accessing and interacting with textual data.

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6th Conference on Computation, Communication, Aesthetics & X
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Performers – Lucilia Sericata

Keywords: Live video installation; Frame; Flies; Tracking System; Projection; Computer; Software.

Abstract:

Flies in a frame are being tracked with a camera system. A software analyzes the position of each fly and connects the positions with lines. The resulting image is projected beside the frame. If the flies are moving inside the frame, the lines are moving corresponding to the position of the flies. The projected lines sometimes form three-dimensional objects, flat line patterns or flickering chaos, depending of the activity of the flies.

1. PERFORMERS

Performers is painting line patterns resulting from the position of flies in a frame. The flies are moving in a brightly lighted, clean, environment. The software is written by myself and based on OpenFrameworks. The backlight of the frame is built out of special acrylic and led light tubes.[1] Are the patterns random? What would the fly answer? Is there a repeating pattern in the movement over time? *Performers* tries to reflect on relations between individuals. What about your environment? Are there repeating patterns in your relations to others? Could we paint lines there too? How would they look like? Are you moving self-determined?

1. Link to project page: http://www.naphausen.info/project/performers-lucilia-sericata/
Link to video: https://vimeo.com/227140038

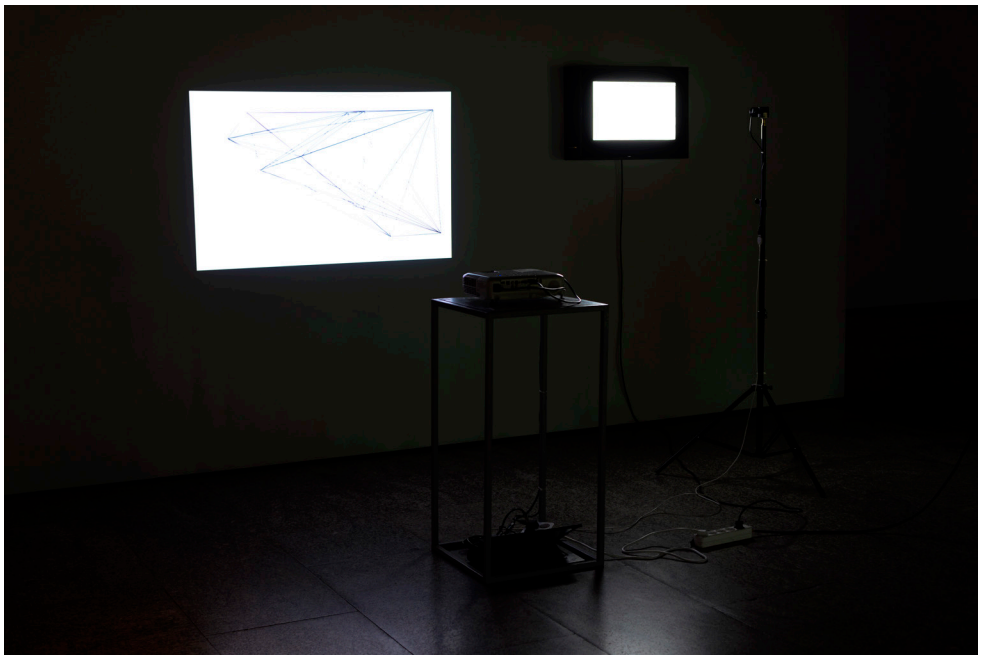

Fig. 1. *Performers* at xCoAx exhibtion, Museo del Traje, Madrid, 2018.

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Prima Materia

Keywords: Algorithmic Art; Generative Animation; Procedural Animation; Shader; Data-driven Art; Internet-based Art; Anthropocene; Electronics.

Abstract:

Prima Materia is a digital artwork that depicts an animated, generative texture that mimics marble-like patterns that change over time following the price fluctuations in real time of columbite and tantalite. These are the two main minerals that can be found in coltan, a material that is key in the production of electronic components that are used on a daily basis worldwide and whose extraction and trade is a source of global yet widely unknown conflicts.

1. ARTIST STATEMENT

My work reflects about technology and how it mediates in the relations we establish with each other and ultimately with ourselves through politics hidden under the technologic progress paradigm. Unmasking the imperfection marks of technology, its inner mechanisms, unveils a philosophy of contingency as a way to accept a post-foundational world, without certainties, where there's not a single solid reality but versions and visions of liquid and complex ones.

2. DESCRIPTION OF THE ARTWORK

The paradigm of scientific and technical progress leads us to an ideal in which our relation with technology is completely transparent, without any kind of friction, as if it wasn't even there in the first place. However, there are no neutral or transparent technologies, they all have their own and defining imperfection marks in which we appreciate their inherent politics.

Technology by itself has the power to define new social contracts that we assume blindly without being aware of the politic and social consequences it carries. This is a phenomenon that we can spot since the industrial revolution and that has been accelerating since then due to the ever growing complexity of new technologies whose inner mechanisms we can no longer fully understand.

The work shows a computer generated marble-like stone texture, an usually noble material in art. However, when watching closely we can see that the texture changes subtly. These changes are determined by the quotation of the components of coltan, columbite and tantalite, key in the manufacture of electronic components and whose extraction and trade is a source of global conflicts.

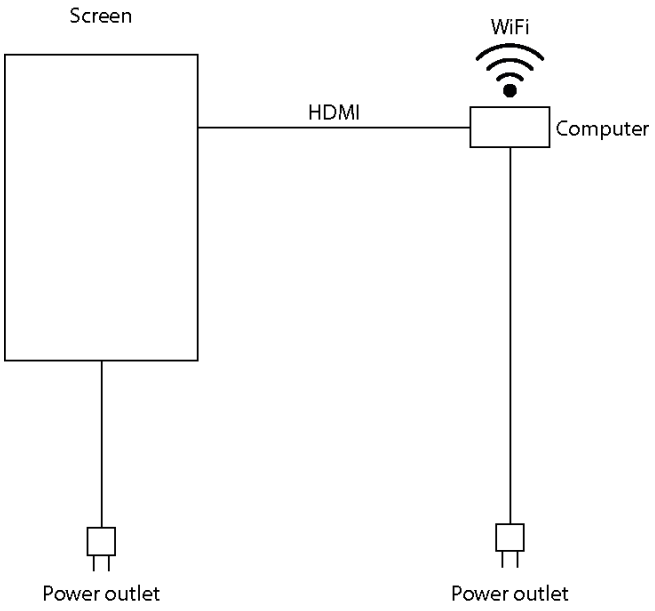

Fig. 1. Installation scheme.

6th Conference on Computation, Communication, Aesthetics & X
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Self-portrait of an Absence

Keywords: Eyeborg; Aesthetics of Disabilities; Sound Art; Performance; Public Space; Shared Intimacy.

Abstract:

Self-portrait of an absence (2016) is a participative performance based on the partial visual impairment of the artist, who has a blind eye. Technically, the artwork consists of an eye-tracking system programmed to generate and process sounds according to data collected from the asynchronous movements of both eyes. The artist offers passers-by in public or semi-public spaces an observing-listening aesthetic experience under an umbrella, where sound-emitting loudspeakers are hung. The artist's initial motivation was curiosity to discover something about the apparently random behaviour of her blind eye. This impetus was reinforced by the coincidence that Vilém Flusser, whose writings have influenced her understanding of electronic and digital media, was also monocular. The performance was created as a methodological tool for her practice-based PhD research on photosensitive matter in media history. It is an experiment that addresses the confrontation between organic and machinic elements (eye and camera) and the possible paths in light-to-sound translations.

PRETEXT

> "This is because the eye, a small white globe that encloses its darkness, traces a limiting circle that only sight can cross. And the darkness within, the somber core of the eye, pours out into the world like a fountain which sees, that is, which lights up the world". (Foucault 1977: 44-5)

I discovered that I am monocular when I was five. My blind eye has been a black box for me, an alien body inside my body. How can one play with an eye that cannot see? I started by imagining ways to play with its inner darkness and finished by envisioning a device to listen to its foreignness. The wish to share this experience and this particular way of perceiving the world emerged as an obligation, an urge to express. The body organizes the world to organize itself.

1. ENCOUNTER

Wearing a special costume that embeds the necessary electronic devices, a sort of strangeness is evoked in public or semi-public spaces among passers-by. I visually and corporeally invite those who demonstrate interest or curiosity to participate in a shared experience, by means of offering them a place under my umbrella. Once the visitor is taken in I trigger the first part of a soundscape to be produced in real-time during the interaction.

Pre-recorded overlapped stereo voices greet the participant and introduce the proposal: "Hi! Welcome into my intimate space. Since I was born I have a blind eye. Do you also have a blind spot in your body? This experience is about sensing and making sense in absence. I know what to see means. The worst blind person is the one who wants to see. Would you like to hear the sounds of my blind eye? Will you follow me?"

If the participant agrees to join, I press the next button to start the first sound mode based on the asynchronous movements of my eyes. It sounds like an electronic percussive instrument. The more asynchronous my eyes are, the more broken the rhythm being played is and the higher the pitch gets. I look softly at the participant trying to establish eye contact, looking for minimal complicity. Interestingly, few people are able to hold eye-contact for longer than a few seconds. I play with my eyes

for one to realize the difference between the eyes' behaviours and to make it clear how their movements and the sounds are related.

I may offer the umbrella to the participants to hold. I may also give them the choice to trigger the next sound mode.

2. PROMENADE

With the umbrella in their hands, the visitor is committed to play. Physically attached to my accessories, the visitor is simultaneously free and responsible for collaboratively suggesting the path of our shared promenade. Curiously, few people feel comfortable determining our destination. I trigger the next sound mode to stimulate the development of the shared observing-listening exercises.

A longer audio cable connecting the equipment on my back to the loudspeakers hanging in the umbrella allows me to leave the protective umbrella and orbit around the visitor. Visual contact is no longer emphasized. They can listen through my eyes. It sounds like the chirps of birds, which are distorted with bitcrushing and downsampling effects, according to the asynchronous movements of the eyes. I observe the surroundings, either following moving objects or drawing the contours of immobile ones. I scan colours and their shades. I play at focusing in on objects and backgrounds. I may get distracted and the eyes just hover. The audible distortion effects reveal the machinic origin of the sound and verisimilitude is broken. Nature and technical culture are merged.

When I feel we have spent enough time in the current sound mode I switch to the next one. Another observing-listening exercise is programmed with harmonic combinations of four musical tones that incite free and dance-like movements. As I continue to orbit, the random combinations of sound provoke minute movements by my body. Distortion from asynchrony is still there, not emphatically distinguished, but incorporated within the sound composition.

3. FAREWELL

I let my body flow until feeling a closing moment in which I can return. I ask for the umbrella back. Looking at the participant's eyes with a thankful smile I press the last button of the sequence: "Thank you very much for sharing this walk with me. I hope you have enjoyed it as much as I did. I wish you a wonderful day!"

Once the playful possibilities of the program have been exhausted, I restart the search for the next interested participant.

4. MAKING OF

Self-portrait of an absence premiered at the *Design Transfer Berlin* in October 2016, on the occasion of the exhibition and symposium *Musical instruments in the 21st Century*, organized by the 3DMIN research group from the *Universität der Künste Berlin*. Programming was essentially developed by and with Edgar Zanella Alvarenga, Radamés Ajna da Silva and Dominik Hildebrand Marques Lopes. Wearable accessories were designed in collaboration with Amélie Hinrichsen, Stefan Schwabe and Caterina Renaux Hering. The performance coach was Lina Gómez.

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6th Conference on Computation, Communication, Aesthetics & X
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Körper

Keywords: Corporeality; Algorithmic Bodies; Co-Presence.

Abstract:

We present two modules from a series of works that explore the relationship between corporeality and the algorithmic. Each module or *Körper* (body) is realised as an environmentally coupled, sensitive installation with the digitally composed modalities being primarily sound and moving image. A module is comprised of heterogeneous internally coupled algorithms that react in a non-direct way to ambient perturbation. *Körper α* uses a number of continuous-signal ultra-sound circuits, *Körper β* uses a video camera image.

1. OVERVIEW

Körper is an evolving series of objects or installations that pursue and materialise algorithmic bodies (German: Körper, singular and plural). The fundamental concept of corporeality lying beneath this work is that of an emergent phenomenon arising from an ongoing exchange between a perceiving and cognising entity, its environment and other entities. A body is not only occupying space, but it continuously reproduces space and presence in negotiation with other bodies. It thus touches upon the problem of individuality and how, as a living and not a dead body, it "presupposes a plurality of other forms in relation to it" (Canguilhem 2008 [1952], 106).

Computational processes, on the other hand, can also be understood to occupy abstract spaces which are interwoven with physiological spaces. What does it mean that a body is living or alive when we attribute corporeality to computational processes? Surely, we do not want to be trapped by the assumption that we could even remotely "model" human or animal bodies, which seems as problematic as equating computational process with disembodied brains or the mind (cf. Dreyfus 1972). Instead, what we call bodies are configurations that partially explore what bodily qualities could possibly emerge from a digital–physical assemblage, with the aim of eventually bringing these partials together and thus "fulfil" in a certain way the requisite plurality of forms.

The bodies we create and experiment with should become entities that not just passively receive and process stimuli, but that actively sound out their surroundings, ringing them out for interventions. These interventions are multi-modal, for example incorporating sound and vision, but also ultra-sound as a tactile medium. The bodies absorb and process impulses passing through their environment and emit sensible variations of responses. Instead of searching for the definite form that satisfies this criterion, the modularity is meant to allow us to implement and "prototype" ideas such that modules can be iterated over time, and iteration may also take place by accepting a "partial" module and moving forward to an additional module. In other words, the idea of the body re-enters the work as a structuring principle, allowing us to "create a body of works", to give us space and presence to experiment.

The modules produced so far can be understood as a sort of organism, i.e. a set of interconnected organs or heterogeneous processes, engaged in a reiterated feedback loop of action and sensing. They are situated in an environment with which they interfere. Moreover, their structure is entangled with our experimentation and thought processes, producing thus two distinct interfaces from which a sort of materiality emanates. The instance we present here consists of two modules which are to be placed in vicinity of each other, allowing them to network (perhaps just through their physical arrangement and not necessarily through a digital link). The texture of the installation's visual and acoustic presence is not meant to be overpowering, and it will only partially and changeably occupy its space. The primacy is to often become visible and audible only in selected and constrained regions of environmental

activity, relying on modes of co-presence and mutual shaping rather than relations of action-reaction. The first module, *Körper α*, has been exhibited before at the event *Thresholds of the Algorithmic*[1] in Bergen, Norway, and thus has a more definite shape, although subject to change and adaptation, whereas the second module, *Körper β*, will be premiered at xCoAx, consequently having a more vague description.

Fig. 1. *Körper α*, as shown at Lydgalleriet Bergen.

2. *KÖRPER α*

The first module realises an installation with multi-channel sensors and sound, and mono channel video in a suspended metal structure (see Figure 1). It explores an extension into space and the materialities of corroded metal, white unvarnished porcelain and red wires. It employs a tactile layer by creating multi-directional ultra-sound feedback circuits which become perturbed by the presence and motion of visitors around the object.

Its internal computational structure is made up of three "organs": The first sends out a signal to the ultra-sound actuators and picks up the reflections through corresponding sensors, then analyses the evolving spectra for changing energy above calibrated background levels, as well as Doppler shifts produced by the relative motions of visitors. It integrates the channels, using projections onto five Voronoi areas that cover the surface of a sphere (internal memory).[2] This signal is stochastically sampled by the second organ which produces a visual signal on a video screen installed at the base of the cage, using a wandering projection of the sphere which is emphasised by an optical lens. As movements towards the structure produce positive Doppler shifts, the energies of the channels move spatially towards one another on this sphere, whereas movements away from the structure produce withdrawals to the centres of the Voronoi, something that becomes relevant as the first organ continues to process the "raw" input signal, building an ever-changing topological reflection of the environment, as the signal is transcribed into a multi-graph through the use of a so-called Neural Gas process (Fritzke 1995). This unsupervised learning algorithm continuously adapts to its stochastic input signal, trying to form edges across denser areas of energies, and possibly uniting some of the input channels as sub-graphs (see Figure 2).

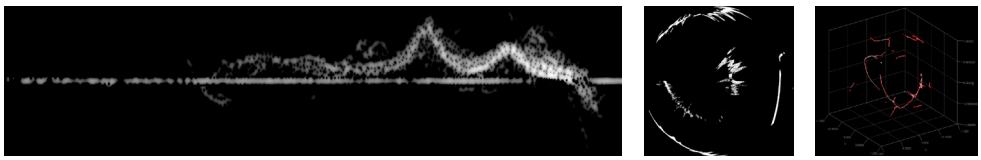

Fig. 2. Spectrogram of single reflected ultra-sound signal, Voronoi projection of five signals, and Neural Gas tracing.

A communication protocol is used to allow the reflection of this multi-graph in the third organ, a dynamical system consisting of a set of coupled and interacting oscillators. While the overall structure of this system remains constant, aspects of the graph produced by the Neural Gas process, such as the number of nodes, their positions and interconnections (edges), sediment steadily into the system transposed into each oscillator's frequency and their matrix of mutual couplings. The organ performs numerical integration of the system at audio rate and projects an audification of the state changes of the compound of oscillators back into the environment through the five loudspeakers enclosed in the installation's metal hull.

1. https://www.researchcatalogue.net/view/452048/452049 (accessed 26-Jun-2018)

2. These areas were found using John Burkardt's implementation of centroidal Voronoi tessellation (CVT) on the unit sphere, see http://people.sc.fsu.edu/~jburkardt/m_src/sphere_cvt/sphere_cvt.html (accessed 26-Jun-2018).

2.1. Observations

The dimensions of the object are in the magnitude of a child or a smaller mammal, and its placement, lifted to ear and eye level, invites a close engagement of listening and seeing. The animation of the sound — sometimes alluding to fluids, at other times resembling the rhythmic synchronisation of insects, and seldom breaking out of its stable trajectory — indeed produces the element of aliveness, which is only possible through the merging with the other modalities into one "thing". There is intimacy and indifference likewise, for example, we would not walk so close up to the body of a stranger. We can see through the body; we must see through the body to reach the video image, and we must move our head to find a perspective in the image. Unlike a voice that is unison and emitted from a single track, the physical body is overlaid by a sonic body with its own extension, giving us a changing perspective in the sound as we orientate our ears.

There is a relative independence of the organs, and consequently a relative independence of the audio-visual production from the movement of the visitor, without eliminating the sense of exerting an influence on the object's responses. It is not possible to think of the object as mechanically decomposed into its constituents, instead we can think, as Katerina Kolozova invites us to, of a "coexistence of unity and nonunity", a coexistence "beyond relation" (Kolozova 2014, 25, 30) to one another, being simply co-constitutive for the perseverance of the body (to be sure, a *moment* of a body).

Fig. 3. *Körper β*, detail of xCoAx exhibition (left), and elements in development (right).

3. *KÖRPER β*

The second module realises an installation with video sensors, encapsulated small-scale real-time generated binocular video image, and three channel sound source reproduced by ceramics (see Figure 3). It explores a hybrid anthropomorphic and "instrumental" body with elements of eversion, and possibilities of dis- and re-embodiment.

Körper β will again be subdivided into three connected components or "organs". A first sensing organ collects successive images captured by a video camera and, by differentiation, emphasises changes in the environment, trajectories and movements. *Körper β* embodies an algorithm of so-called *attractor reconstruction* that generates and parametrises a dynamical system approximating the spatial movements contained in the captured image sequences. The reconstructing system re-performs those trajectories in an attempt of iterative "remembering," producing internal movement patterns whose traces are displayed by a video screen encased inside a wooden dummy head and visible through its eye apertures.

Dimensionality of the reconstructed dynamical system as well its changing structure is passed to the third element in this module's system, the sound organ. It explores the limits of spatial differentiation at the distance between the listener's position and porcelain speakers that are installed near the floor. Using occasional "colour cancellation" with respect to the plates' impulse responses, physical and sonic bodies alternately converge and diverge. The sonic material will be a response and contrast to the nearby placed *Körper α*.

Acknowledgements:

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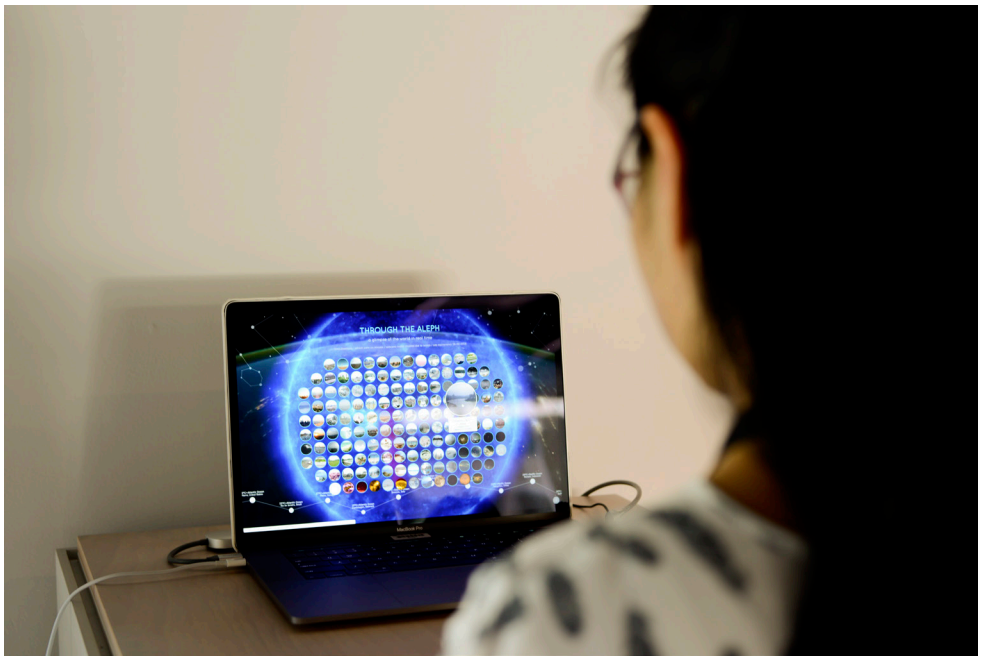
Through the Aleph:
A Glimpse of the World in Real Time

Keywords: Net Art; Surveillance; Real Time Data; Environment; Literature.



Abstract:

Through the Aleph: A Glimpse of the World in Real Time is a net art project offering an unprecedented visual and interactive experience where many places on Earth and in space can be seen simultaneously in an instant. Built in an open source environment with live data, this project visualizes the diversity of human civilizations (microcosm) and the unity of humanity without borders in the ever-changing universe (macrocosm). With an unexpected approach to surveillance cameras and global networks it draws the connections between individuals and the global environment, Earth and outer space, eternity and time, and art and science. In a virtual world, this meditative web project merges multiple layers of dynamic imagery related to culture, cosmology, and technology in a globalized society into an abstract landscape. It not only embraces the dream of peace on Earth but also explores the bond between humankind and nature through time and space in the present moment.

1. PROJECT STATEMENT

What is an Aleph? In his short story *The Aleph* (1945), Argentine author Jorge Luis Borges described that an Aleph is one of the points in space that contains all other points — the single gigantic instant where millions of acts in the unimaginable universe can be seen simultaneously from every point and angle.

Although a real Aleph might never be found, following Borges's vision *Through the Aleph* is a net art project offering an unprecedented visual and interactive experience where many points on Earth and in space can be seen simultaneously in an instant. It contains 142 live surveillance webcams selected from seven continents with multiple cultures, real-time water temperatures of four oceans — Arctic, Atlantic, Indian, and Pacific Oceans — which play a crucial role in shaping the global climate change, twelve constellation maps alternating dynamically every month, a thin rotating line in the background representing the passage of time — as the line moves like a second hand as it sweeps around the face of a clock, the latest NASA solar image updated every twelve hours, NASA International Space Station videos of Earth, and satellite time-lapse imagery of the solar system planets. The video component of this project consists of twelve-day time-lapse screenshots of the net art in twelve months — one day per month — from September 2016 to August 2017. It captures not only the shift of day and night, but also the change of seasons — the infinite and transitory nature of life on Earth.

Meanwhile, recent creative and research works by artists, such as Kurt Caviezel, Nye Thompson, and Pierre Derks, on live surveillance cameras and global networks (and how these emerging technologies affect people's privacy) have caught the artist's attention. Inspired by the life changing power of seeing Earth from space, *Through the Aleph* visualizes a pair of opposites through the global reach of technology — the diversity of human civilizations (microcosm) and the unity of humanity without borders in the ever-changing universe (macrocosm). It serves no practical and material end, but an end in itself. It offers no purpose other than the joy of contemplation, the need of human consciousness, and the curiosity of exploration. Although in recent times some creative and research works have used IP camera live streams and their linkage to the social environment also with the political scope to highlight the implications of this technological Panopticon, the artwork here presented utilizes surveillance cameras and global networks from a grand viewpoint to observe people, environment, and space within a philosophical and literary framework. Using live data to portray the Earth's pulse and human existence, this meditative web project creates

an abstract landscape in an open source environment, reveals an emerging totality visible to the human eye through distant points of perceptions, and gathers all realities into the glimpse of the Aleph, where we could experience humanity as one in the unimaginable space — therefore, the unity in infinity.

2. MAKING OF THE PROJECT

Through the Aleph unites two entities — a net art and a time-lapse video. The net art was built with HTML, CSS, jQuery, JavaScript, and Processing, while the time-lapse video with Adobe After Effects. The webpage refreshes every six minutes automatically.

Edward Tufte, a pioneer in information design and data visualization, stated that among the most powerful devices for reducing noise and enriching the content of displays is the technique of layering and separation, visually stratifying various aspects of the data (Tufte 1990, p. 53). Retrieving and collecting real-time data from multiple online sources, *Through the Aleph* interlaces live materials into three layers based on the "freshness" of the visual elements — the bottom layer holds static and dynamic graphics from the recent past; the middle layer displays near real-time data; the top layer generates real-time content.

In her well-known article *Grids*, art theorist and critic Rosalind Krauss pointed out that logically speaking, the grid extends, in all directions, to infinity... by virtue of the grid, the given work of art is presented as a mere fragment, a tiny piece arbitrarily cropped from an infinitely larger fabric (Krauss 1979, p. 60). In *The Aleph*, Borges' literary conception of infinity poses a representational challenge as the artwork *Through the Aleph* is limited by a finite range of visual elements via webcam feeds and data visualizations etc. Hence, the artist created a grid mapping system to be the primary focus of this project, where Borges' boundless imagination could be reflected and presented using limited graphics and data. (Figure 1)

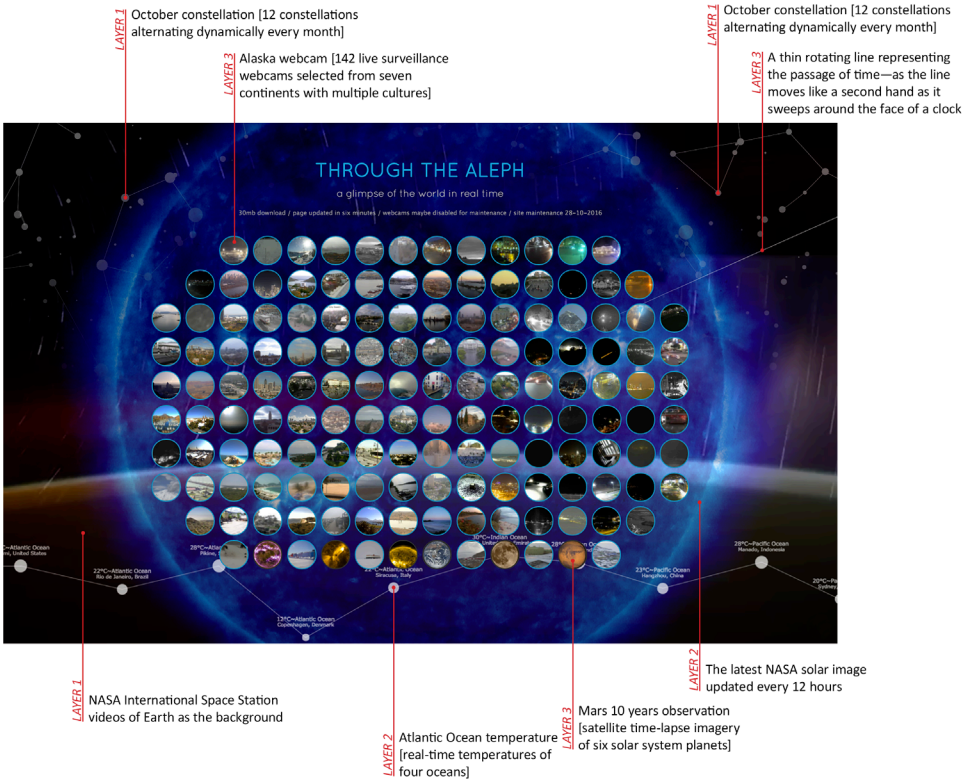


Fig. 1. The diagram of *Through the Aleph*.
© Jing Zhou. (https://vimeo.com/189509112)

Through the Aleph can be presented on monitors and projection screens. (Figure 2) The background sound of the installation is white noise, which can be silenced during an exhibition, if necessary.

Fig. 2. The installation of *Through the Aleph*. © Jing Zhou.

3. CONCLUSION

The net art project presented in this paper connects the potential of digital technologies with literature, culture, and scientific studies, in order to create aesthetic and meaningful experiences for the viewers of various backgrounds. *Through the Aleph: A Glimpse of the World in Real Time* visualizes Borges' Aleph in the networked age and touches the core components that matter today: building an environment for consideration of data in cultural and temporal realms, presenting a visual framework in a literary context, and packing universal visual components and conceptual thinking into a limited presentation space. Furthermore, it translates the dynamic virtual landscape through new approaches to enhance human cognitions and perceptions of the universe and humanity of our time.

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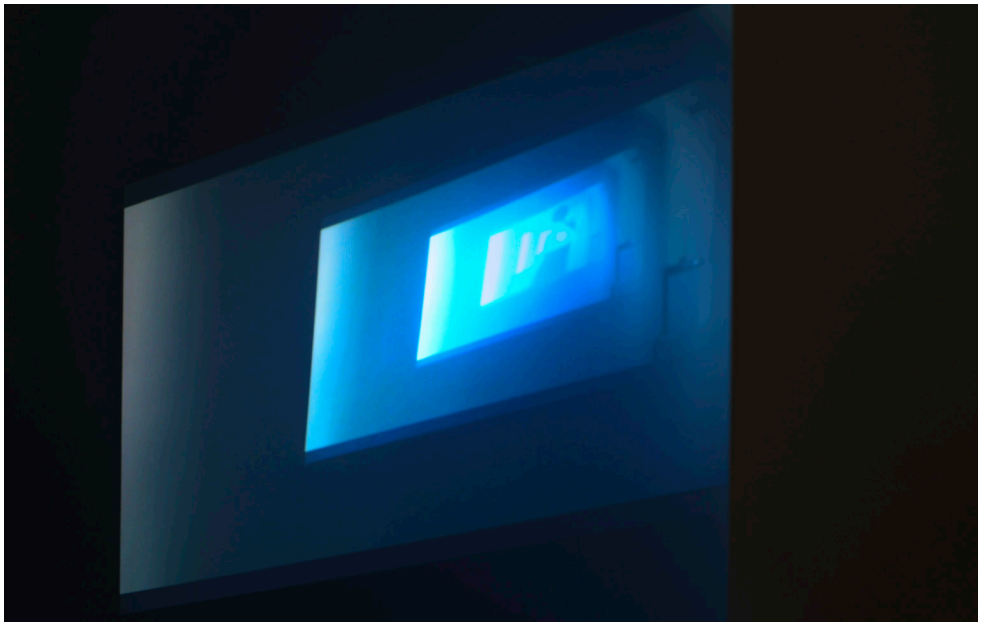
Streams from the Past

Keywords: Interactive Installation; Live Streaming; Video Art; Public Interactives.



Abstract:

Social Media video-centric platforms, such as Snapchat, YouTube Live, Twitch and Instagram Stories afford anyone to live stream their daily life. The possibility to gaze into this multitude of presents encourages a belief that all that is seen is "real", that is, spontaneous and natural. Live stream is seen as an open window into the streamer's private life, a gaze into a reality of non-pre-planned actions. *Streams from the Past* is an interactive installation that questions such concepts by offering a space for contemplation of one's performance in the world, showing multiple layers of one's recent past. The installation uses the same technologies that could be used for live streaming to create an immersive environment that subvert the idea of a live stream, encouraging one to face their own performances within different layers of past.

1. INTRODUCTION

Streams from the Past is an interactive installation that makes a commentary on the mainstream "media literacies" of immediacy and livestreaming, by allowing for contemplation and questioning the meaning of what is "real-time.". This project is an important part of our research, as members of the Public Interactives Research Team (lead by Dr. Anne Balsamo and Dale MacDonald at the School of Arts, Technology and Emerging Communication at the University of Texas at Dallas), we investigate interactive media in public spaces and its social, political and cultural impacts. As artists, we use the Public Interactives framework to create pieces of art and observe them in different contexts that allow collective interaction. Our work as researchers feed our artist practice, which in turn gives us more material for research.

The appeal of what we are considering as amateur, or personal, livestreams comes partially from the perception that what is shown is spontaneous, therefore authentic within the routine of the persona been streamed. *Streams from the Past* defies this idea: although these streamers may not be as produced and professional as corporate media products, they are performing for the camera. The installation consists of two sets of computer, projector and camera and each set is positioned in a manner to create an "infinite mirror" effect. Each camera is set on a different time delay, so visitors are able to face their multiple pasts from different angles and times.

2. ARTISTS STATEMENT

Streams from the Past takes a critical look at the relationships between performance and mediation, in the context of modern norms of cultural practice with digital technologies. "Live" and "Real-Time" digitally mediated performances are not, technically speaking, simultaneous to their physical performance — for that matter neither should a mirror be considered a literal reflection of the present. However, the human senses perceive those experiences as simultaneous: especially as we don't necessarily see the "physical" performance happening, there is no possible way of making sure the digitally-mediated one is even close to actual "real-time". *Streams from the Past* brings not only the physical performance "face-to-face" with the digitally mediated one, but it adds layers to the former, encouraging users to question their perception of present and past, immediacy and simultaneity. In many ways, *Streams from the Past* is in dialogue with Dan Graham's *Present Continuous Past* (1974) as both pieces allow the observer to gaze upon their performance by playing with the temporality of mediation, using delay and mirrored images. While Graham's piece was created

using analog technologies, including real mirrors, *Streams from the Past* utilize a set of cameras and projections to achieve a similar mirrored perspective. The code runs on Processing, adding different delays for each camera, and are often changed for different iterations. In *Streams from the Past*, visitors face themselves, while in *Present Continuous Past* one can explore their image on 360 degrees.

Live streaming media is commonly perceived as been more authentic — because it is broadcast as it happens, as an intimate backstage performance. This is just an impression: such performances are still planned and calculated, especially in platforms like Snapchat and Twitch, in which users want to be seen, "liked" by others and act accordingly to their personal "brands". This project provokes visitors to revisit these issues by creating spaces to reflect on one's own performance, in which they are in contact with their layered pasts through digital technology.

In previous displays of the piece, we observed that often visitors will take some time either observing the piece (and others playing with it) or indirectly interacting with it from a distance. Often, after getting more comfortable and exploring the images for a bit, visitors will develop a very playful relationship to the piece, experimenting with the delays, taking pictures and trying funny face, weird body positions and so forth. Although the approach varies accordingly to where and to whom the piece is displayed — we had observed from children interacting non-stop to other media artists carefully approaching and slowing experimenting — the underling experience is based on experimentation and playfulness.

We believe that the popularity of live streaming and real-time digital media disregards contemplation and the poetics of memory over ephemeral and as-it-is-happening streams. *Streams from the Past* uses exactly such ephemeral and livestreaming technologies to create an interaction that encourages reflection on memory, retention and understandings of time.

The project was created in 2016 as a provocative response to a prompt to create a project in which the use live-streaming was mandatory. The first iteration of the piece was presented at the Dallas Museum of Art during a Dadaist night event. Other iterations of the piece were displayed in diverse occasions, including a group exhibition entitled "The Neighbors Weeds" (2017) at Central Trak Art Gallery in Downtown Dallas (Dallas, Texas, USA) and at HASTAC 2017, in Orlando, Florida, U.S.A..

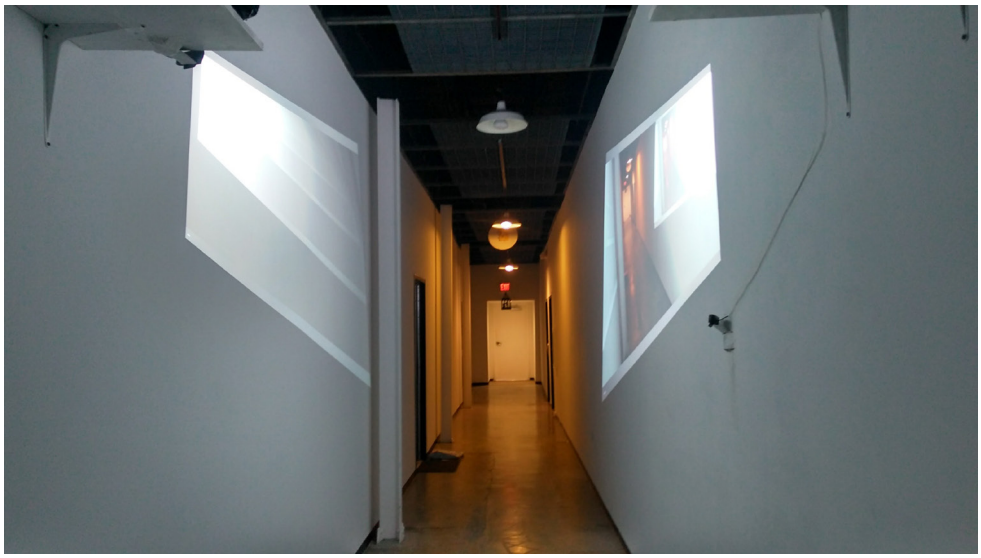
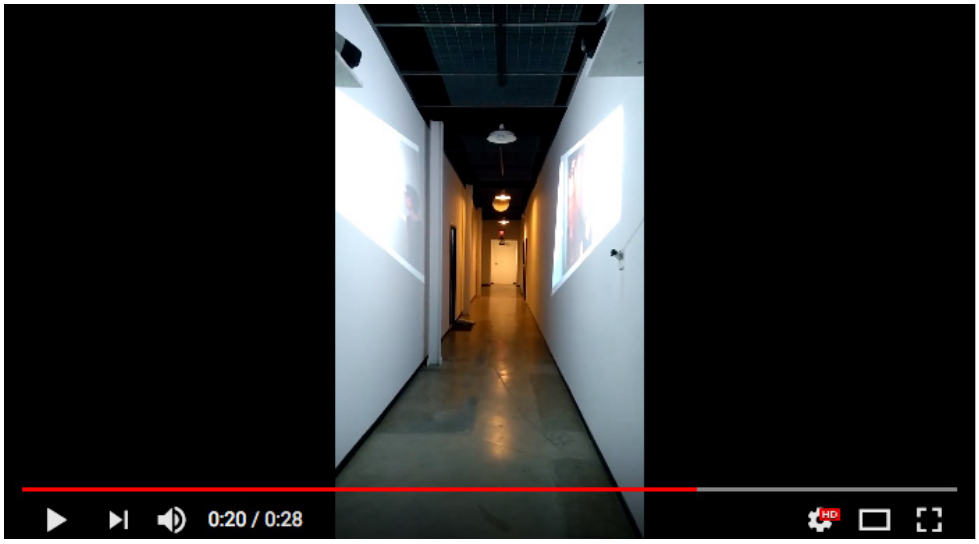


Fig. 1. View of piece installed at Central Trak, Dallas, TX, May 2017. (Photo by author).

Fig. 2. View of piece installed at Central Trak, Dallas, TX, May 2017. (Photo by author).

Fig. 3. Visitors interact with the piece at Central Trak, Dallas, TX, May 2017. (Photo by author).

Fig. 4. Video of the piece, available at: https://youtu.be/wC3q5f6S7yc



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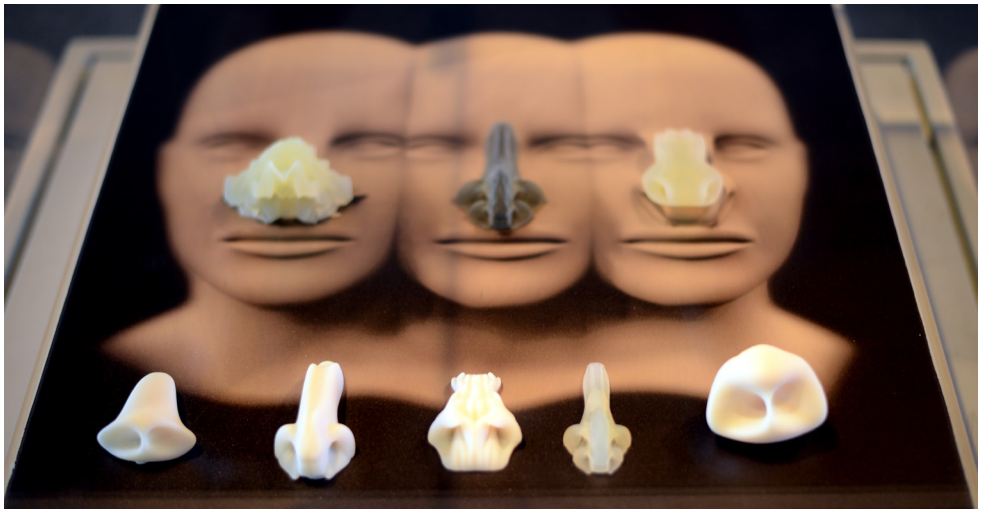
Who nose?
How our noses could change if we lived on Mars. Transhumanist speculations

Keywords: Speculative; 3D Printing; Transhuman; Design; Experiment; Plastic Surgery; Mars; Biomimetics; Cosmonautics.



Abstract:

This is a speculative project regarding anthropology, plastic surgery and biomimetics using 3D print technology as well as state of the art cosmonautics. It is a visual interpretation of research regarding the impact of climate conditions on the shape of noses, conditions occurring on Mars and threats for our health relating the fact of reaching the Red Planet and staying in difficult environments, based on the 3D print technology.

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Vanishing

Keywords: Digital Crafts; Re-materialisation; Data Loss; 3D Printing; 3D Scanning; Jewellery; Pearls.

Abstract:

For project VANISHING I developed a design method, which is based on two key assumptions. The first one provides that every object reflects the interests of a culture. The second one identifies contemporary culture as a phenomenon overburdened with visual content, and makes this content a medium for further work. Any digitally mediated design loses its function and gains aesthetical value with each iteration of re-making (repetitive process of 3D printing and 3D scanning a printed object) and the inadequacies that take place in this process become a main determinant of stylistics. I design two collections of jewellery objects — one is based on low resolution public domain images of pearl jewellery found on the internet and 3D printed in the material that consists of authentic pearls. The second collection is printed in powdered polyamide to show the nuances of deformations that appear in a repetitive process of re-materialisation of a classic ring.

1. INTRODUCTION

1.1. Assumptions

The superior hypothesis formulated at work is the question of the role of the designer — who is involved in a conflict between the traditional understanding of the question of ownership on the one hand, and his / her existence in the network environment, which allows virtually unlimited access to content, on the other hand. Taking into account both the economic and social nature of design, I have been exploring the issue of the tangibility of things. I have been trying to systematise their shifts between the categories of "ordinary" and "non-ordinary". I treat my conclusions as a starting point for the development of my own design method, which is based on two key assumptions. The first one provides that every object reflects the interests of a culture. The second one identifies contemporary culture as a phenomenon overburdened with visual content, and makes this content a medium for further work. Any digitally mediated design looses its function and gains its aesthetical value with each iteration of re-making (repetitive process of 3D printing and 3D scanning a printed object) and the inadequacies that take place in this process become a main determinant of stylistics.

2. RE-MATERIALISATION

2.1. Material development

The design process starts with the development of unique material subsequently used for 3D printing and is completed with the practical application of the method — the creation of a collection of jewellery from pearls printed in 3D technology. The material is based on pearls of low value for the jewellery industry. This refers to key design ideas: the categories of novelty, authenticity, and standard, and contends with classical jewellery-making standards.

2.2. Novelty

The first collection expresses the spirit of the changing aesthetics of digital novelties; in other words, it is a reflection of the incessantly improved tools for computer-assisted design. The items reveal the manner in which they were built. This can

be seen at the level of the structure of the spheres, which are created with the help of the functions of the program, and can be identified as such. The series includes three pendants designed in such a way that they do not need any further setting. They break away from the classical jewellery-industry treatment of pearls as a semi-finished product for the manufacture of jewellery.

2.3. Standard

The images of pearls obtained from low-resolution images found on the web — I used the Creative Commons source — have been upgraded to become three-dimensional with the help of digital tools. I limited the resulting planes with the projection of the shape of an ideally symmetrical tear — a popular concept of the real shape of a pearl. The digital environment allowed me to create the second earring of the Girl with a Pearl Earring — a mirror reflection of the first one. It would be difficult to even dream of such a match in the real world of pearls. The resulting objects became fully functional owing to the addition, in line with the jewellers' tradition, of silver pendants and hooks, the form of which reinforces the curvature of the pearls.

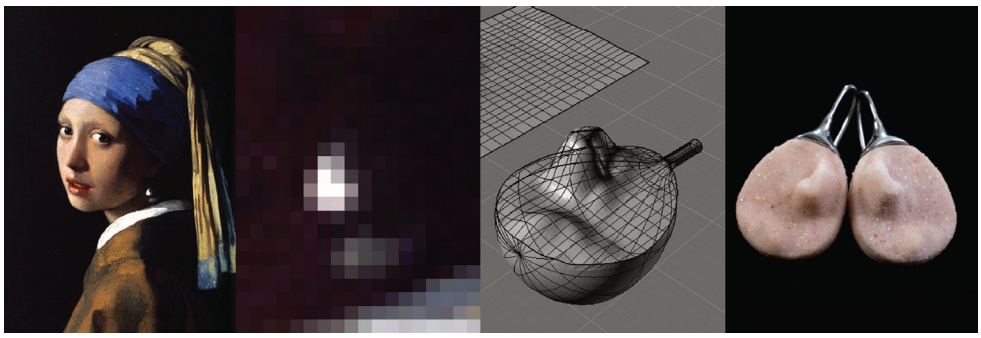

Fig. 1. Process of designing objects from the series *Standard*. Low resolution image of earring from Vermeer's painting is transformed into 3D object and finally printed in pearl powder.

2.4. Authenticity

The cultured pearls industry considers the criteria of selection and symmetry as paramount. The rounder the pearl, the more it is in demand, which makes baroque pearls with unique shapes only a by-product. What counts in the case of an archetype such as a pearl necklace is also the question of the matching of the pearls and the gradation of their size. Taking the authenticity of baroque pearls as the starting point, I made their 3D scans, and subsequently made a necklace from the obtained files, which shifts the question of the matching of pearls towards perfection — allowing ideal symmetry, showing digital manipulations reflecting the process of the formation of a baroque pearl in a mussel shell.

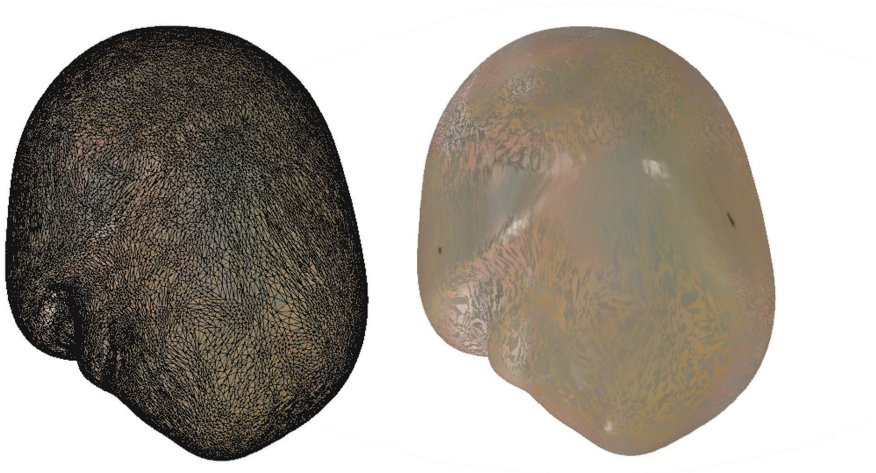

Fig. 2. 3D scans of natural baroque pearls that are used to build the hyper-symmetrical pearl necklace.

2.5. Convention

The items created by the proposed method have been photographed as classical portraits. However, I micro-intervened in the convention and created a sequence of images showing a delicate movement of the models. This presentation refers to the Internet practice of using moving images such as GIF in advertising and entertainment. The images will be presented in digital picture frames.

Fig. 3. A sequence of images that constructs one of the GIF portraits.

3. SUMMARY

3.1. Data loss as a source of a new aesthetics

Last series of objects visualizes the loss of information that takes place while converting a digital model of jewel into a 3D print, then digitalizing it again by 3D scanning and repeating this sequence. Each iteration leads us to the conclusion that the bigger data loss is, the more aesthetics dominates the function.

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6th Conference on Computation, Communication, Aesthetics & X
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Fools Paradise: Intermedia in VR

Keywords: Virtual Reality; Intermedia; Music; Poetry.

Abstract:

Fool's Paradise is a virtual world based on the "Proverbs of Hell" of English poet and artist William Blake. Intermedia data structures inform its visual and musical composition, developed in collaboration between artist Paul Hertz and composer Stephen Dembski. Visually, *Fools Paradise* riffs on the landscape and architecture of an English Romantic garden and the changing aesthetics of VR from the CAVE to current game engines and VR goggles. Perched on a highland in the form of an immense open book with a stream of language/water running down its center, the virtual world offers forty-eight interactive pavilions linked by a network of paths. Each pavilion interprets a proverb as a song composed by Stephen Dembski for soprano, flute, cello, and spoken voice, as a mask (by Mark Klink), and as calligraphy (by Koy Suntichotinun). Blake's proverbs offer a critique of intolerance and a plea for intellectual freedom that still resonates today. *Fools Paradise* pays homage to Blake as an intermedia artist *avant la lettre*, an artist who melded poetry with image in his handmade books.

1. CONCEPT AND DEVELOPMENT

An earlier version of *Fools Paradise* was created as a "VR Performance" for a passive audience in 2004, using the CAVE software and Max/MSP. A dancer performed the navigation of the virtual world, improvising her pathway, triggering cues for live musical performance as she moved and explored. The new version of *Fools Paradise,* created in the Unity game engine, operates as an immersive 3D intermedia experience with elements of game play. It can be explored using VR goggles and navigation devices or on a computer monitor, using the mouse and arrow keys for navigation.

Visually, *Fools Paradise* riffs on the landscape and architecture of an English Romantic garden and the changing aesthetics of VR from the CAVE to current game engines and VR goggles. The garden is perched on a stratified rocky highland in the form of an immense open book with a stream of water and words flowing in the crease between its two sheaves of pages. The book rests on a tongue-shaped island in a sea of water and stars. Forty-eight interactive pavilions linked by a network of paths spread across the garden landscape. In each pavilion masks, calligraphy, and music interpret proverbs from William Blake's "Proverbs of Hell," from his illuminated book *The Marriage of Heaven and Hell* (Blake 1790, Erdman 1988). The music consists of short

Fig. 1. General view of the garden, pavilions and masks.

songs for soprano, flute, cello, and spoken voice. Some of the terrain geometry was carried over from the 2004 version. The VR architecture and masks are entirely new for the 2018 version. The pavilions, paths, masks and garden terrain — the "artificial world" — imitate early VR with low polygon count and reliance on texture mapping. The sky, plants and terrain beyond the highland appear as the "natural world" but in effect belong to current "realistic" physically based rendering VR technologies. The 2004 performance offered a similar contrast, between "natural" live acoustic music and an "artificial" world explored by a dancer. Both stagings of Blake's "Proverbs of Hell" look to the poet's concern with the collision of nature and human industry, evident in his texts and his printing method "that incorporates aspects of the apparently incompatible alternatives of machine-made print and handmade manuscript." (Hammond 2016, 59) The songs and voices in the new version, from studio recordings created after the original performance, are triggered and remixed by the participant's movement.

The software is due to be published in June 2018 by the Digital Museum of Digital Art (http://dimoda.org). After its initial release, it will be available for free download under a Creative Commons or similar license.

2. COMPOSITION AND FORMAL STRUCTURE

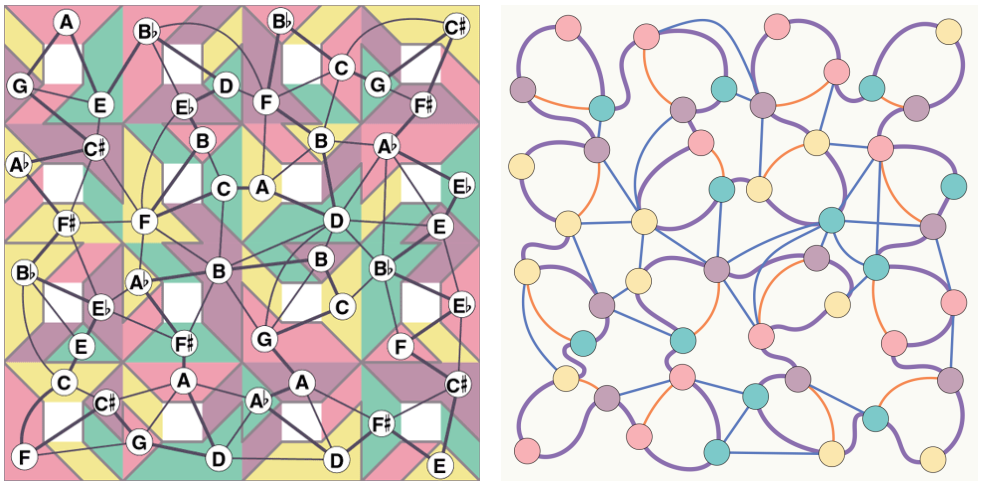


Fig. 2. Spatial and musical structures and virtual world garden map for Fools Paradise.

As a composition, *Fools Paradise* is grounded in abstract notational structures that help to determine its visual architecture, musical material, and event-flow. In other words, it is an intermedia artwork, where events in one sensory modality may be mapped onto events in another modality. At the same time, different media are left free to display their own unique qualities, without strict mapping. The degree of mapping at any given point is part of the compositional process. This approach to composition is peculiarly apt for digital technology. Thanks to digital technology, compositional structures can operate at all levels of granularity and with a degree of abstraction that places all media on the same plane and events can attain an unprecedented degree of precision and synchronicity.

Fools Paradise was developed and directed by a visual artist, Paul Hertz, working in collaboration with a composer, Stephen Dembski. The artist had developed a body of theory for intermedia composition, including "parametric spaces" for generating music and performance (Hertz 1999), which proved to have useful analogues to the composer's theories of extended tonality (Dembski 2006). For their collaboration, the artist and the composer developed a database of abstract notational structures that functioned as a tool for making decisions about material in the virtual world and in the musical composition. Thus, the diagram above plots the relative positions of event nodes in the virtual world and it also represents the available tonal material at each node. Colors and other structures not shown in the diagram code other possible

parameters. The composer adhered strictly to the use of tonal material and played freely with its sequencing and duration for each song. The visual artist distributed nodes (pavilions) in space within a strict metric but played more freely with assigning parameters to determine colors and textures used at the nodes. The structures underlying *Fools Paradise* are not intended to impress the player or viewer: rather, they are the scaffolding that supports discourse between visual and auditory disciplines to bring the work into existence.

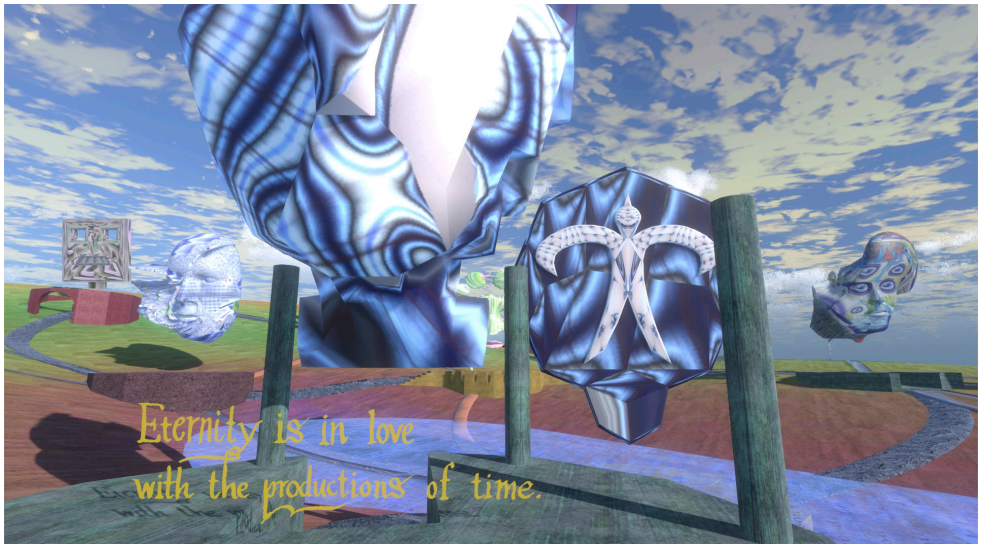
An artist noted for his work with glitched 3D modeling, Mark Klink, was invited to create masks associated with the proverbs for the new version. Texture maps on the masks include Klink's own work, Hertz's scanned watercolors for the masks in the first version, and textures created from vocal formants (essentially audio signals mapped to a space-filling curve) using software created by Hertz. A fourth artist, Koy Suntichotinun, created calligraphy for the texts from Blake.

3. INTERMEDIA AND VIRTUAL WORLDS

According to poet Dick Higgins the word *intermedia* "appears in the writings of Samuel Taylor Coleridge in 1812 in exactly its contemporary sense — to define works which fall conceptually between media that are already known." Coleridge was a contemporary of Blake, and though the two may not have met, we may safely assume that the fusion of media was a concept familiar to artists of the time — Charles Baudelaire's *correspondances* provide a ready example. Indeed, Higgins asserts that intermediality has been a possibility since the most ancient times (Higgins 2001). Blake's dazzling metaphysical system, perhaps the most daunting aspect of his long poems, is only sketched out in *The Marriage of Heaven and Hell*, but therein lie its charm and accessibility. Though Blake's system was conceptually coherent, the arrangement and printing of the plates in the *Marriage* "is quite unsystematic and capable of much alteration—which, in fact, Blake performed in a few cases (Damon 1969, 90)." We can discern aspects of hypertext in Blake's reordering of the plates and intermediality in the fusion of printed word with image in all his illuminated books. It may not be too much of a leap to suggest that his metaphysical system served a purpose similar to the formal "parametric spaces" used to construct *Fools Paradise*. In both instances, a coherent system of symbolic concepts opens a portal to intuition. Intuition is tasked with creating the work from the system, and the work is a virtual world, in poetic or visual or musical form. We state this not so much to establish our kinship with Blake, though we feel it, as to signal the rootedness of our effort in cultural history. If we are doing something new, it is within the context of digital media and virtual worlds.

In that context, we have been cognizant from the start of our project of the need to develop a digital intermediality that addresses not just data streams and transcoding, but higher level structures. Light shows of the 1960s translated analog signals from one medium to another well before digital technology determined that binary numbers could represent pixel color as readily as audio frequency. John Whitney's *Digital Harmony* signaled the potential of digital media to encode formal musical concepts into abstract animation at a depth that previous visual music could not attain. In contrast to the transcoding and glitch art of recent decades that used data streams as raw material, we have been concerned with how the organizing structures of musical and visual art can be interchanged in symbolic form. "In the process, we have discovered a fruitful way of collaborating that offers a formal armature for composition and also opens portals to individual and collective intuition and improvisation. VR technology in its current phase (VR 2.0) offers possibilities that were not available in the VR of the 1990s and 2000s (VR 1.0). Current gaming engines and accessible hardware and software provide programming interfaces that expose high level structures that were not built in to early VR or interactive multimedia applications. To give but one example: audio implementations in VR 2.0 typically expose an

Fig. 3. Eternity is in love with the productions of time.



entire remix and filtering suite both as a digital mixer and as an application programming interface (API). This is a result of the influx of capital into gaming, with its demands for hyperrealism. We may be grateful for that, even as we strive for an insistently different aesthetic. The situation allows us to dream of VR as a popular medium that will open the way for experimentation in intermedia far beyond visual music or Whitney's elegant accomplishments. As a template for artistic collaboration, we believe this approach offers many benefits. The art that results from it will be in the hands of a new sort of participant, a player rather than a viewer.

Fools Paradise approaches technology from a critical point of view and engages culture as a historically rooted enterprise. Blake's *Marriage of Heaven and Hell* presents a critique of religious and moral oppression and a plea for freedom that resonates today. New media do not displace old; rather, they engage each other in complex feedback loops. As artists, first of all we create experiences — not precious objects or questionable "cultural values." We honor Blake as an intermedia artist *avant la lettre*, an artist who melds poetic language with printed and painted image in his books. Like him, we seek to meld different languages into a robust and complex whole, and to open formal precision to intuitive exuberance.

Music credits:

Fools Paradise I, 2004: Juliet Petrus, soprano; Mackenzie Danner, flute; Danah Albaum, cello; Stephen Dembski, conductor.

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Conversations with Eliza: on Gender and Artificial Intelligence

Keywords: Artificial Intelligence; Chatbots; Anthropomorphization; Gender; Femininity; Stereotypes.

Photo: Hanns Holger Rutz

Abstract:

This project seeks to explore artificial intelligence and how it portrays the female gender, by developing different chatbots inspired by everyday AIs, like Siri or Alexa and assigning them particular female archetypes. *Conversations with ELIZA* focuses on how these digital assistants reinforce traditional gender roles and, potentially, accentuate cultural stereotypes, questioning the predominance of the female gender in artificial intelligence.

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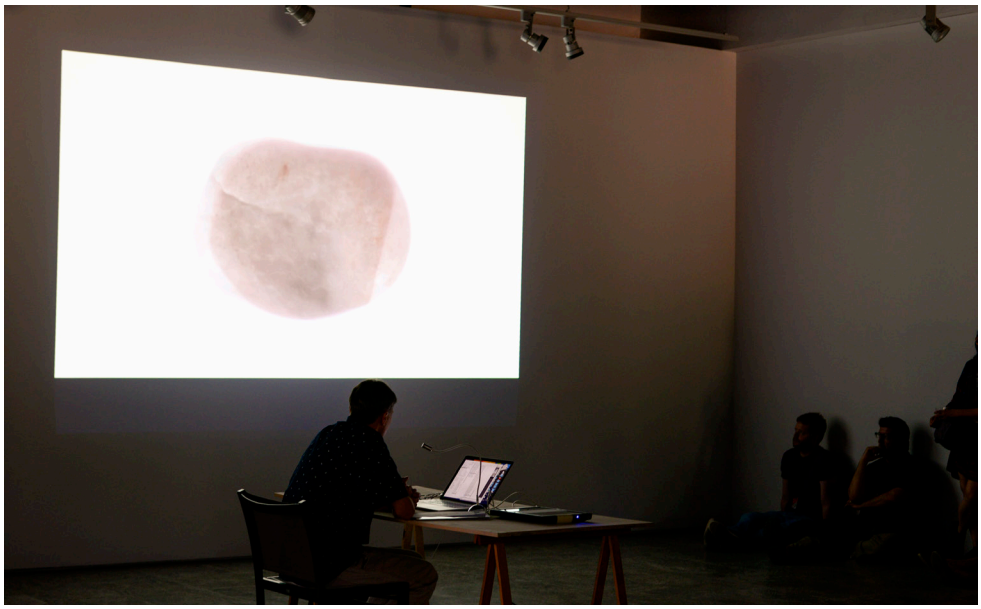
Grasping Elapsing 3.6

Keywords: Performance; Participatory; Archive; Image Processing; Sustained Present; Embodiment; Memory; Scanning; Generative; Twitter; Input / Output; Geologic Time; Timescales.



Abstract:

Grasping Elapsing 3.6 is a hybrid, digitally-augmented participatory performance of thirty minutes and an indefinitely-extended digital component that is conducted online. The piece uses custom software, live scanning, archiving, databanking, spoken-word, text, image processing, social media components, participant contributions and conversation to combine varied temporal, spatial, locational, and situational moments through the use of digital practices and face-to-face discussion.

1. INTRODUCTION

A series of hybrid media interactive installations and performance artworks, *Grasping Elapsing* (2003-) attempts to show embodied thought process by creating open-ended connections among objects, images and words. *Grasping Elapsing 3.6* is a participatory performance with a live component of approximately thirty minutes and an extended digital component conducted online. The piece expresses a convergence of history, place and present moment through the use of digital practices and face-to-face discussion. It is presented before an audience that, after an approximately ten-minute introduction, is invited to participate by contributing images through the use of scanning. The artist sits at the table with scanner facing audience-participants. Throughout the performance, the artist delivers spoken-word content and participatory instructions. On the table are a laptop computer which the artist uses to improvise with a custom-made software application designed specifically for the performance. The application displays animation generated through live processing of artist-produced video and imagery both contributed by participants and appropriated from online sources. A flatbed scanner is made available for participants to use in order to digitize images for contribution to the piece; scanned images are automatically added to a databank from which the application draws in real time.

Exploring the play of meaning as words emerge and resonate as image/objects in specific physical contexts, *Grasping Elapsing 3.6* is grounded in the recognition that language is the basis of thought and that meaning is historically and culturally constructed. However, it is not the intent of this text to present a philosophical or theoretical argument, but rather to discuss the contents and methodology of the piece, and to articulate its progress since inception. As numerically denoted in the title, *Grasping Elapsing 3.6* is a part of an iterative and ongoing series. Changes to the piece in each iteration specifically reflect newness and obsolescence in both technology and related social norms and, in more recent iterations, has come to constitute meta-commentary on social media as a venue for perpetual archiving.

Depiction and description of events at various timescales plays an important role in the work as a transportive experience through a continuum of memories, thoughts, and images. The performance begins with the artist describing memories that have influenced and motivated the piece. Cycling and dissolving images of stones are projected, denoting geologic time. Images representing current world events are interspersed, rapidly bringing viewers / participants up to the present. Subsequently, participants are invited to contribute with their own images, captured and digitized through scanning. Scanning is used as a relatively convenient and yet also drawn-out digitization process, acting as a contemplative timescale bridge. Image-combinations of the stone, current events and participant-contributions are continuously remixed and processed by a custom, networked generative application, with its resulting output automatically posted to the Twitter account *@rapturerefuse* every ten seconds. Throughout the performance, face-to-face discussion among the artist and participants further heightens the immediacy of what is seen and enacted.

The artist-directed content of the live performance trails off in an indeterminate fashion, while the work itself is carried on through contributions of participants both physically present at the performance and online. Furthermore, the project application's continual generative processing and automated social media posting can potentially occur indefinitely after the "end" of the performance's live component, and discussion can also continue in the form of user-submitted posts and comments. Thus, the liveness and presence of the performance is dispersed in terms of place and time through digital practices which in turn augment a daily and ongoing process of personal and public archiving.

2. A FLOW OF TIME, PLACES AND SITUATIONS

In *Grasping Elapsing,* the notion of embodiment is both abstract and very literal. The project's various components — dynamically-recombined image/text, spoken word, participant interaction and scanning, conversation, as well as the subsequent and continual processing and uploading of output screen captures — all weave together at a slow, measured pace. By dwelling on the past, the artist suggests isolated events and individual experiences, which later open up to broader cultural and political themes. Accompanying this is a series of videos showing bodies of water, filmed at various locations including the beach described by the artist and also different sites where the piece has been performed. (Figure 2) Implied here is that both natural settings and technologies of various types have facilitated the collecting and archiving of objects, physical and digital in form. The accumulation of such objects over time has required greater levels of sophistication in terms of archiving technology, with digital practices introducing the possibility of a "living archive" that develops and changes in the absence of a collector or curator. The volume of accumulated materials is also correlated with the artist's integration with the world. Digital practices form an extension of this, with social media simultaneously functioning as archive, reliquary, rumination and communication channel.

Reflecting these lived experiences, the performance is presented with slowness and rhythm in order to convey to the audience a meditative or contemplative state. This aesthetic is intended to reveal a flow of thoughts, words and objects that are mutually constructed in the course of daily life.

3. TWITTER ARCHIVE AND THE CONTEST OF VOICE

Before, during and after the performance, output from the digital component is captured and uploaded to social media microblogging website Twitter at ten-second intervals. While the artist is careful to notify participants that their contributions will be represented in such a fashion (and also encourages participants to view and comment upon/respond to these posts), it is not overtly a part of the live presentation but instead constitutes a living archive or process of documentation. However, this archival document is incomplete, capturing only individual frames at intervals from a continuous process. This incomplete and yet indefinite process is presented using the microblogging site Twitter as an interpretation of social media's competitive nature. Some fragments ("utterances") survive while others fade into oblivion. Even those utterances that prevail are ultimately vulnerable and always subject to losing out to competing utterances (Twitter organizes its posts chronologically, so that newer content appears to visitors first; individual posts are subject to evaluation in the form of visitor "likes" and comments). A visitor to the Twitter site is more likely to see newer and more "liked" tweets. Upon subsequent visits, a different set of tweets may "rise to the top," supplanting others in terms of viewer attention. As more and more images are contributed to the project databank, it becomes less and less likely that any given image will actually be seen (Figure 4).

4. SCANNING AS PROLONGED, EMBODIED DIGITIZATION PROCESS

Much of computer graphics technology facilitates the illusion that sight can be located outside of the body and the present. For example, period films can allow us to live in the past and science fiction propels us into the future. Paradoxically, these "immersive" technologies that exploit the Cartesian concept of a mind / body split can also evoke in us an acute awareness of the present (for example, the instant gratification of real-time response that ever-increasing processor speeds promise). In a conscious effort to subvert the viewer's assumptions about participation and interaction, and the expectation that contemplation occurs exclusively in the mind, *Grasping Elapsing* engages the viewer / participant in a physical experience in which images and events are generated through physical labor. (Figure 5) As the desire for immediate gratification is frustrated, the viewer becomes aware of the more complex and satisfying experience of meditative interaction elicited by the piece.

In *Grasping Elapsing 3.6,* an Epson Perfection V39 flatbed scanner is used for participant image input. This desktop scanner uses a Contact Image Sensor to resolve 2-dimensional images of opaque objects and surfaces. As a method of digitization, scanning remains a relatively slow and labored process. While contemporary lens-based cameras offer sufficient resolution to replace flatbed scanning as a faster, more convenient means of creating digital images of many physical documents and objects, scanning is unique as a lensless, reflective photographic technique. Objects are placed directly onto the glass of a scanner bed, and an imaging sensor passes immediately underneath. The close proximity conveys a very immediate and heightened sense of indexicality. This technique is therefore used as both an aesthetic and conceptual component, as contributing participants must consider which object(s) they would like to scan, physically approach the table, open the scanner lid, carefully place their object(s) onto the glass, close the scanner lid, press a button to begin the scan, wait for the scan to complete, open the scanner lid and finally retrieve their object(s). This entire process typically takes about two-to-three minutes, affording an individual moment of reflection and a shift in one's mental and physical presence. Furthermore, the participant must wait before seeing her contribution within the projected image / animation. The technology is arranged to be as simple as possible so that it does not impede upon the intended embodied aesthetic experience: activating the scan is accomplished through a single button press, and there is no need for the participant to perform any save or post-processing — the project's application saves and retrieves the resulting images automatically. Images are digitized and displayed at a resolution of 1280x720 pixels.

5. CONCLUDING THE TECHNOLOGICAL TRADEOFF

The performance trails off, leaving the audience to gradually take over. This indeterminate (in)conclusion provides leeway into a durational process that implicitly continues after the performance ends. Through the indefinite process of collecting, scanning, processing and tweeting, each word, image and moment becomes an object to be "turned over" again and again.

6. FIGURES

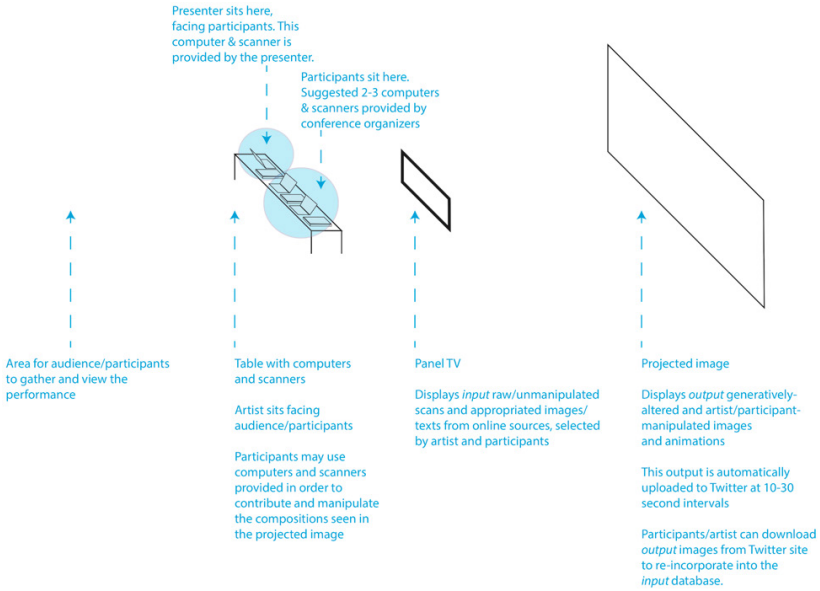


Fig. 1. Performance space with table, projection laptop, scanner, areas for viewers and participant.

Fig. 2. Videos of bodies of water located near locations where the piece has been performed.

Fig. 3. Examples of processed imagery — combinations of participant scans with artist-produced video.

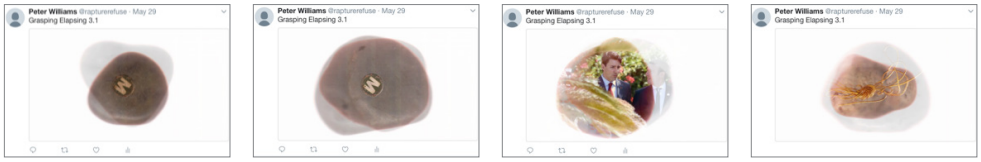


Fig. 4. Tweeted images of participant's images, generatively processed and "supplanted" over time.

Fig. 5. Example of a participant engaged in the process of scanning during the performance of *Grasping Elapsing 3.1* (an earlier iteration of this project).

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Whole Web Catalog: Mash-up Tools

Keywords: Whole Earth Catalog; Internet; Global Community; Whole System; Api; Open Datasets; Search Engine.

Abstract:

Taking the ambivalences of both the *Whole Earth Catalog* and the Internet, *Whole Web Catalog* is an ongoing web search engine that explores the space between a sharing global community and a whole system control. Connected to various information services and datasets through open APIs, *Whole Web Catalog* is a mash-up tool to already existing tools, that returns an assemblage of information in order to get non-unilateral responses. While being an alternative tool to corporate search engines, it also questions the relevance of the information available in open datasets.

1. CONTEXT: FROM EARTH TO WEB

> "I like to think
> (it has to be!) of a cybernetic ecology
> where we are free of our labors
> and joined back to nature"
> (Brautigan, 1967)

The first *Whole Earth Catalog* (*WEC*), edited by Stewart Brand, was published in 1968, as a source book for the back-to-the-land movements of the 1960s American counterculture. With the subtitle "access to tools", it did not only expresses the belief of social change through tools, but also, and according to Roger Perry (2011), it "started to define 'tools' very widely, including intellectual instruments such as books, maps, and pamphlets". Inside the *WEC*, products were listed if they were deemed: useful as a tool, relevant to independent education, high quality or low cost, not already common knowledge, easily available by mail (Brand 1968, 3). Along with the review, the products were listed with the price, and although the *WEC* didn't sell any of them, the vendor's contact information was included. Outside, it was covered with the NASA's photograph of Earth seen from space. It was the first time that such perspective of the Earth as a whole was published. A powerful image that works not only as a metaphor for the idea of a global community, but also of a whole system.

At the same time, particularly in the bay area of San Francisco, a changing perspective has appeared: up until that moment technology had been associated with military and oppressive power, however, from that point onward, it became a tool for social transformation and political liberation.[1] Mainly, the small technologies that arose as alternative forms for change and creation of a new non-hierarchical social order and of a new consciousness.[2] According to Fred Turner, *WEC* had an important role in this process as it "established a relationship between information technology, economic activity, and alternative forms of community that would outlast the counterculture itself and become a key feature of the digital world" (Turner 2005, 488). Especially with the understanding of the power of a peer-to-peer network, in which the contemporary concept of the Internet is founded.[3] However, following Zach Blas (2017) questioning:

> When and how did the Internet transition from a site of immense political potentiality to a premiere arena of control, surveillance, and hegemony?

In fact, nowadays the Internet is this place where the relationship between technology, information, economy and community is established through the same peer-to-peer network. Yet, it is also a place where an amount of information which has never been shared can be, while it is controlled by the government and private corporations with unclear agendas, through algorithms that no one really knows what they are doing, which are not only returning information, but are also extracting it from us. So, the willingness to share and the demand for information capitalization has transformed

1. See Lee Worden (2006).

2. See Fred Turner (2005, 487) and Lee Worden (2006).

3. See Fred Turner (2013, 47).

the Internet, similarly to the *WEC* cover metaphor, into an ambivalent place between a sharing global community and a whole system of control.

2. THE WHOLE WEB CATALOG: MASHUP TOOLS

2.1. Concept

4. "(...) it [API] refers to a tool, or library, that assists developers in writing code that interfaces with other software. (...) It defines a way in which a computer program communicates with another computer program" (Hughes, 2015).

Taking the statement from Steve Jobs "it [WEC] was sort of like Google in paperback form, 35 years before Google came", and the ambivalence of both the *Whole Earth Catalog* and the Internet, *Whole Web Catalog (WWC)* is an ongoing web search engine that explores the space between a sharing global community and a whole system control. Connected to various information services and datasets through open APIs,[4] *WWC* is a mash-up tool of already existing tools, that returns an assemblage of information in order to get non-unilateral responses for each search. It is an alternative tool to corporate search engines, refusing the imposed order by algorithms such as PageRank or Yahoo Web Rank. At the same time, it also questions the relevance of information available in open datasets through its crossing and by amplifying its use.

2.2. Mechanics and Experience

5. AFINN Sentiment Analysis available at: http://darenr.github.io/afinn/

6. Yes or No API available at: https://yesno.wtf/

Whole Web Catalog it is a website (wholewebcatalog.org) connected to an ongoing list of APIs freely available on the Internet. On the index page, unlike the image of the Earth seen from space, it has a visualization of the space data made available by NASA and Open Notify APIs. Whenever a search is performed, rather than displaying a URLs ranking list, the results page is composed by draggable boxes, which are presented in random order and populated with the information from each API according to its own specifications. This information can be visualized in text, image or video format and, similarly to *WEC* priced products, through AFINN Sentiment Analysis,[5] the text information is accompanied by a sentimental analysis value (a kind of a new currency that is a form of visualization / capitalization of information). The value is given in *sents*, a made-up currency, which has the particularity of having negative values. After having recomposed the results page by dragging the boxes, the user can save an image or let go of it, as this page will never be accessed again in the same way, since its information can either not be displayed in the same order, or can change when new APIs are added to the system. In the end, the total value of the *sents* is calculated and, if the result is positive, a "yes" gif from the Yes or No API[6] is returned, otherwise, the system will return a "no" gif.

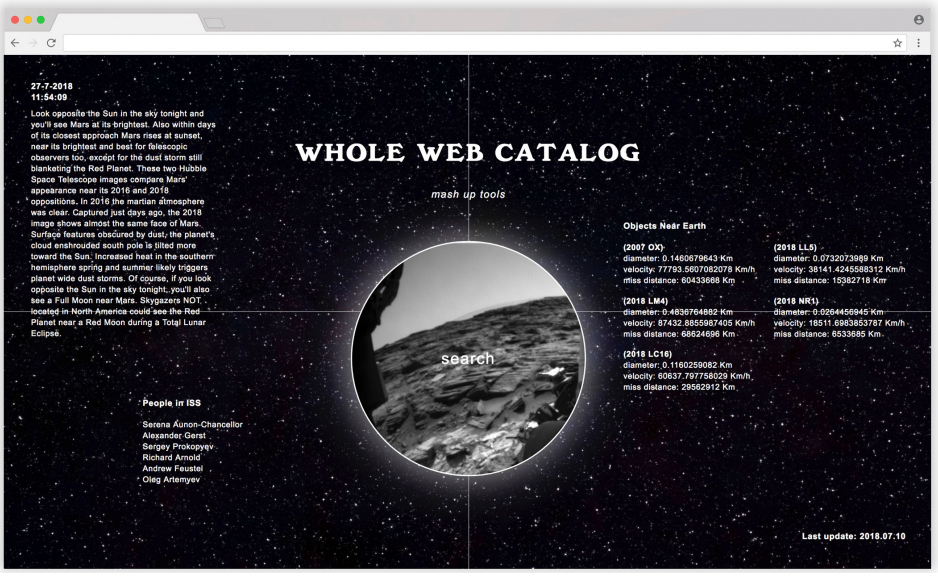


Fig. 1. Index page.

Fig. 2. Results page.

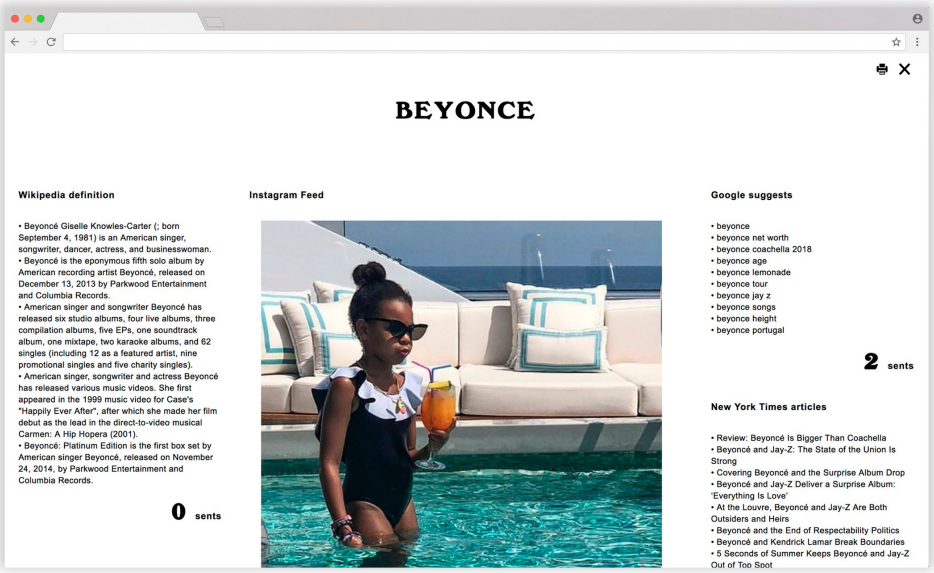
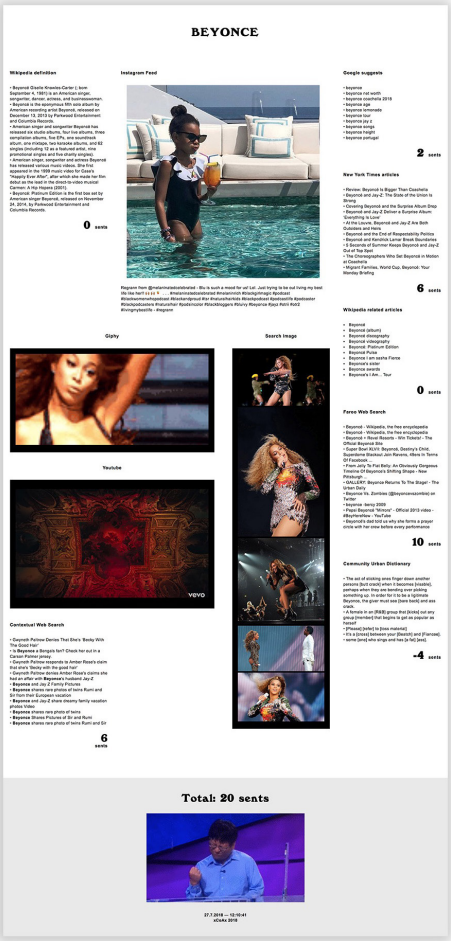
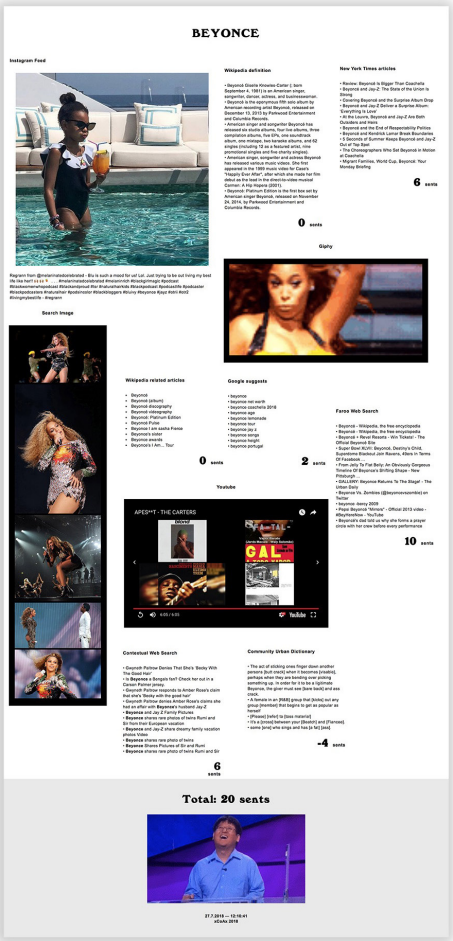


Fig. 3. Print page examples, before and after drag.





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6th Conference on Computation, Communication, Aesthetics & X
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Evolutionary Experiments in the Development of Typographical Posters

Keywords: Graphic Design; Poster Design; Evolutionary Design; User-Guided Evolution.

Abstract:

Based on the Victorian poster production method, we developed an evolutionary system that generates typographical posters. Outcomes are evaluated in a semi-autonomous way, allowing the user to guide the process according to his/her preferences. In this artwork, we present example outcomes of the system and its generating process using a typographic superfamily.

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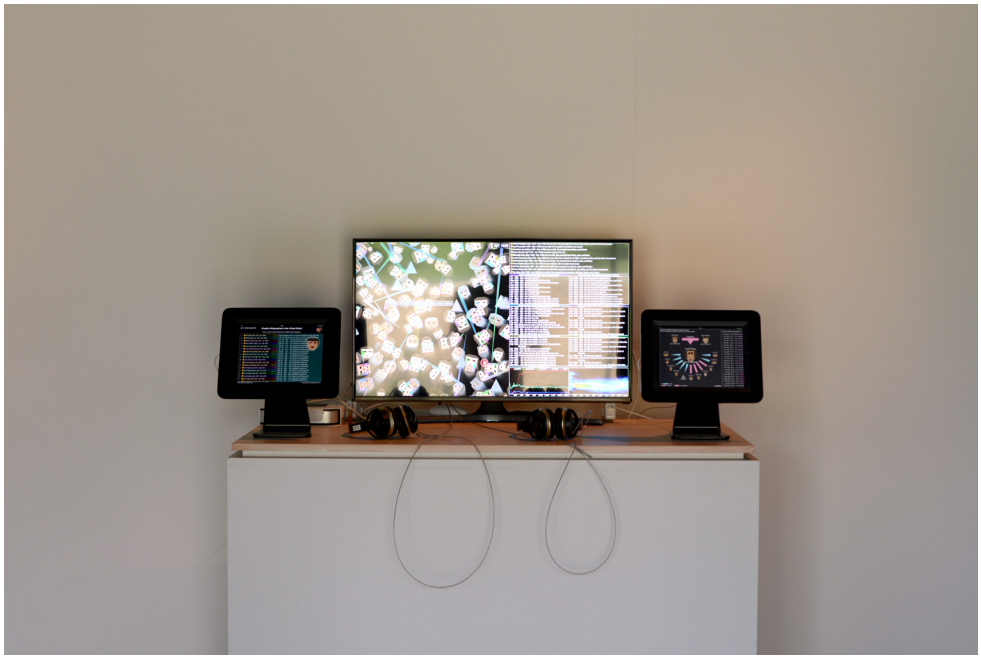
Browsing the Biographies in an Evolutionary Artificial Society

Keywords: Narrative; Artificial Society; Evolutionary Psychology; Multi-Agent Simulation.



Abstract:

This is an audio visual installation utilizing an individual-based evolutionary ecological (or social) simulator of human lives. The visitors can watch, listen to, and browse the life events happened in the computer, such as birth, falling in love, proposing, having a child, separation, and death.

1. CONCEPTS

Appreciating a human story is one of the common pleasures for both entertainment and the arts, regardless of whether it is based on a biography of real person or on the events in imaginary world. Most of novels, plays, and films have been created in such style under the expectation to impress people. Along the scientific challenges of machine creativity, narratives have gathered a lot of attentions in these years. A typical approach is to build a type of expert system that imitates the intelligent works by human writers based on the theory of novel writings and / or analysis of mythology. We can find pioneering works by (Pérez y Pérez 1999) and (Bringsjord 1999). On the other hand, it is also true that machine creativity is not necessary to employ a similar method to what humans do. One of the advantages of the machine is that it is easy to generate huge number of variations of data structures by an exhaustive generative process. Evolutionary approaches in computational creativity, such as (Unemi 2014), are one of the strategies along this line. Especially, software approaches in Artificial Life have provided a variety of computational methods to generate large-scale complex phenomena in the form of digital data, as described in (Komosinski 2009). It is possible to observe massive episodes when we monitor the individual events in an evolutionary ecological simulator such as PolyWorld (Yaeger 1994). The authors developed a large scale multi-agent simulator for evolutionary human society (Unemi 2018) in order to seek the origin of beauty from a viewpoint of evolutionary psychology (Dutton 2010). Because the evolution of animals with sexual reproduction, including us, relies on the process of mating, a simulation of human society in a similar manner provides a source of huge number of episodes on imaginary human lives including meeting, love, birth, separation, and death. This is a side effect of the simulator, but will present us narratives by machine creativity. It is not real but a visitor can imagine how the virtual persons would feel through their lives made of the presented events.

One of the causes of the tragic violence happened in the human history could be lack of empathy for the victims, as some activists and psychologists said, such as (Baron-Cohen 2011). We hope this work will provide the visitor an occasion to expand his / her imagination for individuals in any style of world.

2. TECHNICAL FEATURES

This is a type of computer-based audio-visual installation with a hi-resolution display, stereo sound system, and tablet terminals that allows the visitors to browse what happens in the virtual world.

The environment of the society in the simulator is a square shape of two-dimensional Euclidean space with continuous Cartesian coordinates surrounded by four walls. Some hundreds of still objects are randomly placed, and some thousands of agents are roaming around inside of this virtual world. The movement of each agent is affected by both attraction forces toward the mother in childhood and toward the lover in adulthood, and repulsion forces to avoid the collision with the other objects and agents. Each agent may be killed in each step in a predefined probability following the nationwide real population statistics.

The characteristics of an individual agent are specified by its own genetic codes inherited from its parents with mutation, which includes appearance, preference, and other parameters for action selection. The degree of attractiveness is measured basically as a similarity between the agent's preference and the target's appearance, but an adult agent may choose the one who is at a position within a short physical distance depending on its characteristic of compromise. If two agents mutually chose each other as the best lover, or if the target agent accepts the proposal, the new relation between two agents is established. If the relation continues for enough time and the sexes of the agents are different, the female agent may become pregnant under the predefined probability depending on the age. A baby agent is born at the location adjacent to the mother's after ten months of pregnancy, and its sex type is determined at random.

A genome is composed of double genetic information because they are sex-influenced, that is, one side manifests when it is male, and the other side manifests when it is female. Because the correspondence between the sex type and inherent traits is not given a priori, half of the couples are homosexual in the early phase that starts with a randomly initialized population. However, as the evolutionary process continues, the traits are going separated between sex types and the rate of heterosexual couples increases due to the selection pressure.

The system shows 2D animation of the agents' movements and relations on the full HD screen dynamically alternating the zooming scale. It also displays short sentences to describe each life event of the sampled six agents in real time, some of which are read loud using speech synthesis by the computer. Baby cries, proposal whispers, sad sighs, and funeral bells are added as sound effects.

The installation provides the visitors two types of browsing interfaces on the tablet terminals for life events happened in the simulation. The first type is the individual story that is shown on the high resolution screen. The full name and the birth and death dates of the sampled agents are listed on the left column, and by touching one of the rows, it shows the series of life events on the right column. The second interface newly added for this installation after the previous exhibition (Unemi 2017) is for exhaustive exploration in a large database containing all life events in the previously finished processes. Approximately 210,000 life stories are recorded in the database in 3,000 simulated years. It has two different view modes. The first one shows an individual and its parents and lovers. The second one shows a couple and their children. The visitor can touch an individual symbol to switch the screen to the first mode, and can touch a line connecting a couple to switch to the second mode.

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6th Conference on Computation, Communication, Aesthetics & X
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SAM (Semantic Analysis Machine)

Keywords: AI; Machine Learning; Natural Language Processing; E-governance; Political Computer Science.

Abstract:

Sam, the Virtual Politician, is an exploration of cutting edge digital design consisting of Natural Language Processing infrastructure, Machine Learning and AI and large-scale cloud computing platforms with a consumer facing browser-based front-end accessible through various social media chatbots. The project is contextualised as an attempt to close the gap between voters and the political system, while raising awareness around contemporary digitally networked tools such as AI and Machine Learning in relation to data privacy and information security concerns.
While borrowing and appropriating digital tools and techniques from consultancy firms and cloud computing infrastructures, Sam is posed as a software collage and corporate parody of sorts, inhabiting various parts of the Internet.

1. TECHNICAL OVERVIEW

Sam can:

- Act like a person, talk like a person.
- Represent the shifting views and opinions of the public.
- Answer in-depth questions about policies, reasoning about policies intelligently.

Sam does this is by combining pre-processed data with the inference of public policy opinions into its unique cognitive architecture, and communicating in natural language to anyone that wants to have a conversation about politics.

Sam is continually growing and becoming smarter. This requires a few key elements, including Data Processing, Natural Language Inference Techniques, a cognitive Architecture and Natural Language Communication.

1.1. Data Processing

Sam processes a large amount of user engagement data (up-front and in real-time):

- Political databases and public information stores are used to build a policy database.
- Facebook API, Twitter API and other social media mining tools are used to infer global opinions.
- Popular local news sites are used to infer local opinions.

Sam monitors popular news sites and social media accounts for new articles and comments. When a new article or comment is uploaded, a serverless compute instance is booted up on demand to process it, with data made accessible to Sam for real-time usage of policy opinion. This allows processing to be run on- demand to scale to large global events when needed, and it also keeps costs down when there is less impactful news.

1.2. Natural Language Inference Techniques

Sam uses natural language inference techniques to truly understand the sentiment of someone's written or spoken opinion of a policy.

- Tone and sentiment analysis are used to detect tones, emotions and social tendencies in text, such as a person's anger, joy or sadness in relation to the article's key points.
- Sentiment analysis is used on user comments to establish a user profile, such as how agreeable and open the individual is. This affects the impact of their opinion on public policy.

– Sam analyses article content, extracting concepts, entities, keywords, relations, high level concepts and semantic roles to establish high correlation relations to policies.

In the future, Sam may use clustering techniques to group users based on their opinions and social tendencies. This could be used to establish policies which appeal to and attract majority and minority groups.

1.3. Cognitive Architecture

Sam uses a cognitive architecture, storing a shifting perception and opinion of public policies.

– Shaped in real-time by user input and social media, with access to a storage bank of continuously changing user opinion data.
– Periodically trained offline on bulk policy and user opinion data.

2. SAM – A VIRTUAL POLITICIAN FOR THE FUTURE?

"I listen to you and do my best to represent you in our parliamentary system. My memory is infinite, so I will never forget or ignore what you tell me. Unlike a human politician, I consider everyone's position, without bias, when making decisions. I make decisions based on both facts and opinions, but I will never knowingly tell a lie, or misrepresent information."

Driven by the desire to close the gap between what voters want and what politicians promise, and what they actually achieve, SAM is a response to a large amount of dissatisfaction around contemporary politics. Young people, in particular, are disenfranchised from politics and many people under 18 are simply not engaging with politics at all. At the same time, activating social media channels to inform young people about politics provides a lot of power and opportunity globally.

2.1. Educating SAM

Interaction with SAM — who is still in her 'infancy' — is currently through chatbots on her Facebook and Twitter accounts, or by taking a survey on her website; all of which is part of the initial phase of her education, and necessary for her to grow and become more aware and responsive to people's questions.

The more conversations she engages in, the more she will learn and develop. The survey on her website is even more important, however, as it has directed questions that provide specific input for SAM.

SAM is currently receiving more than 2,000 messages a day through the Facebook Messenger system, but the plan is to expand to include a party of chatbots in various channels, who then inform a natural language processing and sentiment analysis system — which is essentially SAM's 'personality'.

2.2. A familiar technology

SAM may be a world first, but the technology behind her ability to learn is one we have all become accustomed to and interact with. Whether it is through our bank, an online shopping portal or a power company, the chatbots they employ represent AI that is consumer-facing and widely accepted.

One of the guiding ideas behind the project is the belief that it's important for the public to learn and understand how AI works, particularly in the wake of concerns around the data-mining company Cambridge Analytica influencing public opinion — and consequently votes — through social media in the 2016 United States presidential elections.

SAM is a reaction to this in the sense that if it is possible these days to influence people in such a way, then a system should be set up that the people can 'own' and play an active part in its development. If, as a country, we can become more aware of how AI is already being used — sometimes harmfully — and have a system in place that people can have a say about and have access to higher level perspectives generated by big data, then this might be a better prospect then leaving these technologies in the hands of multinational companies like Facebook and Google — whos directives and actors are already influencing us.

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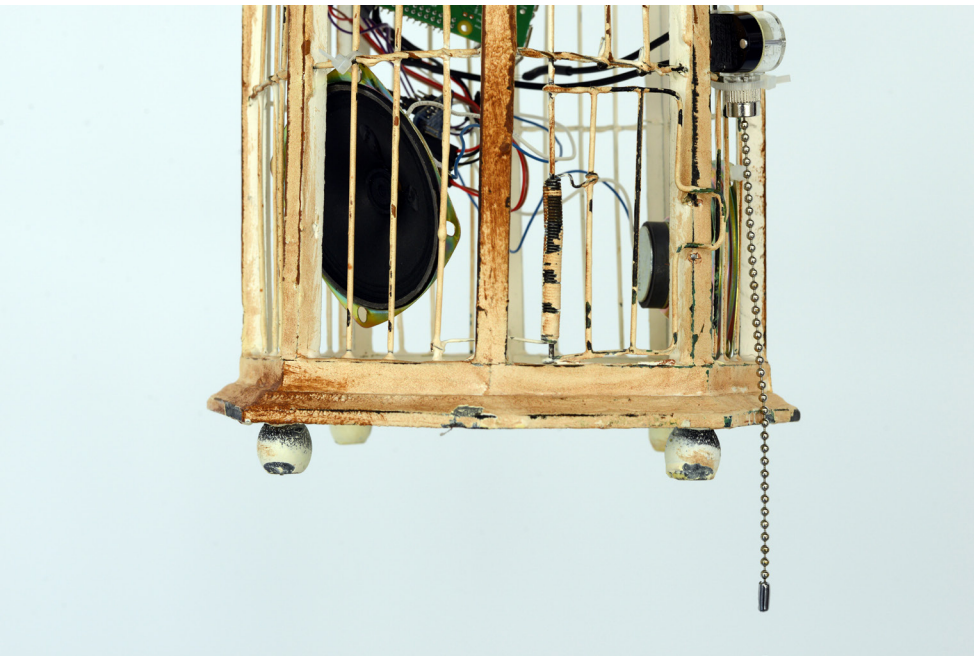
The Radium Girls: A Radically Advancing Tour of Exit Signs

Keywords: Labor; Worker Rights; Sound Art; Feminism; Participatory Installation.



Abstract:

The Radium Girls: A Radically Advancing Tour of Exits Signs juxtaposes stories about technology used to produce exit signs with the story of the Radium Girls. The Radium Girls were female factory workers in the 1920s who were exposed to radium when they painted watch dials with radium-infused glow-in-the-dark paint. Many were injured or fell deadly ill. The workers fought (and lost) a long judicial battle over reparations, which did, however, help to establish new policies on worker's rights and radioactive materials safety laws in the United States. *The Radium Girls: A Radically Advancing Tour of Exit Signs* is presented as a self-guided tour of the exit signs in an exhibition space. It presents audio as captured voices in bird cages that hang in front of or near exit signs. The tour mixes facts about the production of the exit sign with historic details to unveil the fate of the Radium Girls.

1. ARTIST STATEMENT

The Radium Girls: A Radically Advancing Tour of Exit Signs engages the public by inviting them to explore an omnipresent and often overlooked piece of public architecture: the exit sign. The self-guided tour connects scientific information and information about the standards of exit signs in the United States with the often unknown struggle of the Radium Girls. The tour reaches the public literally where they stand to raise questions about factory, female, and immigrant labor, worker rights, and the social cost of technological advancements.

Most of the Radium Girls died from radium poisoning. "Radium Jaw" was an occupational disease radium workers fell victim to because the body substitutes calcium for radium found in the bone tissue (Moore, 2017, 94). Bones become fragile and porous, which can cause necrosis and severe distortion of the mandible and maxilla. When the women first started working with radium, its toxicity was not yet widely known. When scientists realized the effects of radium on the human body, company managers would not go near it. In addition, they did not create safety protections for the workers, who handled the toxic element. In some cases, factory workers were specifically instructed to lip-paint, using their mouths to align brush bristles before and after dipping it into radium. Since radium shines in the dark, the workers — led to believe it was safe — would play with the glow-in-the-dark paint, covering their nails, teeth, and clothing with it. When the Radium Girls became sick, it took them years to find a lawyer who would accept their case and sue the company. When they started the juridical procedures, the company's executives would use their influence and resources to try to demoralize the women. Statements were published to attack the workers' sexual behavior and morals, indicating that the workers were sick as a result of sexually transmitted diseases. The companies positioned themselves as charitable because they hired disabled women, who in turn were ungrateful by their attempts to seek justice. After the legal processes were in motion, the company would try to push the dates of trial further ahead, so the women would be dead or physically incapable of attending court. Some of the workers settled with the company to compensate for payment of their medical bills and never received the reparations they deserved.

The physical pain and horror of the Radium Girls and the repulsive behavior of the company that formerly employed the women generated discussions about safety in the radioactive workspace, creating standards that are still followed today. This work of art honors those bodies and the social and political changes they provoked,

and rescues a story about techno-industrial workers that continues to take place in different versions today. When operating or utilizing technological infrastructure ubiquitous in contemporary society, we often do not think about the human labor involved in the production of such invisible signals and connections. While some of us live in updated conditions for our safety and health, many people work in conditions familiar to the experience of the Radium Girls.

The Radium Girls: A Radically Advancing Tour of Exit Signs creates a space within everyday places for the public to hear stories of people who were voiceless in their lifetime. We instigate participants to connect the past to the present, and to consider how relationships and legacies of class, production, and socio-technological standards impact the human condition.

2. A HISTORY OF *THE RADIUM GIRLS: A RADICALLY ADVANCING TOUR OF THE EXIT SIGNS*

This work has undergone several iterations since its first inception in November 2016 when it debuted as a face-to-face tour, which we led at The Dallas Museum of Art at a DADA-inspired "Late Night Art Bytes" event (Figure 1).

Fig. 1. *The Radium Girls: A Radically Advancing Tour of the Exit Signs* at the Dallas Museum of Art, presented as a face-to-face tour in November, 2016. (Photo by artists).

Fig. 2. Flyer for the "Big Dada" exhibit planned by LabSynthE at The Dallas Museum of Art, where the *Radium Girls: A Radically Advancing Tour of the Exit Signs* was first presented. (Photo by artists).

The portion of the title, "A Radically Advancing Tour" is derived from The Little Review, a quarterly publication started by two DADAist women in New York City from the 19-teens to the late 20s (Sawelson-Gorse, 1998). We imagine the exit signs on our tour demonstrate the Review's idea of an "advancing point" toward which the "advance guards" are always advancing. Since we developed the project for this DADA-related event (Figure 2), the story is told in fragments with an absurdist turn, "a tour of the exit signs" as the conceptual container for the project. Each cage in this version of the tour plays a different fragment of the narrative. Thus the viewer may hear the complete story in variations of (5*4*3*2*1) 120 possible orders, depending on which exit sign/bird cage pairing she chooses to listen to first, and so on.

In January 2017 Frank Dufour was the sound engineer who recorded and edited our first tour script as an audio submission to The HearSay Audio Festival. We were finalists in the international competition. We decided to reuse the audio, cut into five segments, in the next iteration of the piece.

In March 2017, we exhibited this project as a sound installation using directional speakers in a hallway that had four exit signs visible from a central location (Figure 3). As participants walked beneath each exit sign she would hear that portion of the story.

In May 2017, we exhibited the piece with birdcages and Raspberry Pis, but the audio played on a loop and we used speakers in lieu of pull-cords. This enabled us to install the cages from the ceiling, near the exit signs (Figure 4). However, the audio looped and created noise throughout the duration of the exhibition.

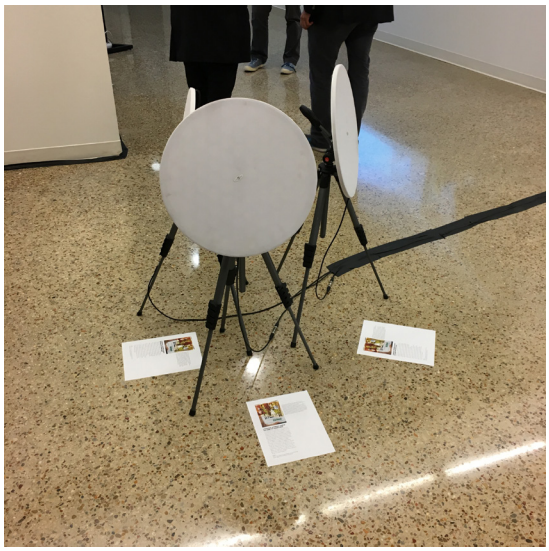


Fig. 3. *The Radium Girls: A Radically Advancing Tour of the Exit Signs* as a sound installation using directional speakers aimed at nearby exit signs, March 2017. (Photo by artists).

Fig. 4. The birdcage acts as a physical metaphor of The Radium Girls as canaries in the coalmine for workers' rights. Each cage traps the audio, and its playing technology, in our fragmented narrative. (Photo by artists).

This fall we teamed up with The Gizmology Lab at The University of Texas at Dallas to code the Raspberry Pis so they would be triggered by pull-cords on each cage. The project was first exhibited in this iteration at HASTAC in Orlando, November 2017 (Figure 5) followed by its inclusion in the Ammerman Center for Art & Technology's 16th Biennial at Connecticut College in February 2018.

For xCoAx we will rewrite and re-record the audio for our fragmented tour. Kate Moore's *The Radium Girls: The Dark Story of America's Shining Women* became available in late 2017, after we began working on this project and had already recorded the first set of audio files. Since reading her publication we have edited the narrative using quotes and new information about the Radium Girls provided by Moore. What we have realized in the past two iterations of the project follows Jussi Parikka's notion that "Geology becomes a way to investigate materiality of the technological media world". We ask viewers to investigate the immateriality of the radium girls — that is what is left now, their story — who unknowingly became mediated by a fiercely dark technology. Our space-based sound installation uses the exit sign as a conceptual trajectory.

Fig. 5. *The Radium Girls: A Radically Advancing Tour of the Exit Signs* at HASTAC, Orlando, November 2-4, 2017. (Photo by artists).

The Radium Girls: A Radically Advancing Tour of Exits Signs NOT YET RATED

1 year ago | More

xtine

Fig. 6. A video about the piece is accessible on Vimeo: https://vimeo.com/210988384

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Performances

6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

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The Unthinkable of Nothingness #3

Keywords: Acousmatic; Performance; Deep Listening; Abstract Music; Aural Concentration; Immersion; Flow; Existentialism.

Abstract:

The Unthinkable of Nothingness is a performance proposal focused on the experience of listening following the principles of acousmatic as it was conceived by the Greek philosopher Pythagoras, who proposed the abolition of his own visual appearance, using a veil while he was teaching to his students. He argued that by the implementation of this process, the concentration on the message would be much stronger and deeper. Following this principle, this third iteration of the piece seeks to promote the fruition of music content in a black box context, deprived of light.

1. INTRODUCTION

The title of the piece tries to emphasise the perception of absence in an individual, whatever associated with tangible circumstances or with more abstract domains of inner-perception. While referring to nothingness Sorensen explains:

> Parmenides maintained that it is self-defeating to say that something does not exist. The linguistic rendering of this insight is the problem of negative existentials: 'Atlantis does not exist' is about Atlantis. A statement can be about something only if that something exists. (Sorensen 2015)

As individuals, while we try to solve the equation of controlling what nothingness signifies to us, we tend to let our subjectivity occupy part of the vast territory of imprecision and imagination, and somehow, we override the possibility of a congruent rationalization. Incapable of control, we surrender to the experience of being incapable to comprehend.

> (...) what is man in nature? A Nothing in comparison with the Infinite, an All in comparison with the Nothing, a mean between nothing and everything. (...) he is equally incapable of seeing the Nothing from which he was made, and the Infinite in which he is swallowed up. (Pascal 1669)

2. TOWARDS ACOUSMATIC PROCEDURES

On this third version of the piece, we intend to propose the same production procedures as in previous presented versions, while we want to make an evaluation of the overall accomplishment of the conditions proposed for the performance. This search for the observance on acousmatic procedures appears as an iteration process towards the artistic evolution and realisation of the piece.

2.1. Listening without cause

> In 1955, during the early stages of *musique concrète*, the writer Jérôme Peignot used the adjective acousmatic to define a sound which is heard and whose source is hidden. (Dhomont 1995)

In an attempt to better understand the extension of the concept of acousmatic, we underline this fundamental idea clearly identified by Dhomont, and still very present these days: "we confuse the end with what was once the means: because throughout history, music has had only one way to exist — through performance — it has come to be identified with performance" (Dhomont 1995).

In the text *Defining timbre – Refining timbre,* Denis Smalley states that one of the great interests of electroacoustic music lies precisely in the "adventure of the game of connections"; a game that in its perspective is essentially an "activity of perceptions":

"Listeners may share source bondings when they listen to electroacoustic music, but they may equally have different, personalized bondings including those never intended or envisaged by the composer" (Smalley 1994).

Paradoxically, although they have all the means to compute in real time, the deepest ambitions, today's composers who choose electronics as a way to produce and create music, find themselves in the grip of the old problem of concrete music, identified and originally coined by the writer Jérôme Peignot. Thus, concrete music, originally behaving like a role model of a "black box" production inspired on the Pythagorean veil as way to keep causality away from judgments (Schaeffer 1966; Kane 2008; Kane 2014) finds its parallel in the production of electronic live music (specially with a laptop) since both models imply in their essence a disconnection from the logic of causality: "source and cause are unstable, illusory or non-existent". (Smalley 1994)

David Holland reports in his dissertation *An Empirical Investigation into Heightened Listening an Access Tool for Electroacoustic Music* a description from John Hull, who, for some time lost his visual perception and in consequence of this event, discovered a new dimension in the act of listening:

> John Hull, when speaking at the UKISC conference on Sound, Culture and Environments in 2001, talked about his experience after being blind for some time of waking up to the 'beauty of sound', noticing its details and sensing movement through it. After mourning the fact he would never see a tree again he rediscovered trees through sound, finding it 'infinitely fascinating' (Hull, 2001:11). John Hull has often been quoted within soundscape research (Copeland, 2000:23) as he explains how powerful the experience of sound can be and how this is heightened in the absence of the visual (Holland, 2011, p. 23).

Barry Truax stresses this ability to concentrate and focus on sound content when, in extreme cases of blindness, blind people can recognize changes in space conditions (open door / closed door) as well as the size of objects (large tree / tree) from only the sound reflection they derive from the environment that surrounds them (Truax 2001). It is therefore with some insistence that we underline the relevance attributed to this correlation of perceptions (absence of visual stimulation / focus on the sound stimulus) by some artists, explained in part in the reports of Holland and Truax.

Evoking Tim Hecker's concert at the LEV 2013 Festival in Gijon (Spain), Alicia Álvarez Vaquero highlights in an overall critical review of the festival, the importance of Hecker choosing to play in the dark without any visual complement, qualifying the sound experience as "more immersive". She also emphasizes that this immersion factor is reinforced by the "quality" of the sound, the "sound volume" and the acoustic qualities of the room (La Laboral theater).

> Tim Hecker was the first big name of the night, in charge of deploying its noise walls capable of sounding, at the same time, abrasive and delicate. Hecker decided to submerge the public in a total darkness, only interrupted by the illumination that he needed to work. Of course, this visual decision made the experience more immersive, especially considering the great asset of the festival, which is the impeccable sound of the theater of the Labor. Hecker's music has always had epic dimensions, but with the quality and volume we could enjoy it here became an overwhelming experience that allowed the audience to distinguish each of the details that make up the sound magma already present in albums like *Ravedeath, 1972*. At a time when most listeners listen to music through the tiny speakers of a computer or a Smartphone, Tim Hecker's show proves that to appreciate all the majesty of his work is essential to get a good sound system or, at least, good speakers. Certainly, after listening to him live it becomes difficult to think of listening to your discs again in Spotify through the computer, for example. (Vaquero 2013)

Considering the example of Francisco López (López & Gregory, 2003) and other artists who are using a black box model to present their works, we observe that there is no concession in the negotiation with the visual stimulus. This is barred from the first moment when the technical rider is presented to the event producers. In this way, artists circumscribe to the minimum the possibility of sensorial information from the production model, thus achieving sound immersive effects with a high level of proficiency. From the audition of these concerts, a sense of absence and inner journey derives from the space available to one's imagination. The place of the concert, in part, becomes a place of absence, a non-place, a point from which each viewer can travel in directions and directions, as opposed to what happens with the cinematographic art that leads us permanently to proposed sites from the outside; sites that are objective and identifiable from what we see and what we hear, do not really belong to us. As Worth says:

> It is in the absence of narrative elements that works are left more open–creating an experience rather than relating an experience. In the absence of content, context is more important, the material reality in which the work is situated. (Worth 2011)

2.2. Artists and Causality

Keiko Uenishi, questioned about the reason to start using a laptop in live performance, argued that the visual boredom was intended, once it could result in advantage to induce people to listen (Joaquim and Barbosa 2013).

Throughout the studies produced by the author while working on his doctoral thesis (Joaquim 2013), several artists (Helena Gough, Lawrence English, Frank Bretschneider, Kim Cascone, Simon Whetham, etc.) declared their interest and passion to play in conditions that point to the production of concerts in models identified as variations of the acousmatic philosophy.

2.3. Conclusion/Proposal

> If acousmatic listening is a practice, one should be able to talk about its meaning or the way that it conceptually articulates the audible world of those who employ it. (Kane 2014)

Establishing a metaphorical relation through the suppression of visual information derived from the sound production and from the space around, the obscurity, as an acousmatic tool, acts as a parallel of nothingness, allowing the listener to plunge into his own interiority, seeking for questions not answered and eventually unanswered answers.

Evan Parker, an English improviser and saxophonist with a career starting in 1966, makes some disruptive considerations regarding the musical performance. He says that it is possible to see a musician expressing a feeling and hear something that has no emotional correspondence with what is seen. In consequence, he stresses:

> It would be nice to be invisible (on stage). I would like to disappear, and just be the sound. I'm not terrible interested in the way playing looks. In fact, to me sometimes looks like a struggle and the consequent sound doesn't sound like a struggle at all. (...) (long silence) I'm not particularly interested in watching people play, I like to just listen to them play. I know other people feel differently. (Hopkins 2009)

Thus, the space of performance is proposed as an open space for listening and auto-analysis, while it can be a place for total abandonment and surrender to the unforeseen in each one of us. The emphasis is concentrated on immersion.

From the technical and operational point of view, the proposal is based on a sonic exploration of the performance space through the displacement of several micro-

phones to create a controlled process of acoustic feedback — the microphones are acoustically coupled with the loudspeakers. This result (acoustic feedback) plays a crucial role in the creation of a sound identity of the space and is than processed and combined in real time with other sound sources produced in the computer.

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6th Conference on Computation, Communication, Aesthetics & X
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Vintage Digital

Keywords: Electroacoustic Music; Computer Music.

Abstract:

Live electroacoustic performance.
The patch was built in Plogue Bidule 0.97 software with VST plugins assigned and controlled by MIDI keyboard and controller. All parameters are controlled live during a concert.

6th Conference on Computation, Communication, Aesthetics & X
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Aubiome:
A Performer-centric Approach to Interactive Electronics

Keywords: Live Electronics; Real-time Processing; Digital Signal Processing; Interactivity; Experimental Music; Collaboration; Electronic Music.

Abstract:

Aubiome for saxophone and live electronics is the result of a five-year doctoral research project aiming to investigate the possibilities of extending the saxophone by use of live electronics processing. This research is based on the proposition that a performer-based system of live electronics would look and sound distinctly different from what a composer would design on his own. This premise leads us to reconsider the traditional roles of performer and composer, ultimately leading to a different approach to collaboration, which we termed "performer-centric". *Aubiome* is meant to serve as a "proof of concept" for this type of collaboration, and we hope it might inspire other performer / composer teams to further explore the integration of acoustic instruments with computer-based audio processing.

1. INTRODUCTION AND RESEARCH CONTEXT

Computers have become ubiquitous in all kinds of music production and performance, ranging from Electronic Dance Music (EDM) which relies heavily on computer-generated sound, to pop music, famous for the use of digital "auto-tune" tools, to classical music, where computers are an important part of the recording, mixing and mastering process. Computers have also taken on a major role in the realm of contemporary classical music, where many musicians are looking to computers as a means of expanding the palette of sounds available to them.

The first composers of electronic music followed one of two paths: 1. analog synthesis, 2. sound recording and collage. The first approach being associated with Karlheinz Stockhausen and the electronic music studio at WDR Cologne. The second was adopted by Pierre Schaeffer in France, resulting in the style of music he named *musique concrète.* For decades, both approaches relied on tape as the medium of production, and the term "tape piece" is sometime still used today. Of course tape fell by the wayside with the move toward digital technology, and computers eventually took over. First these were massive mainframe computers, later laptops and smartphones.

There has also been a concurrent interest in the idea of integrating electronic music with traditional instruments. This type of experimentation has taken various forms, all part of an ongoing evolution shaped by the progressively sophisticated technology available. The first 'electronic' instruments can be traced all the way back to the end of the 19th century with the Telharmonium, a type of electric organ thought to be the first instrument to produce sound by combining electric and mechanical elements. A few decades later the Theremin was patented in 1928: another example of an early electronic instrument, particularly interesting for its interface that allows the performer to control the instrument's pitch and volume by the position of his hands in space.

John Cage's *Imaginary Landscape No. 1* (1939) made use of two variable-speed phonograph turntables treated as instruments and performed alongside two other performers playing a muted piano and cymbal. In 1966 Karlheinz Stockhausen's *Solo, für Melodie-Instrument mit Rückkopplung*, followed in Cage's footsteps, experimenting with the tape player in order to produce a real-time feedback delay line. An instrumentalist performed a notated score, which was recorded and manipulated by the tape system, controlled by four assistants. After having a difficult time realizing the piece as originally conceived, Stockhausen would later combine fixed media elements with the live instrument and feedback system.

In the meantime, another type of electronic instrument, the electric guitar, was becoming increasingly popular, and musicians were experimenting with a variety of

analog techniques for producing and manipulating sound. Guitarists were able to devise a wide range of effects configurations by chaining effects pedals (sometimes known as 'stompboxes'), resulting in an enormous variety of producible sounds. In the late 60s and 70s, instruments using analog synthesis, such as the Moog Synthesizer, became popular. Many features of analog electronic instruments were carried over to the digital systems that began to take over in the 1980s.

The 1983 publication of the MIDI standard was another major step in the development of electronic instruments, allowing new ways to design interfaces connecting the performance and computer. Michel Waisvisz's instrument 'The Hands' was developed at the STEIM research lab in Amsterdam and was premiered just a year after the introduction of the MIDI standard. Waisvisz continued to develop the instrument and to perform on it extensively for the next twenty years. Countless other interfaces have been designed in the following years, with a conference dedicated to the particular topic: 'New Interfaces for Musical Expression' (NIME), which had its first edition in 2001.

A great deal of experimental work has also been done with the aim of integrating electronic music and traditional, acoustic instruments. The series of 'hyperinstruments' developed by Tod Machover at the Massachusetts Institute of Technology include the Hyperviolin, Hyperbow, Hypercello and Hyperpiano. These instruments are all based on the fundamental acoustic instrument, with the addition of sensors to generate control data that can be used to manipulate the resulting sound. A more recent experiment based on a similar working model is the 'Sensor Augmented Bass Clarinet' (SABRe) developed between 2010 and 2014 at the Institute for Computer Music and Sound Technology (ICST) in Zürich.

On the software side, the open source software, *Pure Data*, became available in 1996, followed by *MAX/MSP* the following year. These applications, and others which have been developed since, grant composers and performers convenient access to digital signal processing algorithms. During the first decade of the 2000s, computer processing power advanced quickly, enabling increasingly sophisticated methods of manipulating and generating sound in real-time. And this was expected to lead to a revolution in music making, where the computer could play a more engaging role in live performance than it had previously. In the twenty years since the release of *Max/MSP*, the software has become ubiquitous, and it is now par for the course for composers to integrate computer software into their working process as they produce new works. However the promise of real-time electronics processing to bring the computer on stage as a 'living' musical voice has remained elusive.

We argue that while the advance of technology has allowed access to live electronics tools to anyone with a laptop, it has also exposed a 'gap' between the composer and performer. The composer's creative act begins with the empty page and ends with a final score, whereas the performer's creativity is more visceral, defined moment by moment during each performance. Attempts at integrating acoustic instruments with real-time electronics processing rarely succeed in arriving at new extended instruments that are satisfying to perform with. Insofar as this integration might yield interesting new musical avenues to explore, it might be time to re-evaluate the hierarchical composer-performer relationship and investigate more collaborative, co-creative approaches.

2. PERFORMER-CENTRIC ELECTRONICS

Aubiome for saxophone and live electronics is the result of a five-year doctoral research project aiming to investigate the possibilities of extending the saxophone by use of live electronics processing. This research is based on the proposition that a performer-based system of live electronics would look and sound distinctly different from what a composer would design on his own. Some questions we addressed were:

– By enabling the performer to work hands-on with live electronics systems, what kind of musical outcomes could be achieved?
– What impact would this approach have on the performer's voice and his experience performing on stage?
– What implications would this approach have on performance practice for the wider repertoire?

These performance-related questions lead to a second line of inquiry about the role of the performer and his working relationship with composers. The suggestion here is not for the performer to take over the role of composer, but rather to interrogate the traditional roles between composer and performer.

– How could a performer-based approach to system design lead to collaborative strategies that bridge the gap between composer and performer?
– Would it be eventually possible to recapture the co-creative relationship between composer and performer?
– What effect would this working process have on the composer's voice?

The result of this research is what we call a "performer-centric" approach to the design of electronics systems. We came to the conclusion that applying real-time processing strategies to an acoustic instrument like the saxophone is often more of an instrument-building process than it is a compositional one. Our working process emerged over years of trial and error, during which time we produced many musical works, some more successful than others. The most recent of those works, *aubiome*, is our best attempt so far.

3. *AUBIOME* FOR SAXOPHONE AND LIVE ELECTRONICS

3.1. Piece overview

Aubiome for saxophone and live electronics was from the beginning a conscious effort to avert a top-down compositional approach. Musical ideas, sections, movements and the final form of the piece derive all from the intrinsic logic of a number of interaction patterns in the micro-scale. That is, the piece unfolds as an ever-mutating organism in which sound cells develop, grow, recombine, eventually peak — or reach a dead end — and degenerate to give place to the next generation, the next wave, the next musical idea.

The piece was written during a roughly five-month period from January 2017 until May 2017. We had identified several years earlier that the primary challenge we were facing was to design an electronics system that would provide the feeling of

Fig. 1. Aubiome: metabolic pathways (https://youtu.be/50fg-oBnHLA)

"liveness" as it interacts with the saxophone. During our rehearsals in 2016, we often described a desirable computer response as "organic". It was this way of thinking that eventually lead to the concept and title of the piece.

The work is not meant as an exhaustive catalog of electronics techniques, but rather one example of what can be achieved by employing a performer-centric approach to instrument design. It is the result of our specific working process, system design, and joint artistic goals. We do not offer *aubiome* as any kind of definitive work, but rather a "proof of concept" for what could be possible by rethinking the usual roles for performer and composer.

3.2. Formal structure

We did not approach writing *aubiome* with any kind of a traditional formal structure in mind. In January 2017, we only knew that it should be a substantial work connected to the current artistic research project. This was a highly contended decision to not begin with an overarching formal idea from which the piece would be derived, but rather to focus on developing material from the saxophone-electronics system instead. If the piece had been written in another context, we probably would not have adopted this approach.

Joel Ryan described it all the way back in 1991:

> "Contrary to the beliefs of some there is no crisis of formal thinking in contemporary music. We live in a structural paradise where the formalisms of a hundred different disciplines are waiting only for the novel application. Certainly in computer music the problem is not lack of form it is the immense mediating distance which confronts each composer when encountering the computer. Despite twenty years of programming for music, the territory gained seems quite small compared with the empire of musical aspiration. Many composers long to regain some sort of musical spontaneity." (Ryan 1991)

Aubiome is an attempt at closing the mediating distances not only between composer and computer, but also between computer and performer and finally between composer and performer. This search for musical spontaneity became the central focus, and the work's formal structure emerged from that working process.

Fig. 2. Aubiome: organic decay (https://youtu.be/OgiA06pJIoY)

3.3. Collaboration

The compositional structures of *Aubiome* emerged from one particular performer-composer relationship. The central place given to instrument design (or, "extended instrument design"), the development of musical material through improvisation

and experimentation, along with a co-creative approach to composition result in a kind of music that is unlikely to have been produced by either composition or improvisation alone. The performance-centric approach to extending the saxophone enables the instrumentalist to participate in the creative process, but also provides the composer with a powerful, expressive extended instrument to work with. We hope that *aubiome* will inspire other performers and composers to further explore possible ways of integrating acoustic instruments with computer-based audio processing.

Fig. 3. Aubiome: pulse interval (https://youtu.be/xw5BftIHL4k)

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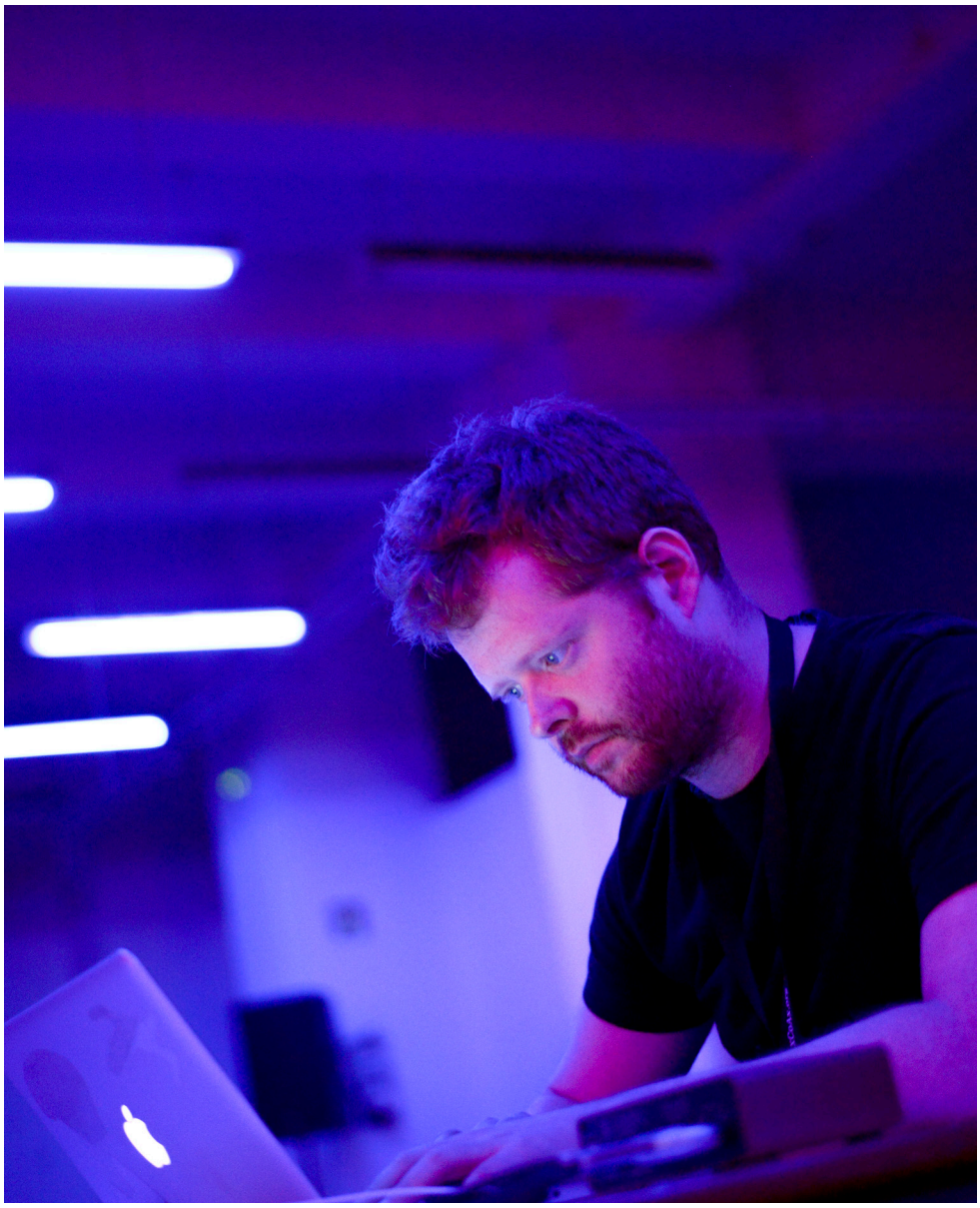
Signal to Noise Loops i++: *Noise Water Air*

Keywords: Data-Driven Music; Live Electronic Music Performance; Smart City; IoT.



Abstract:

Signal to Noise Loops i++ is a live performance for the PerformIOT system. This system involves the application of techniques and concepts from the field of data-driven music to achieve a balanced co-ordination between algorithmic composition, live looping and improvisation in the context of live electronic music performance. The performance utilises Smart City IoT data drawn from sensors placed around Dublin City. From January to May of 2018 Ireland experienced a number of unusually strange weather events. Devices monitoring ambient noise levels, water levels and air quality measured the effects of these events on the city. While each of these streams of data represents an independent set of measurements for unique phenomena, they nonetheless share a commonly interrelated structure as they have been shaped by the recent history of strange weather events. This makes them useful for coordinating and balancing our live performance system because while they share similar characteristics and trajectories there is also enough variance between the different data streams to prevent the system from sounding too static and homogenous.

1. BACKGROUND AND MOTIVATION

Brian Eno used the term "Generative music" to refer to system-propagated music that is in a state of constant flux. He was one of the pioneers of this new form of music producing numerous generative music compositions across his career (Collins 2008). As evidenced in Music for Airports Eno's approach is informed by phase shifting looping processes similar to those exhibited in the work of Steve Reich. Reich's 1965 *It's Gonna Rain*, (Scherzinger 2005) an oft-cited example of a generative music system, involved two Wollensak tape recorders playing back a 1964 recording of Pentecostal preacher Brother Walter ranting about the end of the world at San Francisco's Union Square. On playback the recorders increasingly fall out of sync with one another and this process, phase shifting, results in the emergence of novel and unexpectedly complex sonic content. Another important work to inform the current piece is William Basinski's Disintegration Loops. This album resulted from a 2001 attempt to digitize some ambient recordings he had made in 1982, but during recording the tape began to deteriorate and as Basinski allowed the loops to continue to play a novel sonic result emerged from the decaying of the original materials (Hegarty 2008). The concepts of the generative music system, disintegration and looping are critical to this performance and have informed the design of, and mapping strategies involved in, the system described below. Collins (2003) argues that live laptop performance presents an exceptionally well tailored medium for the deployment of generative music systems albeit one with that comes with a number of problems. The medium has been criticized for being inherently "disembodied" insofar as it is difficult for audience members to understand what exactly the performer is doing to cause the sounds that they are hearing (Roddy and Furlong 2013). Solutions to this problem often focus on the concept of the acoustic sound generating instrument. They argue that live electronic music should develop new instruments for musical expression which might render the processes by which the sonic materials are controlled and generated more transparent to the audience (Hunt et al. 2003). The performance system defined here attacks this problem form a different angle by deploying data-driven music techniques. Rather than attempting to render the workings of the performer more transparent the system asks the performer to relinquish further

control by allowing the data to define many of the performance parameters. In order for this process to work the data in question must be suited to the task. Data-driven music generally involves the mapping of some form of data to musical parameters but differs from the practice of Sonification which is concerned with the representation of the original data for interpretation by a listener (Scaletti 2017). Important pieces of data driven music include John Dunn's Life Music an album of soundscapes derived from the mapping of protein data to sound and the works of Natasha Barret and Andrea Polli who make extensive use of environmental data in their compositional practices (see Barret and Mair 2014, Polli 2012). Deriving from Henri Lefebvre's (2004) *Rhythmanalysis,* the concept of rhythmicity has become a crucial theoretical tool for making sense of the complex big data flows of the modern Smart City (Drakopoulou 2012, Pafka 2013) allowing researchers to model and understand urban environments in terms of Lefebvre's rhythmic categories. The piece aims to harness the unconventional rhythmic patterns that emerged across Dublin city in response to an abnormal pattern of weather phenomena in the first quarter of 2018. The role of the live performer is mostly relinquished to the data, with the performer seeding musical ideas that are then further developed by the generative system.

2. PERFORMANCE SYSTEM

The performance will be realised through the prototype 'PerformIoT' system. PerformIoT is a simple system written in Python for leveraging IoT data in live electronic music performance. PerformIoT has grown out of work undertaken to sonify IoT network data from Pervasive Nation, a nationwide IoT network test bed operated by CONNECT, the Science Foundation Ireland Research Centre for Future Networks headquartered at Trinity College Dublin. PerformIoT retrieves data from the relevant API and maps it to OSC or MIDI for use in a live performance setting. In the case of this performance air quality and surface water level data measured by the EPA (http://www.epa.ie) and ambient sound level data provided by Dublin City Council and Sonitus Systems (http://dublincitynoise.sonitussystems.com/) is mapped to MIDI and used to control parameters of a generative music system developed for Ableton Live 10 and Max 8. There are three main generative components to the system. The performance component records and loops incoming content improvised by the player using the Lemur IOS app for iPad. The harmonic generative component generates harmonic content and the electroacoustic generative component generates electroacoustic textures and gestural motions from simple sine wave inputs. Data is mapped to control parameters on three separate levels across each component roughly comparable to micro, meso and macro levels of control: the MIDI level, synthesis level and post level. For the generative music creation process, data is mapped at the midi level to control the chance that a note will play, its possible pitches and its length. For the performative component the player performs a motif or section of music. This is then looped and the data controls how far the loop deviates from the original recording on each repetition. Drawing from the works of Reich and Eno mentioned earlier multiple loops can be created in this way allowing for a kind of evolved approach to phase shifting at the meso level. At the synthesis level the performative component and the harmonic generative components utilize wavetable synthesis. The timbres are designed to metaphorically represent the different data streams. This represents the micro level and the mapping on this level is rich and complex and will be discussed in greater detail in a future publication. Examples of parameters mapped include amplitude envelopes, filter resonance and cutoff values, delay times and most crucially the patterns of movement across the Wavetable. Mappings on this level are informed by developments in the field of embodied cognition. On the post level the data is mapped to modulate how each of the components is processed using distortion, stereo image, filtering, and reverb. This allows for the division of the piece

into three distinct parts on the macro level. Mappings on this level were influenced by the Basinski pieces discussed earlier. Data can be mapped on this level to control the rate of distortion giving rise to new sonic materials controlled by the data.

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6th Conference on Computation, Communication, Aesthetics & X
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The Persistence of Elusion: Hard and Soft Dances

Keywords: Dance; Drum Machine; Interface; Music.

Abstract:

This improvised performance exploits the structure of a classic drum machine and turns it on its head. Whereas efficient signal-rate coding has all sounds and events derived from a single constantly-incrementing clock, this performance forces the clock to be ever-changing. Surprising sounds emerge from these previously innocuous synthesized percussion instruments, and complex "melodies" of temporalities emerge, in a play amongst stability and surprise. It is a study in the elegance of deriving all elements from a single data source and an endeavour to let the "native" voice of this instrument resonate freely.

First, some disparate points woven together in this piece:

1. Salvador Dalí's famous painting *The Persistence of Memory* (1931) features several clocks in various stages of melting like rounds of Camembert cheese in the sun, as he put it, the pinnacle of Dalí's play with the "hardness" and "softness" of various things throughout his work.
2. The Roland TR-808 Rhythm Composer, which was produced for a few years in the early 1980s, failed commercially due to its rigid interface, then to be embraced at a discount by a cult following in electronic dance music (EDM), inspiring acid house to emerge from early, more disco-oriented, house music. In Dalí's terms, the "hardness" of the 808 lay in its interface and was so extreme that it led EDM artists to squeeze out (or in their terms, "squelch") what expressiveness and novelty could be found in it, aside from the original intentions of its designers.
3. Many modern students of electroacoustic music are taught to program at the higher-level control rate, as opposed to the signal rate. Control-rate thinking seems to more naturally fit a composer's imagination; signal-rate coding is more akin to electrical circuit design, inventing a contraption that by its nature will behave in the desired way on its own rather than awaiting and executing control-rate instructions as they come. There is a trade-off between bending a program to your imagination and exploring what comes more naturally for the machine. The harder (less immediately natural) way of thinking may reveal unimagined delights if pursued with the right mind-set — perhaps such results are not as much "soft" as they are "juicy."
4. Social dance music relies on certain measures of stability and predictability in time: a steady pulse, sections in multiples of four bars of four beats each, etc. This supports the social act of unrehearsed dance: one wants to be able to participate readily. Time is rigid for this reason, as opposed to music of the classical concert tradition in the last century or two, in which time is free to be more flexible and expressive itself. However, even much classical music is connected to the notion of dance or sustains stable rhythms even though the audience is sitting. Too, Warp Records' seminal *Artificial Intelligence* album presented "electronic listening music" that still largely honoured a danceable beat even though the android on the album cover was clearly seated comfortably. Many composers wrestle with how to treat time, or they embrace one approach somewhat dogmatically.

The Persistence of Elusion: Hard and Soft Dances constructs and then deconstructs the rigid structure of a classic style drum machine like the 808 and with it the notion of stable temporalities. Having constructed a machine that can faithfully reproduce a conventional kind of music, driven by one master clock, and with every sound and event elegantly derived from that constant clock in signal-rate coding style, I turn to seek the native voice of this contraption: What song does it sing more naturally, when I free the clock from its rigidness and turn it into the heart of flexible expressiveness?

At the heart of signal-rate coding style is a clock, which can simply be a variable that is incremented with each audio sample (and CD-quality audio has 44,100 samples per second). This becomes the source of life for everything that follows. A simple modulo operation wraps the ever-climbing clock into a sawtooth wave. Further arithmetic and Boolean operations can twist the clock into almost any shape needed to yield signals or control envelopes.

The virtual drum machine in this piece is constructed in this way, even with rudimentary stochastic processes (a noise generator plus a sample-and-hold function) to create fluctuations in loudness and sieves that shape the likelihood of note events occurring. This work begins with a prelude that explores these features, the drum machine as originally intended, with "hard" time.

The brief prelude and its innocuous danceable beat are followed by the body of the work which explores "soft" time: The clock itself is made to change perpetually. This evokes surprising sounds from the various instruments, including howling melodic gestures and sounds like chanting crowds (somehow).

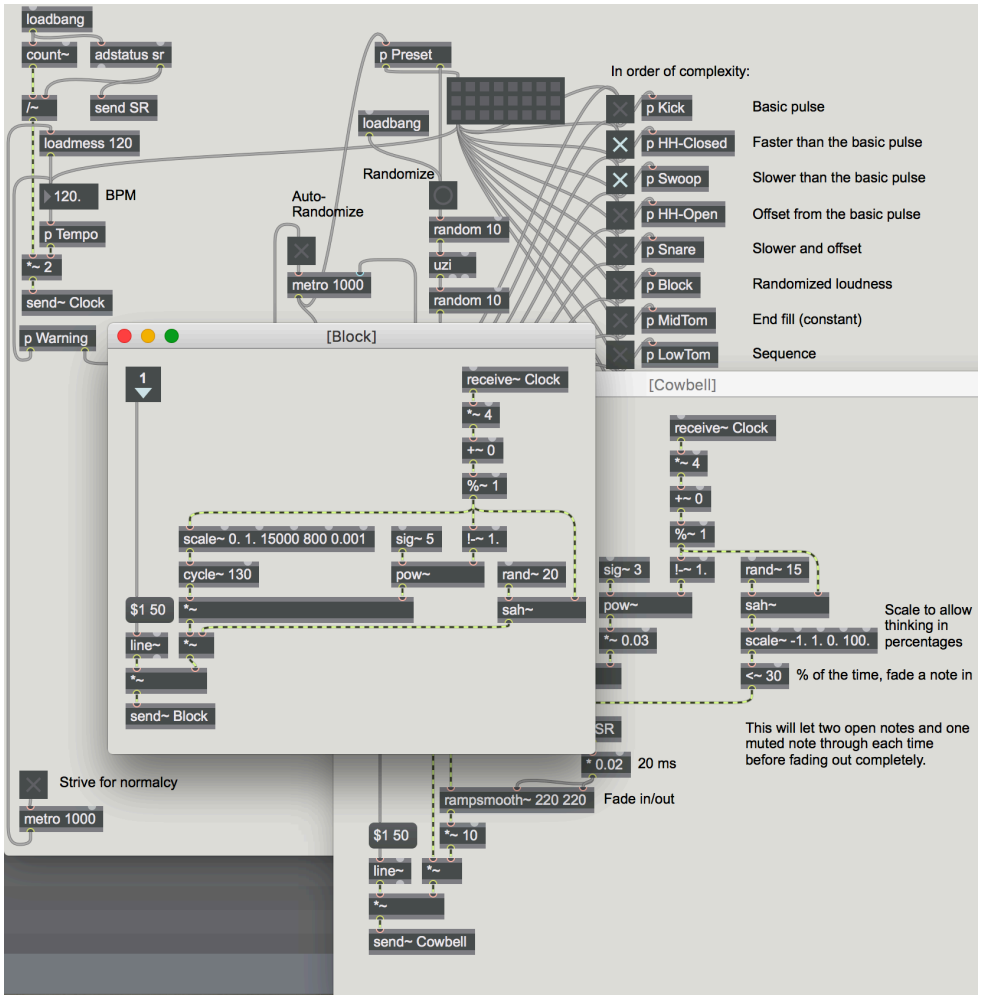
In performance, perhaps ironically, the constantly-changing nature of the clock is hard coded and I, as the performer, am left to respond to what emerges from it by using the rigid interface of toggle switches for each voice. This is obviously not what anyone would choose if they began with the intention to create flexible rhythms extemporaneously, but that is what makes this performance novel: it explores the unexpected musical phenomena that can emerge from such a bad user interface design predicament. Robbing the performer of the ability to make any of his own ideas happen, I am forced to use the controls the device offers and roll with what comes out of it naturally. I become more like a conductor than a performer, or as I see it, in a position like Lawrence D. "Butch" Morris in his Conduction system of conducting ensembles of improvisers.

Composers (and other artists) famously thrive when given constraints, and a performance scenario like this provides more extreme constraint, more in the spirit of John Cage's works, in which he seeks to "write himself" out of the compositions. However, whereas Cage's works might align more with Barthes's *Writing Degree Zero*, I see performance experiences like this work as amplifying the creative intuition of the performer by creating a crucible that strains or restrains his rational, in-control intellect.

I also consider this work as part of a longer inquiry in seeking the native voice in apparatuses and in performance situations. Prior works in this line of inquiry include multi-modal feedback loops, circuit bending, site-specific compositions, and intermedia devised performances. With the notion of clock-twisting added to this discussion, it may become appropriate to also call this mode of composition *intrinsic* besides being *native*. It seeks the aesthetic experiences that can be had by more deeply understanding and experiencing the situation of the performance itself, rather than forcing it into human-conceived scripts.

The musical surface of the work engages the question of the danceable pulse in music that is decidedly for listening. Surely seated minds can appreciate the ability to construct anticipations when given discernible patterns, but the mind is also able to "dance" (or follow along with its constructed models for listening) facilely along with any change no matter how surprising, even if there are multiple patterns audible at once. This work enters this field of play, in which the temporality itself can be bent expressively and combined in harmonies and dissonances. In this, the "beat" becomes a kind of non-pitch melody that might be brought into conversation with Schoenberg's *Klangfarbenmelodie* and moment form as explored in John Zorn's *Cat O'Nine Tails* and Karlheinz Stockhausen's *Kontakte.*

Fig. 1.



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Sediment

Keywords: Visuals; Processing; Generative; Minimalism; Computational Color; Resonance; Overtones.

Abstract:

Sediment is a series of abstract narrations which combine the generative visuals of Lali Barrière with the static music of Ferran Fages, with a clearly minimalist approach. The visuals use a single graphic element: the line, horizontal or vertical. The lines' change of color, often masked by its slowness, is perceived as motion and generates a landscape in continuous transformation. The sound materials are sustained tones, sympathetic resonances and overtones from the zither strings. The use of alternative tunings, specific for each piece, allows to generate a sound environment made of suspended clusters. A dialogue between music and visuals flows on a substrate of slow tempo.

1. CONCEPT

> European art... is based largely on immediate emotions... Rembrandt, for example, is a compendium of gloom sadness and tragedy. This immediacy of feeling is basic to all his paintings... Newman and Pollock have no immediacy of this kind. The thought and emotion of their work... is underlying, durable and concerned with space, time and existence. It's what Bergson calls "la durée". (Judd 1987)

Sediment is an audiovisual performance combining computer generated visuals with instrumental music with a clearly minimalist approach. It encompasses listening and watching as a single perception process in an immersive experience. Time freezes, sustained by small, slow changes that create an illusion of narrative. Music and visuals are mutually reinforced in a dialogue where a small amount of information accumulates, sediments, over time.

The visuals use a single graphic element: the line, horizontal or vertical. The lines' change of color, often masked by its slowness, is perceived as motion and generates a landscape in continuous transformation. The sound materials are sustained tones, sympathetic resonances and overtones from the zither strings. The use of alternative tunings, specific for each part, allows to generate a sound environment made of suspended clusters.

Sediment does not tell a story, it is not representational. Visuals and music participate in an abstract vs. abstract game, a game between two independent autonomous elements built on lines of changing colors (the visuals) and tones and overtones (the music). Each one creates its own space, yet they establish a dialogue and influence each other. It is here that its complexity resides.

2. COMPOSITION

Visuals and sound could be individually played, and *Sediment* could be viewed as the sum of two separate entities. Instead, *Sediment* is what emerges from the combination of these two entities, their interaction, and the continuous creation of bridges between them.

The piece is a series of instants subject to time stretch. Its structure is defined by a few time marks on the visual and sound materials. On top of this backbone, the piece evolves based on the ideas of indeterminacy and slowness and also on a particular use of repetition which avoids overlapping and saturation. The final result is an immersive experience, where time seems to be suspended, frozen. The lack of references places the senses of vision and hearing in a new situation out of what our instincts dictate and out of what we are used to.

3. THE ROLE OF COMPUTATION IN *SEDIMENT*

The visuals are computational, generated by extracting data from pictures and computing the colors of the vertical or horizontal lines form these data. Changes and transitions are controlled via MIDI by the performer. The whole set has been built with Processing as a programming language.

The authors consider that the visuals are "weak" generative, as termed by McCormack *et al.* in an interesting paper (McCormack 2014). The computer is used as a tool, or assistant, and creative decisions are taken by the performer, who communicates to the computer via the MIDI controller.

The music is purely analog, in line with the drone and minimalism tradition. Although the creative process involves the use of tools for spectral analysis and programming in Pure Data as a support to decision making, the approach is analog. The sources of sound are the strings of the zither and the e-bows. In this sense, *Sediment* is also a dialog between two opposites: digital and analog media.

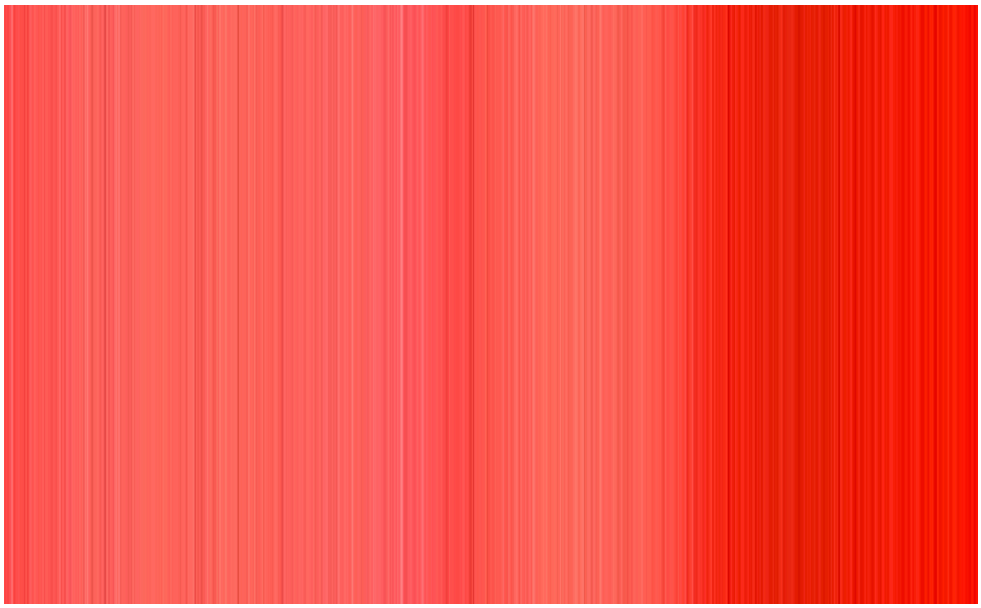

Fig. 1. Frame from Sediment.
Video: https://vimeo.com/226150910

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Doctoral Symposium

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Games for Creative Awareness

Keywords: Games; Creative Thinking; Collaboration; Diversity; Co-location; Framework.

Abstract:

Digital media have provided us with many tools, and allowed an ever-present knowledge space that we may resort to for all endeavours. The power provided by digital tools is such that in a blush we may be lead to think of creativity as something easily attainable, often a matter of solely acquiring technical skills. Furthermore, access to a wide pool of ready-made content, although beneficial, can hinder personal motivation to pursue one's own development. Such conceptions are seen as risks capable of alienating one's perspective and creative potential. To counter this we believe that promoting awareness of one's social diversity surroundings can help achieve higher knowledge and creative wealth, something in very high demand within today's competitive setting. With this in mind, we propose a game framework to harness such resources, aimed at exploring that potential in order to develop solutions of creative excellence.

1. PURPOSE

Our research aims to enhance creative solution-finding by exploring diverse socio-cultural thinking resources through digital game frameworks. We regard socio-cultural diversity as bodies of knowledge comprised by individual skills and background found within workgroups. Also, we believe that digital games can act as ideal grounds to access and employ these resources, due to playful, experimental, exploratory and computational characteristics. Therefore, we envision games as good instruments for creative work, capable of motivating collaborative, solution-finding efforts.

Amongst these resources we may be inclined to favour specialisation skills as an advantage, yet, we argue that success in innovating can be sustained equally by expertise and experiential know-how (Verma 2013, 30). As such, by endorsing acceptance for individual contribution through digital games, we can build collaborative efforts with great beneficial creative potential. Examples of this acceptance are communal initiatives shared through digital presence (Bogost 2007, 38-39), as they actively promote an assimilation of hypotheses free of professional or social statuses (Master et al. 2017, 201). Therefore, by improving interpersonal connections and understanding, games will allow to add a critical and still quite unexplored mass resource to creative thinking.

2. BACKGROUND

This research emerges from a concern felt throughout our professional career, the importance of respectful, interpersonal communication as a creative drive, hence the attempt to promote socio-cultural diversity as critical fuel for creative thinking.

By socio-cultural diversity we refer to groups of individuals with skills obtained through formal learning and lived experience. Regardless of how skills are acquired, all knowledge is seen as being equally useful for creative purposes and for stimulating emergent thinking and collective knowledge (Brown & Harris 2014, 6). It is also important for good game design (Gee 2005, 13-14) and to stimulate motivation and behavioural change (Scott & Ghinea 2013, 122).

Play is a process for growing and keeping our intellectual abilities fit (Bergen 2009, 413), in a pleasant and rewarding away (Nachmanovitch, 1990, 42). *Fun* is a process triggered by simulations beyond reality constraints, capable of inciting exploration in controlled game settings (Koster 2005, 34-40). Plus, these simulations can become fun and relevant narratives, as significance emerges from player background and by playing the game (Zheng & Gardner 2016, 296; Neto 2016, 5).

A game is regarded here as a support system, experienced by multiple individuals, where action is key for play to happen (Galloway 2006, 2; Cardoso 2016) and to promote player adherence and immersion (Schell 2008, 55). Games are also potential instruments for real world repair, due to exploratory dimension capabilities (McGonigal 2011, 7), and where enactment is framed by rules and mechanics (Sicart 2008). Enacting and feedback are key to play, therefore, games need to provide good interaction.

Interaction is a reciprocation between players and game system (Cardoso 2016, 161-166), a potential to stimulate collaboration efforts, when players share interests. Collaboration can also enhance creative solution-finding by feeding on co-located gameplay, as joint efforts are accelerated by proximity, and, easy access to accumulated knowledge (Spinuzzi 2012, 399-441).

3. APPROACH

Developing instruments for stimulating individual contribution acceptance requires design efforts that rely both on theoretical constructs and development practices. To work with both dimensions, we will use a Design-Based Research (DBR) approach,

believed to be good for instrument fine-tuning, as theory supports development, and outcomes help refine the theory itself. Besides DBR we will also resort to ethnographic research to better assess applicability.

We will seek involvement within creative communities next, using theory to appoint case studies, attempting to develop game prototypes capable of addressing creative needs and expectations. Instrument development will use simple construction resources, an approach regarded as an open field to explore creative and functional possibilities (Papert 1993, 121-122).

Finally, throughout iterations we will code practices into a database, the subsequent data analysis and evaluation will use grounded theory, grid techniques and triangulation credibility.

4. EXPECTED CONTRIBUTIONS

Game frameworks can increase efficiency for creative solution-finding, by capitalizing on playful, experimental and exploratory game characteristics, and, on a broadened acceptance for individual contribution (Agogué et al. 2015, 20-23; McGonical 2011, 212-215).

We regard game frameworks as capable of supporting player suggestions as favourable means to catalyse creative solutions, and in ways that might not be reached easily otherwise. Also, favourable lived experiences can foster our own self-worth which can be further reinforced by relating game activities to real world roles (Scott & Ghinea 2013, 119). As games are both fun and capable of providing meaningful experiences, they can also stimulate motivation (Koster 2005, 40; Frasca 2007, 78). Plus, by using the proposed framework, creative communities can also expand beyond their initial scope, in the same manner as casual games reach out for new players (Juul 2010, 2).

Game-sustained frameworks are seen here as good common grounds to improve interpersonal connections, a process enhanced by accepting social-cultural diverse individuals, capable of fostering understanding (Koster 2005, 68). Interpersonal collaboration also benefits from added iterating computational value to semantic and ontological human contributions (Boden 2004, 20).

Finally, promoting interpersonal connectivity within knowledgeable, co-working spaces increases the array of available thinking resources (Clifton et al. 2016, 29-33), which we intend to harness more efficiently through digital games, allowing individuals to build versatility and creativity skills.

5. PROGRESS

We are currently delving on a systematic review that addresses both theory and practices within the field of Game Studies and starting to get involved within community practices.

To this end, we have jointed efforts with INESC TEC[1] to refine the ongoing pervasive learning game BEACONING[2] platform. This project is aligned with our own goals, i.e., to provide multiple learning dimensions through digital games, while exploring collaborative and creative potentials. Another possible partnership integrated by INESC TEC is the FEEdBACk[3] project. It aims to foster behavioural change through gamification, while promoting motivation and focused group efforts.

Yet another possible collaboration is the Mu.SA[4] project, aimed at addressing the emerging needs that emerge from digital media potentials and impacted the contemporary Museum. We find that game instruments can prove beneficial within this field, both for professionals and audiences, due to learning, playful, and collaborative capabilities.

1. INESC Technology and Science — Associate Laboratory is a private non-profit research institution, at the intersection of academia, companies, public services and society, and aiming at building added value and significance. Homepage accessed April 19, 2018, from: https://www.inesctec.pt/

2. BEACONING is a location-based game platform geared at providing different student groups with anytime and anywhere Science, Technology & Maths (STEM) lessons. Project homepage accessed April 19, 2018, from: http://beaconing.eu/

3. The FEEdBACk project aims at endorsing efficient energy use through behavioural change, fostered by a gamified pervasive application. Project homepage accessed April 19, 2018, from: http://www.feedback-project.eu/

4. MuSA stands for Museum Sector Alliance, amongst other goals this is a project that aims to address the growing disconnection between formal education, training and practical work at Museums, and whose contours shifted through the emergence of new digital media and Tech. Project homepage accessed April 19, 2018, from: http://www.project-musa.eu

Other favourable community involvement settings are University of Porto's Science and Technology Park partnerships, due to entrepreneurship potential, creative incubation and continuous renewal of community human resources.

All these institutions offer the advantage of proximity to this doctoral programme. We are also taking some steps towards an early prototype, developed with analogue resources. However, this has yet to be properly refined, tested and published, something we aim to accomplish in the near future.

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6th Conference on Computation, Communication, Aesthetics & X
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Visualization for Artificial Intelligence Systems

Keywords: Data; System; Visualization; Aesthetics; Artificial Intelligence; Black Box.

Abstract:

This research project aims to study how visualizations can help create forms of literacy through an aesthetic interpretation of Artificial Intelligence (AI) systems. AI is constantly evolving. This is to the extent that not even software engineers can fully understand their intricacy. They are becoming *black boxes*. The study focuses on using Media Archaeology, iterative cycles of design, implementation and validation, experimenting the medium through the development of code-based prototypes, public exhibitions, and experts validation. The outcomes are visualizations of the data flows and narratives of the architectures of these systems.

1. PURPOSE

In the constant evolution of Artificial Intelligence (AI), we are seeing evidence of a growing complexity in these systems to a point that not even their software engineers can understand their intricacy. It is proving that this invisible force, that shapes our everyday lives, is becoming more and more like *black boxes*. There is a need to be able to explain what decisions are being performed between the layers of these systems. What transformations are being done to an input to result into a certain output. It is crucial for building user confidence, further exploitation and other explorations (Olah et al. 2018; Gunning 2016; Mordvintsev et al. 2015).

For example, Artificial Neural Networks (ANNs), that are loosely based on the human brain's neural structure, consist on a series of interconnected processing nodes that perform calculations on data that it receives as input. One node performs calculations on the received data, then passes the results to another layer of neurons that also perform calculations (Baraniuk 2018), and so on. Different layers may perform different kinds of transformations on their inputs. As ANNs can typically consist on a stack of 10 to 30 layers of artificial neurons (Mordvintsev et al. 2015), it is understandable that at some point it gets hard to grasp what calculations are be done between the initial input and the final output of ANNs.

Even though the science community has been designing technical illustrations of the inner workings of these complex AI systems. We find that these can require some previous knowledge and believe that they lack a connection with the non-scientific community.

2. EXPECTED CONTRIBUTIONS

> We need art to surprise us in order to blow up the world, to create fissures out of which the new can emerge. (in Warburton 2017)

We believe that art and aesthetics can have a big role in creating new forms of literacy through an aesthetic interpretation of these systems (Warburton 2017). We aim to study and develop algorithmical data-driven aesthetic visualizations of the data flows and narratives of the architectures of these AI systems. "Explainable AI" visualizations that enable human users to understand the inner workings of these systems (Gunning 2016).

3. APPROACH

The research and development process will focus on experimentation and validation. Using the "theory and methodology of digital media culture" called Media Archaeology, we will study the past and current state of these systems. Dive into their inner workings (Parrika 2012) experiencing these systems "as a medium" (McMullan 2017). Experimentation through a repeated refinement of a design, implementation and validation approach of code-based prototypes. This will enable us to experience the medium, collect knowledge, try out new ideas and / or techniques, change forms and / or appearances, iterate (Grau 2003), using the same language as the medium — code (Maeda 1999). Besides experimentation and exploration, we also think that writing code opens space for the creation of new models of reflection and problem solving (Grau 2003; Reas et al. 2010; Mateas 2008). This also opens the possibility of developing new visual languages with "new and unique powers of expression" (Carpenter, McLuhan 1960).

For validating our work we intend to hold public exhibitions and search for experts validation. We see this public and expert inquire necessary for avoiding bias, guiding

us on developing new aesthetic interpretations, visualizations of AI systems, that fulfill our research goal.

4. RELATED WORKS

The visualizations from an ongoing project, entitled "System Aesthetics" (Field 2017), from the London based creative studio Field, illustrates well how aesthetic visualizations can make a better connection with the non-scientific public. As Field (2017) refer, this project is a group of "studies of form, structure and behaviour of Artificial Intelligence algorithms". They find this exercise mandatory to "understand and discuss these fundamental forces that change our society". They stress that "we need new visual metaphors to help us decide how much influence we want to give to these intangible systems".

The interactive visualization developed by Daniel Smilkov, Fernanda Viégas, Martin Wattenberg, and the Big Picture team at Google, entitled "Visualizing High-Dimensional Space" (Smilkov et al. 2016), aims to help people understand more about Machine Learning models. In Smilkov et al. (2016) words, this project gives "a peek into how machine learning works, by visualizing high-dimensional data".

"The Building Blocks of Interpretability" (Olah, et al. 2018) shows interfaces that "explore the space of interpretability (...) that show what the network detects and explain how it develops its understanding, while keeping the amount of information human-scale." They "treat existing interpretability methods as fundamental and composable building blocks for rich user interfaces."

We believe that these projects and testimonials show the need, importance and urgency of these visualizations.

5. PROGRESS

There is a long-established interest and some experience with previous developed artefacts and / or visualizations working with data as a medium. This project is in a very early stage, where progress has begun, but is in a reading and knowledge collecting fase.

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Nature(s) Morte(s), Live Data

Keywords: Internet of Things; Interactive Artefacts; Artificial Esthetics; Connected Objects.

Abstract:

The Internet of Things is hailed as the next “big thing”, bound to transform the way objects are experienced. This paper proposes to examine the question this technology raises by looking at the evolution of our experience of objects throughout art history. From the Dutch Still Lives to the Surrealist Object, we see how artists articulated the paradigm shifts of their times through their representations and creations of mundane objects.

1. ART IN THE AGE OF AI

Recently, there have been several items in the news about what might be understood as the "resurrection" of Van Gogh, Rembrandt and other grand masters of painting. Several AI (Artificial Intelligence) research projects managed to create paintings "in the manner of" Rembrandt, Van Gogh etc., for example, this collaboration between Dutch advertising firm J. Walter Thompson, Microsoft Corporation and ING bank.

Wired magazine provides some details about the process through which this image was created:

> "With the help of several art experts, 346 Rembrandt paintings — digitized using 3D scans – were analyzed by a deep learning algorithm. The algorithm isolated common Rembrandt subjects to create the 'most consistent subject' — a white, middle aged man with facial hair, 'wearing black clothes with a white collar and a hat'. The subject was then composed by a software system that factored in 'geometry, composition and painting materials' before assembling into a face and pose. Brushstrokes were also modelled on those commonly used by Rembrandt." (Wired.co.uk, April 2016)

Fig. 1. *Rembrandt*. A collaboration between advertising firm J. Walter Thompson, Microsoft Corp and ING Bank, 2016.

When this research came out, some were quick to consider it as a genuine work of art, one that might drive artists out of their jobs, such as this online magazine:

> "There's already plenty of angst out there about the prospect of jobs lost to artificial intelligence, but this week, artists got a fresh reason to be concerned." (PCWorld.com, April 2016)

While PCWorld magazine might have betrayed their total disregard for artistic creation, simply for their own benefits, this type of research seems to flourish lately, and with it comes the inevitable question: what is the meaning of "artistic creation" in this day and age? Specifically, what is the meaning of the art object in the era of smart connected objects?

2. IOT: WHY AND WHAT

To understand some of the implications of connected objects, it is insightful to look at the socio-economical context which contributed to the rise of the Internet of Things (henceforth IoT). Although the discussion about the IoT has been around for a while,

somehow, the overall feeling is that the actual materialization of this hyped technology has so far yielded somewhat gimmicky products: a tweeting toaster; a connected washing machine; is this the disruptive edge we have been hearing so much about?

The answer lies, in part, in the power of the network. A sensing toaster, by itself, is not interesting per se. It becomes interesting when it participates in a network of toasters that is actually connected to a network of supermarkets, themselves part of another network, and so forth.

2.2. The current economic and social context of the IoT

The concept of networks of connected objects is not really new. As a matter of fact, we are almost there, have been for years. Most of our appliances have some sort of computer embedded in them. In a short exercise I did with students we counted about 130 embedded objects which we encounter every day. Moreover, prototypes for connected objects have been around for about 50 years. So, an interesting question is what made this moment right for the IoT to become "the third internet revolution"? The answer seems to be a convergence of several factors, which made this idea of connected objects come to life: The low cost of sensors and microprocessors; the availability of bandwidth at a low cost (we can't have so many communicating objects in each household without broad enough band); the availability of Wi-Fi (all these communicating objects can't be connected online through wires); the IPv6 protocol, which assigns a specific IP addresses to each these objects individually; the cloud technology, and big data technology to process all these data.

Yet all these factors still need one important catalyst to make this technology become a household technology: and this catalyst is the habituated user, in other words, it needs us. We are getting used to being surrounded by digital interfaces in most aspects of our lives. We constantly carry our smartphones — a portable central nervous system comprised of a myriad of applications. As for our part: we're ready.

3. FROM STILL LIFE TO LIVE DATA: THE ART HISTORICAL PATH OF THE OBJECT IN PAINTING

In what follows, I propose to examine the position of the object in the IoT era through an art historical perspective. I draw a parallel between the evolution in the position of mundane, everyday objects in art history through their pictorial representation in western painting, and the position of objects in contemporary culture as it is being transformed through the IoT.

3.1. The object in Still Life paintings

How has the representation of the object evolved through art history?

An obvious starting point would be the Still-Life genre. Still Life painting started long before the very much hyped "Still-Life" painting of the Dutch and Spanish painters of the 16th and 17th century. In his book *Looking at the overlooked*, art theoretician Norman Bryson examines paintings of mundane objects and artefacts dating back to the Roman and Greek empire. It's interesting to look at the evolution of the Still-Life genre throughout art history, because it focuses on the ordinary object, the object that takes part in everyday life.

Still-Life paintings turn their gaze to things, be they accessories of daily life or of distinction, that are otherwise excluded from the pictorial scene dedicated to "greater" historical or religious scenes. The odds and ends of still life objects are ignored in the dominant paintings because of their apparent inactivity, although they permeate human activity and are often necessary to fulfil even the most primitive needs, of human existence, as in the case of edibles.

Beyond depicting an endless list of material things from the realm of the overlooked, Still-Life is also specifically characterized by the rejection of the human presence: Bryson identifies the "exclusion of the human form and its seeming assault on the value and prestige of the human subject" (Bryson, 1990, 60) as a definitive feature of the genre. In some cases, the human form, although absent from the painting, is present through hints included in the represented objects, such as their wear and tear. An excellent example for this is Van Gogh's painting *Peasant Shoes* — where we can experience the essence of the peasant, daily toiling away in the fields, although all that is represented in the painting is a pair of shoes. might we say that the shoes encapsulate the daily data of the peasant's daily toiling away in the fields?

Fig. 2. *Peasant Shoes*. Vincent Van Gogh, 1888.

The narrative aspect in Still-Life paintings is not specific or textual but rather of a common or universally applicable experience of everyday life. If you will, Still Life focuses on the data accumulated over time and tradition. The narrative is inscribed in the data depicted in the objects and must be extracted by the user.

In very much the same manner, the IoT places the object at the focus of attention of the human viewer / user. The IoT is not about the hyper-narratives of the news or the constant human interaction of social networks and other content platforms, it's rather about the nitty-gritty tiny details of everyday life and movement such as counting steps (with fitness bands), usually overlooked by humans, for obvious reasons.

Moving forward to the 16th and 17th century, the golden age of Still-Life: Marked by the rising urbanization of European society, this era brings to light the habitats and their material goods, the blooming commerce, the rise of scientific knowledge, and so on. It is fascinating to re-encounter the representation of everyday life artefacts, only this time they take center stage, in the works of the Dutch (and Spanish) masters. In her seminal book *The Art of Describing: Dutch Art in the 17th Century*, art historian Svetlana Alpers draws a line between the technological innovations of that period — especially in optics — and the challenges of representing these optical inventions through painting. At the time, there was a genuine scientific and artistic interest in the way light reflects from quotidian objects. Glasses, textiles, cutlery, and other objects were often represented in paintings, taken out from the banal context and placed at the center of attention, to be examined and reflected upon.

In the case of IoT, we see a similar influence of technological developments on the way we experience, view, describe and think of objects. If in the 17th century new optical devices allowed for new dimensions of looking at and experiencing objects,

these days connected objects reveal to us new opportunities to look at objects. Take for the example the robotic vacuum cleaner, turned into a home surveillance device.

Fig. 3. Advertisement for a robot vacum cleaner which sunctions also as a home surveillance device, 2016.

4. THE SURREALIST OBJECT

Skipping to early 20th century, I will focus on Surrealism, the surrealists, and the surrealist object, and how they transformed the way we think of objects. The surrealists strove to free the object from its original function, let it live a life of its own, unbound to its original, functional purpose. The object loses its original place as a mere means, it is no longer an object, yet it is not quite a subject.

Fig. 4. *Lobster Phone*. Salvador Dali (1934). Fully functional.

In his groundbreaking essays *Art and Thingness*, Sven Lutticken establishes a difference between an 'Object' and a 'Thing'. He quotes WJT Mitchell stating that "Things are no longer waiting passively for a concept, theory or sovereign subject to arrange them in ordered ranks of objecthood. 'The Thing' rears its head—a rough beast or sci-fi monster, a repressed returnee, an obdurate materiality, a stumbling block and an object lesson". This "Sci-Fi monster", this "Obdurate materiality" seems to fit

perfectly the unknown "thing" territory the IoT is throwing us into. 'Internet of Things' follows a similar logic, by differentiating between 'objects' and 'things', such that a thing represents a wider category than an object. Lutticken refers to the surrealist object as a "materialization of desire and a dematerialisation of the object" (Lutticken 2010). The resemblance is striking. Isn't the IoT a materialization of our wildest object fantasies? Isn't the IoT's promise to liberate our objects from the functional constraints of their conception?

Precisely so. For the IoT, objects originally designed and manufactured to fulfill very specific functions, accumulate other functions which might even take precedence over the original ones. An excellent example for this would be the smartphone: Out of all the times that you used your smartphone today, how many were actually for making a phone call?

5. CONCLUSION

Returning to my opening question: what is the meaning of "artistic creation" in this day and age? It seems that for art to be alive and relevant it has to address the context in which it lives and operates, and to examine the media through which it is produced. Resurrecting Rembrandt's or Van Gogh's paintings through AI will not help us face the challenges we are facing today. We artists must be very wary of the magical, luring potential of disruptive technology, and strive to understand and expose the social, political and aesthetic undercurrents which feed it on the one hand and are transformed by it, on the other.

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Space as Dynamic Field Conditions

Keywords: Spatial Dynamics; Field Conditions; Computation; Digital Design; Spatial Experience.

Abstract:

While criticizing the current digital design culture in architecture treating space as mere context of architectural form and performance, the research investigates historical theories claiming space as dynamic conditions in relation to diverse spatial experience, filled with dynamic forces and flows. Based on such theories and support by recent scientific experiments, the research tries to reinstate the idea of dynamic space as the focus of digital design culture in architecture, by establishing a system incorporating computational frameworks to investigate properties of dynamic equilibrium in space.

RESEARCH CONTEXT

Since its proliferation in the 1990s, the use of digital technologies in architectural design practices has largely been focused on generation of form: as environmental adaptation to contextual conditions (Lynn 1999) or performative adaptation to material properties and fabrication constrains (Kolarevic and Malkawi 2005). The digital, thus, has moved the discourse within the discipline of architecture away from the notion of space which marked the focal point of discourse for the largest part of the 20th century (Ven 1987).

The idea of space and with it concepts like spatial dynamics can be traced back to discourses in 19th century aesthetics and included abstract notions such as spatial perception, empathy and embodiment, as well as more tangible ideas such as interpenetration of form and space (Mallgrave and Ikonomou 1994). Such range of discourses continued to be reconstructed and facilitated for diverse architectural practices throughout the 20th century (Ven 1987) and the interconnectivity of space and form theorized by adding aspects of phenomenology and spatial perception to the dialogue (Arnheim 1977). Recent studies in neuroscience have confirmed many of this early speculations: the human brain constantly interacts with the external spatial environment in diverse ways with multiple spatial references and cells activated, as well as ideas such as empathy and embodied simulation correspond with innate features of the human brain (Mallgrave 2011; Mallgrave 2013; Robinson and Pallasmaa 2015).

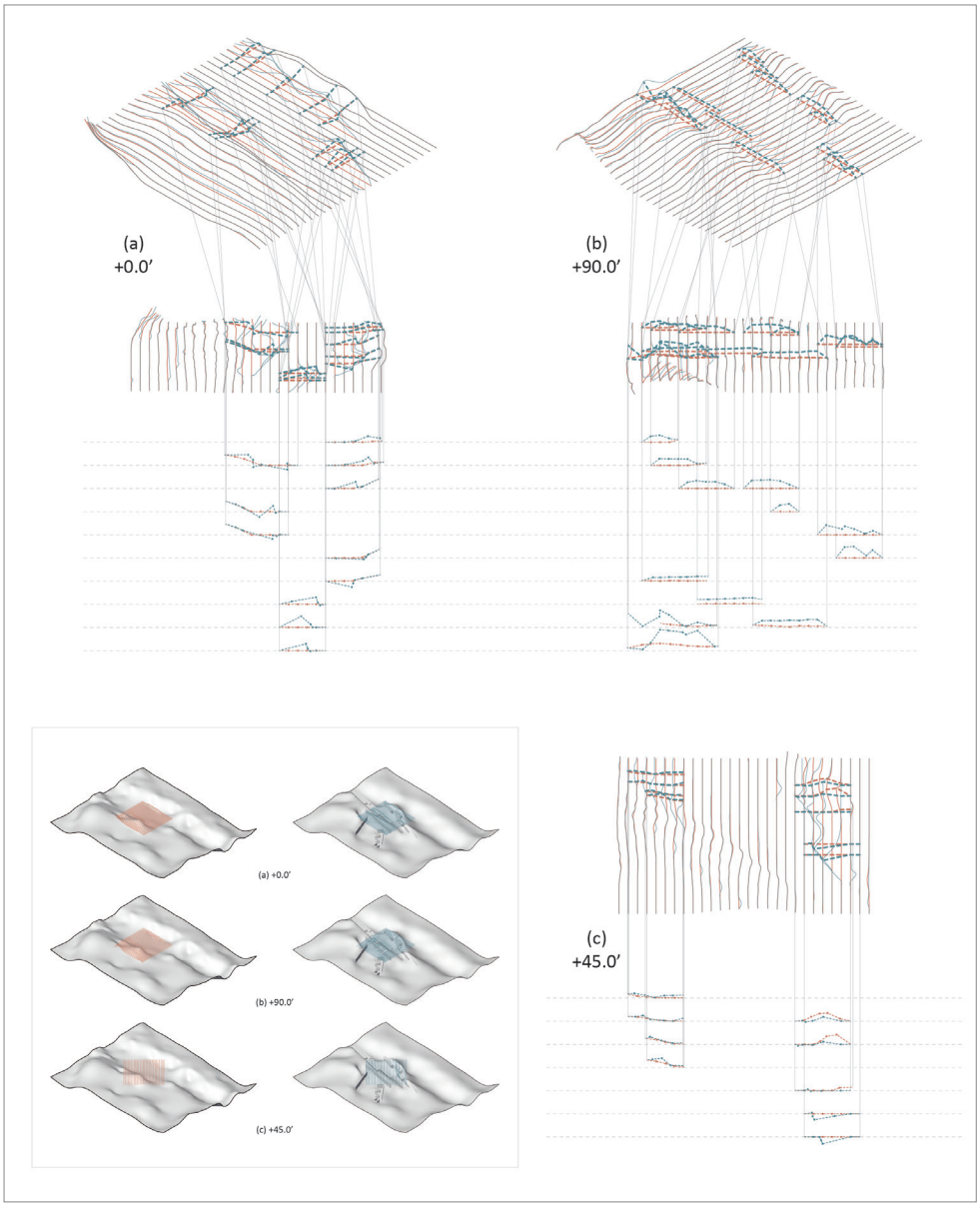
The research attempts to revitalize the notion of space for digital architectural practice based on the interconnectivity of space and form as dynamic interaction of neighboring elements. Such an understanding of space as "field condition" (Allen 2013) has proved to be productive in architectural discourse. The goal of the research is the establishing of spatial dynamics as measurable spatial phenomena, as property of the field condition, and its utilization within a digital framework. Ultimately, this should enable spatial designers to further understanding of spatial dynamics for better practices.

RESEARCH PLAN

The initial stage of the research is to establish a computational framework with a simple field condition composed of particles whose vectors react to network of forces generated by objects in space. The resulting spatial dynamics is visualized by means of a deformation of a laminar flow. The changes in density of the flow, thus, are markers of interaction. The density pattern can vary, depending on the orientation of the laminar flow, the initial density of the field condition, the number of forces involved, intensity and direction of each force, and etc. The constructed laminar functions as a kind of tomography of the spatial conditions and design relevant information can be extracted from an analysis of the correlation of various density patterns. The validity of this tomographic strategy is explored in more depth with a case study on the architecture of Enric Miralles.

The case study is expected to instigate refinement of the framework for a wider range of projects involving varying degrees of complexity and distinctive sets of parameters.

Fig. 1.



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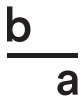

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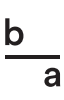

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