

master's thesis

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PLAYS OF *PROXIMITY* AND *DISTANCE*

Gesture-based interaction
and visual music

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Abstract

This thesis presents the relations between gestural interfaces and artworks which deal with real-time and simultaneous performance of dynamic imagery and sound, the so called *visual music* practices. Those relation extend from a historical, practical and theoretical viewpoint, which this study aims to cover, at least partially, all of them. Such relations are exemplified by two artistic projects developed by the author of this thesis, which work as a starting point for analysing the issues around the two main topics. The principles, patterns, challenges and concepts which structured the two artworks are extracted, analysed and discussed, providing elements for comparison and evaluation, which may be useful for future researches on the topic.

Keywords Visual music; Gesture-based interfaces; Audiovisual art; Gestural interaction; New models of interaction; Interface aesthetics; Interactivity; Transmedia art; Realtime audiovisual; User experience design

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Fernando Visockis Macedo,
Berlin - March 2017

1 INTRODUCTION

Motivations

In the year of 2008 as a first year student of Music Composition back in São Paulo, I first became acquainted with works that were music pieces, but not exactly so. As a young curious student engrossed for the most part in aural sensory, I was astounded by these newfound works, which explored the auditory realm in an expanded way, combining it with visual elements in a very intrinsic, almost ethereal manner. I realised right then that such a field presented me with a lot to investigate and experiment with. This profoundly changed my focus in both study and artistic belief. Later I got to know that such practice had a name (or names) and a long and fascinating tradition. Since then I've been actively working as a producer, composer and performer of transmedia artworks that explore these grounds.

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This thesis seeks to fulfil my needs as an art practitioner by analysing and connecting the missing points between human will to cre-

ative expression and the reasons behind it. Its investigation looks at how human-computer interaction in artistic contexts manifests social and human behaviour and their endeavours. Gestural language and expressivity were a constant topic of my interest as an electronic music performer. I wondered how would be possible to overcome the traditional format of such presentation, being a musician seating and facing her laptop. By presenting two pieces composed and produced by me, I exemplify the intrinsic concerns of artworks which use sound and moving images in combination with gesture based interfaces, for expressive purposes. The research question which this thesis investigates is *How can gesture based interaction be represented in visual music?*

From my experience in developing art projects, specifically in audiovisual and new media art, I realised at the beginning of this research that I would opt for a strong emphasis in practical research method. Designing, implementing and presenting visual music pieces are part of my artistic practice and skill set, which could facilitate the realisation and application of the desired method. Also, as a design practitioner, I believe that

8 a hands-on approach is a key element for revealing layers of contexts and concepts, as well as triggering questions around the discussion that a theoretical-only approach would not enable.

I decided to create artistic pieces and take part in all the stages of its process, from conceiving and designing, to implement-

ing, installing, performing and promoting it. This multi-task approach is a relevant decision for, as Mia Makela points[1], even setting up the projections is incorporated as part of the creative process, intensifying the practice's kinship with the field of transmedia artworks. Only in this way would I be able to embrace and measure the conceptual, design, HCI and societal aspects so inherent in this discussion. I find it extreme importance for artists to reflect and analyse their practices at a theoretical level and in this sense, the proposed research here establishes a feedback loop in which the practice and theory are intimately knitted. Such research may provide insightful knowledge to other practitioners of the same field.

Overview of the thesis

The remainder of this thesis is divided into six chapters. In chapter 2, *Literature Review*, I focus on the background research and concepts which are pillars for my practice. I present a large amount of practical works from other authors, as well as showing aesthetic concepts and contextual conditions which are engines for the motivation of this research. The Literature Review chapter is divided between the two main constructive topics of my work: aesthetics and interface investigation. Chapter 3, *Methodology*, provides the reasons as well as the references to my methodological choices.

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Even though the main goal of this research is not to propose a definite terminology for the discipline, I aim to make clear my decision for using one or another term. This reflects

on from which angles I chose to investigate the topic. This perspective build the analysis method presented on chapters 4, *Ramshackle Dystonia*, and 5, *Conducting Senses*. I follow the two literatures afore described to base my analysis about the practical research developed. In this section I seek for a holistic approach, a path that investigates disciplines not for their boundaries, but specially for their touching and expansion points. The structure is divided in four in chapters 4 and 5: *Design Specifications*, *Experiments*, *Findings* and *Audience Studies*. The Design Specifications works as a core structural guidance for these parts, forming the arrangement on how the ideas are there presented.

Chapter 6, *Discussion*, suggests a transversal orientation on how all these notions and practical results can be interpreted. The intention of this debate is to widely open the topics, indicating paths which may serve to indicate ways to develop and evaluate visual music works which make use of gestural interfaces. Again, the concepts there presented make use of the Design Specifications for its guidance.

10 Chapter 7, *Conclusion*, summarises the main findings of my thesis work and presents possible further developments for the continuation of this research.

2 LITERATURE REVIEW

This chapter aims at clarifying and providing contextual background information related to the discussion proposed in this thesis. Aiming at analysing my practical research in accordance to my background, I somehow knew that naturally it would narrow down to a mainly artistic analysis. Meaning it would be focused in conceptual and “*plastic*”¹ components of my pieces. However, the pieces themselves have more in their surrounding than contextual and sensorial facets: the interaction and the user’s role in the practical research were key elements to be studied in order to address my research question. In this sense I had to leave my comfort zone and dig into experience related research and also detailed analysis related to interaction design aspects.

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The literature review is then divided in two main parts:

Aesthetics

This covers the background and theoretical information related to the “plasticity” of the

¹ “Plastic” and “plasticity” will be the terminology adopted by this research when referring to the techniques, form and characteristics of the material (this being sonic and/or visual elements) output from artworks. This concept does not cover sensorial, perceptual and conceptual elements involved in the work, as this will be referred to as “aesthetic” components, as suggested by poststructuralist aesthetic studies. The term “plastic” borrows from Portuguese language, however some English speaking authors theorise around it, such as in <http://numerocinqmagazine.com/2014/07/04/considering-plasticity-art-victoria-palermo-introduced-by-mary-kathryn-jablonski/>

work, such as visual and sonic outcomes. Apart from this, it presents facets of the aesthetic premises and motivations related to *visual music*. It reveals concepts that aim to describe, in a broad sense, the artistic practice involved in this research. As artworks always exist in a social and temporal context, this part covers as well the historical relevant works and discussion that play an important role in the analysis and discussion.

The focus is in what are key elements of visual music as a genre and what would be possible poetic visions that such kind of work searches for.

Interaction

Issues that concern the concept of *gesture based interfaces* were the main focus of my background research in this part, aiming at relating to the aesthetic studies. Some frameworks and methodology around the topic are covered. A special attention is then given to the idea of experience when in contact with an artwork, as proposed by many authors but mainly John Dewey, and to the guideline *Criticism Interface*, which proposes an analytical framework to look at interfaces and interactivity. Practical examples are mentioned to demonstrate the history and successes and failures of such kind of interaction mode. The idea is to navigate what are specificities of gesture based interfaces and moreover, what makes it even more unique when used in an artistic context.

2.1 Aesthetics

2.1.1 *Synchresis, synaesthesia and audiovisual mapping*

The correlation between sound and imagery in performative arts have always stretched beyond each of the practices per se. Since the well known *comedia dell'art* and operas it is noticeable an intention of “saturating the senses with all available technologies”[2], aiming to immerse the audience in a temporal, intermediated experience. A considerable amount of works dealing with trans-media have a touching point in such concept and basis. The design of pieces that delve into a replacement of naturalist and narrative elements by abstract and juxtaposition of sound and visual elements are examples of artworks that intend to take the notion of multimedia into a new level. Two important concepts present in such studies are the idea of *synaesthesia* and *synchresis*.

Synaesthesia is the condition in which the human sensory channels blend, sending information to one another. A subjective condition that shapes and defines the perception of reality for several people. Even though studies[3] and exemplification of the *synaesthesia* phenomenon exist in science and nature, its exploration within artistic practices are extremely difficult, mainly because there is a fundamental difference in between the senses in use, being hearing and seeing. Whilst the sense of seeing is a focus-point based kind of attention, hearing is a omni-directional sense which happens in parallel, grabbing a multitude of events

simultaneously[2]. Artistic works may tentatively achieve this relationship between the two senses offering a coherent establishment between both. And though this mapping process is exactly one of the topics of this research, to believe that true synaesthesia can be achieved through an art piece is fairly questionable. Albeit provoking plain synaesthesia through aesthetic experiences may be an ultimately impossible challenge, such concept has inspired and fed abstract audiovisual works for a long time. A so called metaphoric synaesthesia[4].

Synchresis is a concept from film theory created by Michel Chion in the book *Audiovision* [5]. The word is a combination of “synchronism” and “synthesis” and serves to explain “the spontaneous and irresistible weld produced between a particular auditory phenomenon and visual phenomenon when they occur at the same time”[5]. It describes the fact that, even if the sound and the image do not have the same natural source, when put together simultaneously, enhance the perception of the spectator, making it more real - Chion called it “added value”[6]. Our brain establish a connection between both sound and image, once synchresis happens. Whether the chosen sound is in fact a realistic representation of the visual phenomenon is not really important because, according to Chion, in a *gestaltian* manner, our brains add meaning to it and the fact that they happen at the same time is more relevant than the qualities of its juxtaposition. This concept, even if borrowed from cinema theory, is acutely relevant in the practices described in

this research.

Other relations between both senses shall be explored though: during the nineteenth century, Helmholtz[7] studied the relationship between musical harmony and the human perceptual apparatus. His discoveries can guide an investigation into the relationship between music and visual art. In a key finding, Helmholtz concluded that we appreciate the geometric progression in sound frequencies because our ears seem to produce these overtones even in the absence of their physical presence. In other words, we enjoy the art born from the subtle manipulation of our aural psychology[8].

2.1.2 A (very) brief history of visual music

In search for a definition of visual music

Intermedia experiments which try to translate sonic/music compositions into visual languages, have now a long tradition[4]. Non-narrative, mostly abstract visuals combined with sound, that can be presented either as a film or as a live performance[9]. The artistic practices that, one way or another, correlate to the above mentioned topics, is what is called visual music. This tradition, in the past, has had various names such as *ocular music*, *color music* or *music for the eyes*[10], and more recently as *expanded cinema*, *live cinema* and *audiovisual performances*. Defining a singular term to encompass all the variant practices is not an easy task - and neither is the centre of this research. I chose to make use of the term visual music not only for stylistic reasons, but because it is a vast enough nomenclature to englobe divergent techniques and ideas. It is noticeable a

consistent literature around this topic which had reinforced the suggestion for this name (See: [12] and [9]). The massive presence of imagery in our society, explained in theories such as [51] and [52] may be combined with, for instance, Schopenhauer's suggestions that music was the expression of will itself [11]. The term visual music offers a compact expression for the attempts to align such aspects.

As Moritz points:

Since ancient times artists have longed to create with moving lights a music for the eye comparable to the effects of sound for the ear[11].

The practices here described will show works that try both ways around: 1) of creating a visual stylistic representation of a pre-disposed soundtrack; 2) the ones that explore the generation of music directly from visual aesthetics, a process of 'sonification', without the composer having, necessarily, awareness of how the sonic outcome will be.

The early experiments

16 Composers such as Scriabin or painters such as Paul Klee devoted time to explore the realm of visual music. Instruments such as [11] the *Ocular Harpsichord* (Father Louis Faber Castel, 18th Century), *Clavilux* (Thomas Wilfred, 1930s), *Lumigraph* (Oskar Fischinger, 1940s) and *MobilColor Projector* (Charles Dockum, 1930s) have inspired generations during the last centuries, proposing in different inventive ways techniques for exploring analog technology

for generation of visual content in accompany of music in real time. These works were engineering-based machinery of all sorts that explored the expressivity of the user through audiovisual synthesis. These inventors resembled luthiers, the musical instruments makers, with the addition that the instruments also had a visual outcome. Their interfaces, results and explorations varied in forms, sizes and concepts, but in common they all had the fact that they were closer to being an instrument than a composition - meaning they were used for performances that should offer a medium for endless and varied expression for the user, just as any musical instrument does. Thus, they required tailoring and mastering of specific techniques.

Their studies pointed to different ways of representing the sound visually, combining colour information and graphical shapes, mostly following the designer's choices - that were, quite often, made in an arbitrary way. Some attempts did, for example, the mapping of sound pitch and colour - *see table number 1*. There was, in this case, a belief that exists an objective related quality between between colours of the spectrum and the tempered pitches of western musical scales. Due to technical issues, often these explorations were quite limited. These mappings between visuals and sounds were certainly an obstacle for the user's expressivity aimed by these instruments, since the user was usually confined in the world and vocabulary proposed by the inventor of the work.

		C	C#	D	#D	E	F	F#	G	G#	A	A#	B
Newton	1704												
Gerstner, 1986, p. 167													
Castel	1734												
Peacock, 1988, p. 400													
Field	1816												
Klein, 1930, p. 69													
Seaman	1881												
Klein, 1930, p. 86													
Rimington	1893												
Peacock, 1988, p. 402													
Helmholtz	1910												
Helmoltz, 1910, p. 77													
Scriabin	1911												
Jones, 1972, p. 104													
Klein	1930												
Jones, 1972, p. 111													
Appell	1940s												
Gerstner, 1986, p. 169													
Vishnogradsky	1970s												
Gerstner, 1986, p. 167													

Table 1: An example of colorscales as proposed by different artists among the centuries. Source: <http://rhythmiclight.com/archives/ideas/colorscales.html>

Abstract films

Another branch that existed in the 20th Century - even coexisting with some of the before mentioned works - were the ones exploring cinematic techniques for audiovisual synthesis. This genre is usually referred to as *abstract film*[12]. Inspired by modern art manifestations, artists like (again) Oskar Fschinger, Walter Ruttmann, Viking Eggeling and Norman McLaren made use of preconceived material prepared in laboratories that studied abstract temporal compositions[13]. Techniques such as drawing, toning, hand-tinting, tinting of whole strips, painting, slicing and risking the film's celluloid were explored; others tried using the *optical soundtrack machine* to generate accompanying sounds strictly from visual information, sometimes creating sets of

cards and figures to be read by the optical film machine. These works were usually presented as compositions, since their results were not manipulated in real time.

These practices certainly pushed the cinema boundaries by exploring the foreground aspects of cinematic elements: it was the first time that the very own physical and chemical elements that produce the mediated cinema experience, gained a main character role. They demonstrated a new approach to cinematic space and time, and, at least by implication, declared the independence from the reliance on narrative in cinema[14]. They defined a new kind of 'plot', one closer to the geometric sense of the term than to its conventional meaning in film.

The digital era

The end of the 20th Century welcomes the addition of digital tools for such implementations. More than a clear new world from the technical side, the disruption caused by such technologies also created new paradigms and questions to the poetics of visual music practices, as it will be discussed in the next sections. The practices then branch out in many forms, genres, sub-genres, names and contexts: *Live cinema*, *VJing*, *audiovisual performances/installations*, *audiovisual concert*, *multimedia instruments* among others. Although I shall not go in details about each of them, it is relevant to show the increase of artists practicing it, as well as the space and acceptance it gained with cultural institutions and the so called "mainstream culture" in the last decades.

As mentioned earlier, the use of technologies always played an important role in visual music practices. Computer technology has made it possible to transcend barriers of physical, optical and mechanical systems as well as offered an opportunity to explore real-time audiovisual synthesis that are unbound from the laws of physics[12]. The development of electronic music also pushed the technical development a step further, enabling new paradigms for designing compositions through generative ways based in algorithmic logics. It made possible to conceive and generate content in a broader and more free way, offering a higher amplitude of possible strategies to map visual and sonic mediums. It also enabled new techniques to generate sounds from visual content ('sonification'), purely following complex synthesis processes. In this sense, there is a shift of the composer's role itself. Commonly, the designer assumes again a luthier-alike role, either by conceiving and programming the software of their "instruments" or by working with DIY electronics. In many senses, the process of designing those instruments are analogous to composing.

20 Aiming at disrupting the audience from the condition imposed by Hollywood cinema setups (being a rectangular projection with speakers in a dark room), several artists search for ways to create an "abstracted hybrid that fuses the theatrical gesture of opera with the more intimate creative aspects of a painter's or photographer's practice"[2]. These art pieces would lay somewhere between the studio and concert hall, between

an individual art practice and a stage-based performance experience by an audience. The possible setups expanded then to projection in architectural facades and/or light sources of different kinds such as lasers and LEDs, as examples in the visual realm; networked speakers and hybrid sound sources, for example in the sonic realm; the use of sensors as input for generating the material in real-time, as examples in the controlled intent realm. Artists such as Carsten Nicolai and Ryoichi Kurokawa, are revealing examples of the exploration of visual music in the computational era. Both - with their own unique approach - delve into the world of minimalist digital graphics and sounds, to “giving audiences unrivalled scientific access and accuracies”[57] Their live performances propose complex processes of sound visualisation that incorporate physical simulations like particle systems and gravity, combining scientific theories with poetic premises. They manage to tie sound and imagery in an extremely unified composition, making use of digital ‘transparent’ tools for a mediated, immediacy based sensorial experience.

2.1.3 Post-digital world

The recent shift caused by the overuse of digital tools in our society’s daily lives has been a subject of study from several academic fields, such as media theory, media technology, cultural and social sciences studies. Although it would be hard to affirm the existence of a consensus in such topic, it is clear that our relationship with digital information and technology has been abruptly disrupted in the turn of the century.

One of the terms used to name such brake of paradigm is *post-digital*. It serves to describe the contemporary disenchantment with digital information and media gadgets, a period in which our fascination with such has become historical[15]. This disenchantment may be explained by several societal issues involved in our contemporary relation with digital technology, such as the loss of privacy, the notion that our control over technology is an illusion, the overload of information caused by it, big data and the word of the year 2016 “*post-truth*”². In the artistic context, this withdrawal may be seen by a return to old practices, in which many artists may look for non-digital tools or to a stylisation of visual and sonic content that resembles analog devices to produce digital artistic expression. The simplest definition of ‘post-digital’ in art practices describes a media aesthetics which opposes such digital high-tech and high-fidelity cleanness, “a teleological movement toward ‘perfect’ representation” [16]. The term was coined in 2000 by the musician Kim Cascone, in the context of glitch aesthetics in contemporary electronic music. Cascone and Andrews considered the notion of ‘post-digital’ primarily as an antidote to techno-Hegelianism.

22

2
Word of the year by Oxford
Dictionary
<https://en.oxforddictionaries.com/word-of-the-year/word-of-the-year-2016>

The practitioners of such grew immersed in a society filled with digital technology (“computer fans whirring, laser printers churning out documents, the sonification of user-interfaces, and the muffled noise of hard drives”[17]) and shift their attention to the opaque elements of this media, the arte-

facts and ‘failures’ inherent to them (“glitches, bugs, application errors, system crashes, clipping, aliasing, distortion, quantization noise, and even the noise floor of computer sound cards are the raw materials”[17]). As a result, it is noticeable a retro approach on the one hand, with photographers turning their attention to analogue film cameras, musicians to analog synthesisers and graphic designers to printmaking; on the other hand, some musicians, video and electronic artists searched for ways to “corrupt” the digital tools in order to achieve new results.

An alluring example of the latter case is what german artist Oval did in early 2000s: he printed small images in CD-ROMs in order to make the tracks skip, achieving non-expected musical results. This example resembles experiments from the already mentioned abstract film practitioners, who were drawing in the film celluloid. Overall, there is an idea of revealing how non-transparent our most high-tech media are and bringing such aspects and elements to the foreground of the artistic research.

A genre that fits this aim for digital disruption is the so called *Glitch Art*. Dutch artist Rosa Menkman wrote in 2010 a manifesto for Glitch Studies[18] in which she argues in favour of a more critical attention to glitch artistic practices. At a most basic level, glitch artists can challenge the standard mode of operation of a system by appropriating glitches that are respawned (partially or completely) by production processes[19]. More pragmatically, artists would induce

the systems (being software or hardware) to “misbehave”. As usually those glitches are found to be very hectic and momentary, there is an attempt to domesticate, emulate it in order to recreate, have control (at least up to some instance) over its visual and sonic results. A *glitch-alike* practice as Iman Moradi[20] defines. In such approach, the focus is not intensively on the process of creation through destruction, but more in the final stylistic results that may resemble digital system’s errors. Summarising, would be more descriptive to say that it uses “methods as introducing noisy data to functional algorithms or applying these algorithms in unconventional ways”[21]. A core debate around such aesthetics (*See table 2*) is the role of control in art, the intentional/controlled “destructive” art and the pure/non-controlled “destructive” art.

PURE GLITCH	GLITCH-ALIKE
Accidental	Deliberate
Coincidental	Planned
Appropriated	Created
Found	Designed
Real	Artificial

24 Table 2: Iman Moradi’s table for defining Glitch and Glitch-alike. From the Iman Moradi, *GlitchAesthetics*, UK:University of Huddersfield

Another dwelling exploration of art in such context is the use of the interface as the basic aesthetic form of digital art. Making the interface, its expression and materiality more functional and transparent has been key to interface design and the accompanying

academic discipline, HCI. The more invisible the interface is, the less of an obstacle to the user, the better. If this invisibility was to be true “digital technologies would probably not have any paradigmatic effect on culture and aesthetics since they would not make a marked difference”[22]. As reality proved this not to be quite there yet, artists started appropriating these ‘obstacles’ and its social, behavioural and political impact, as well the ways it shapes our experiences of realities. It found a way to show “us the role of the interface and the significance of the interface as an aesthetic, cultural, and ideological object”[22] The so called *Software Art*[23]. One revealing example of such is the piece *Auto-Illustrator* (2000-2003) by Adrian Ward, in which the artist creates a functioning drawing software that explores several well-known GUI elements but attributes non-expected functionalities to it.

2.2 Interaction

2.2.1 Experience

Seeking for friction points between artistic studies and design disciplines is a challenge. If in the pragmatic side it is clear that both fields share numerous congregating elements (such as form, perception, message and compositional processes), in the conceptual realm their fundamental reasons diverge. The concept of *experience* is a clear friction point between both areas - specially when considering modern human centred design. John Dewey wrote in 1934 *Art as Experience*[24], a philosophical book in the field of aesthetics that aims to explain the relation

between audience and artistic work. The fact that his studies have been instrumental in helping designers understand quantitative and qualitative aspects of their work[25], substantiate that the concept of experience is a significant contact point between the two fields in a conceptual level.

There is no doubt that experience is an elusive term to pin down, but Dewey branches it into two main sub-categories: *Experience* and *An Experience*. Experience is the constant stream of perceiving events in our daily lives, the way we consciously interpret and relate to reality; the way we continuously assess our goals relative to the environment, people and surrounding around us at any time. An Experience is something more coalesced, something that can be named, articulated and set into a timeline. This type of experience may be characterised by a number of artefact interactions and emotions, but is schematised with a particular character in one's memory and a sense of completion[25]. It has a clear beginning and an end and it often enables emotional outcome and/or behavioural changes in the experiencer.

26 Even though Dewey points works of art as important enablers for An Experience, he also thought that practical actions could lead the experiencer to such[26], making it, thus, a fundamental concept for designers focused on user experience. Dewey insists that art and the aesthetic cannot be understood without full appreciation of their socio-historical dimensions. "He stresses that art is not an abstract, autonomously aesthetic notion,

but something materially rooted in the real world and significantly structured by its socio economic and political factors”[27]. From a design point of view, a product, service or design object may be a An Experience enabler. And for that, a sum of aspects have to be considered, such as: surroundings, condition, context, form, profile of the user, intention. But specifically in the case of interactive pieces, the interface and model of interaction are key elements that mediates the user’s relation[28] to it.

2.2.2 Aesthetic analysis of interface and Interface Criticism

The studies of HCI has developed its analysis tools with its basis grounded strongly in cognitive psychology (eg.: [29]) and it has largely been understood in technical terms and developed in engineering laboratories. Empirical experiments that aim to identify features and behaviours of human interaction with computer and machines. Such methods and frameworks have developed so widely that are now fairly simple and cost effective to be used in designer’s daily practices. Such methodology can still make it difficult to understand and foresee unexpected uses deriving from, for instance, user’s change in expectation and experience. To seek for a more extensive analysis methodology as “We need to take into account the broader cultural context in order to understand and design IT-based artefacts today”[30] is thus required. A way to “introduce perspectives on the use situation taking experience rather than cognition as the basic unit of analysis”[30]. The proposed framework in response to this

need is *Interface Criticism*[31], which investigates the potential of critical thinking to analyse interfaces, adding contextual, political and cultural elements to the analysis methods. The afore mentioned method aims to relocate HCI closer to an aesthetic discipline. It offers a shift from “user-oriented” to “experience-oriented” analysis[30].

List of elements from the Interface Criticism[31] framework:

- . Analyse stylistic references in the interface
- . Identify the use of standards and the conformance to tradition
- . Discuss immediacy and hypermediacy in the interface
- . Identify and consider various genres in the interface
- . Identify representational techniques and analyze how they work
- . Identify challenges to users' expectations
- . Consider the developmental potentials

It is important to grasp from the development of aesthetics studies: traditionally it existed as a guideline on how to make things pretty, balanced and well formed; later it expanded to incorporate senses, cognition, signs and perception (eg.: [32]). HCI may be mature enough to overcome the formal, traditional stage and incorporate more from modern and contemporary aesthetics than only from traditional manifestations of the discipline. As mentioned in the above

28 section, the aesthetic of an artefact (eg.: an interface) is not inherent to the object itself, but rather to the relation between the human appropriation of such[33].

The Interface Criticism guide proposes a practical framework, a guideline for analysing interface-based artefacts starting from potential for synergy between *experience* and

critical theory in HCI[34]. Such method will be the one in mind for this research when analysing the results obtained from the practical work.

2.2.3 Gesture-based interaction

Gestures and body language are far-reaching constituents of human communication and dialoguing skills. Not only in HCI, but in human-human interaction we can quickly realise how we utilise a broad range of gestures in communicative situations. This is shown by the fact that we tend to gesticulate even when talking on the telephone[35], for instance. And the range and vocabulary of these gestures vary from culture to culture, revealing specific anthropologic elements of these semiotics. Rime and Schiaratura [53] propose the following gesture taxonomy (table3):

GESTURE NAME	EXAMPLE
Symbolic Gestures - Meaningful to a specific culture	-“OK” Sign/Waving goodbye -Sign language
Deictic Gestures - Mostly seen in HCI	-Pointing to a specific object -Directing listeners attention
Iconic Gestures - Resembles or mimics a physical action	-Conveying size or orientation of an object -“The plane flew like this”

Table 3: Gesture taxonomy proposed by Rime and Schiaratura

Gestural interfaces are not new. Musical instruments in general are both a touch and gesture based interface (special attention to the early 1920s musical instrument Theremin) and position tracking has long played a role in game design[36]. Even some of the colour organs mentioned in the previous section, explored how gestures could in fact translate the user’s intention. In the

field of HCI the use and discussion around gesture-based interfaces has been a relevant topic at least since the 1980s with the success of the MIT's "Put That There"[37] system, which conjoint use of voice-input and gesture-recognition to command events on a large format graphics display. It is important to isolate from this discussion only gestures that are articulated by an inter-actor and recognised by a computer, rather than a consequence of expressing something through a transducer. Thus, I choose the definition of gesture articulated by Kurtenbach and Hulteen [54]:

A gesture is a motion of the body that contains information. Waving good-bye is a gesture. Pressing a key on a keyboard is not a gesture because the motion of a finger on its way to hitting a key is neither observed nor significant. All that matters is which key was pressed.

30 The effectiveness of gestural interaction relies exactly on enabling us to do more than what we can do with a mouse and a keyboard. Trying to do gesture recognition by using a mouse or some other "single point" device for gestural interaction restricts the user to the gestural vocabulary of a fruit fly: you may still be able to communicate, but your gestural repertoire will be seriously constrained[38].

The recent development of the technologies to enable the use of gesture recognition has made it possible for it to become a relevant

component of interaction design, surpassing the fantasy state of inspiration from Sci-Fi movies to become reality - being the most clear example the touch screens incorporated into our smartphones. A disruption of the role of physical objects in HCI, which allow a breakthrough from “purely computational entities like cursors and insertion points, but can begin to take on a more direct role in the interaction”[39]. And it has expanded the possibilities for both users, designers and developers of interfaces.

The challenges that such progress bring are extremely relevant. The Nielsen Norman Group pointed to how UI designers, in the early days of gesture based interfaces, “went wild: anything they could draw became a UI element, whether it made sense or not”[36], and how the developers community’s “apparent ignorance of the long history and many findings of HCI research which results in their feeling of empowerment to unleash untested and unproven creative efforts upon the unwitting public”, pinning how the absence of standards generated a lack of expectations. Roughly speaking, everything was valid and, therefore, very little was really working. This resulted in a general lack of social acceptance from the users and this is still a big lump to be jumped by the designers, developers and companies involved in gesture-based interfaces.

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Only nowadays though, more recent research point to best practices and frameworks for when designing to gesture based interface (see [35] and [36] for further re-

sources). It is an important progress stage in which the paradigm is not only implementing gestural interaction, but thinking on how to make it effectively. Many of these studies tend to praise the use of gesture in a multi-modal context, in combination with other inputs from the user. Zamborlin et al.[40] stresses 4 key elements for modern gestural interfaces(*table4*):

ELEMENT	DESCRIPTION
Continuous Control	Users should be able to continuously and synchronously control the target application moment by moment through their gestures
Tailorable for specific context	Users should be able to define their own personal gestures
Allow expert and nonexpert use	Systems which the end users (rather than the system designers) who can define their own personal gestures
And meaningful feedback	Detailed investigation in the section below

Table 4: Zamborlin et al. key elements for modern gesture based interfaces

Feedback plays a significant role in HCI. And this becomes even more evident when talking about interfaces which use gestural as its only model of interaction. Because gestures are ephemeral, they do not leave behind any record of their path, which means that if one makes a gesture and either gets no response or the wrong response[41]. Zamborlin et al.[40] describe the ideal feedback in this context as “A combination of accessing different levels of information, through different available information streams (such as audio, data, visual)”. They also stress that immediacy in such feedback is a key element “to providing meaningful feedback enabling meaningful interaction for the user”[40]. To overcome the challenges of a pure gestural

interface, designers often require to conventional interface elements, such as instructions, menus and GUIs, because a convention of gestures (vocabulary) is not well established yet. Although this vocabulary slowly expands and gets more accepted (eg.: pinching for zooming or swiping for dismissing in touchscreen devices), for now these solutions will be recurrently used[41]. Complex manipulations in a computer require deep levels of abstraction and this is extremely hard and tiring to achieve only through gestures[42]. Dismissing a notification may be a very comfortable task to be done with a gesture because we can easily find correspondent gesture in the real world (deictic gestures). But more abstract actions (eg: creating a duplicate of a file) may not have a direct correspondence in our everyday body language, and then designers tend to rely on overlaying GUIs to simplify an abstraction.

The use of gesture based interaction in the context of visual music pieces brings its own peculiarities, challenges and specificities. Issues and questions related to body language expressivity, performance, interactivity in artistic contexts and realtime generation of content are added on the top of the discussion previously shown in this thesis. This research aims to pin some of these challenges and point directions on how can they be surpassed. One insightful example is the work *Soft Revolvers* by Canadian artist Myriam Bleau: the performer developed a series of spinning electronic devices which emit light and control complex sound parameters of an audiovisual composition. These devices are

capable of reading the intensity and speed of the gesture input from the performer, making it an expressive instrument. During the performance she explores an improvised choreography, remixing the audiovisual content by wandering through the stage and rotating each of the devices, revealing an intense ballet between the performer and her instruments.

2.2.3 *NUIs are not natural*

One crucial point to be stressed about gesture-based interaction is its nomenclature. Both researchers and companies have been calling such interaction model by the word NUI (Natural User Interface). And the words we use to describe technology matter, specially when naming the novelty of technology development. They carry more than connotation, but memories, values and meanings to the user. The word “natural” establishes a dichotomy between interfaces that are “natural” and the ones that are “not-natural”[43]. This may work for marketing purposes, but “it highlights qualities that it does not help us understand and explain adequately”[43] thus it should be completely avoided by HCI and interaction design researchers.

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According to Foucault’s discursing analysis[55], words are not only descriptive, they shape and define the way we perceive and act in our world. His concept details on how the dominant discourse of certain period makes it hard to understand and reveal that the world could be any different from the one proposed and described in that very

same discourse. This communication strategy is widely in use by populist politicians, for instance. Roland Barthes' concept of *naturalised connotation* goes in a similar direction: it describes when a connotation (a representation or understanding of something), is mistaken for a denotation (a fact, a given, a natural occurrence)[44].

Apart from the semiotic issues involved in such term, it tends to promote qualities of it that are not completely true; read *invisibility*. This notion was based on the idea that, on NUIs, we do not intermediate our interaction with a machine through a device anymore and also that we all know how to use gestures and therefore we wouldn't need to learn how to interact with it. Is this how it actually works?

List of constraints for “invisibility” in gesture-based interfaces:

- . Still requires use of devices (e.g: Leap Motion, Microsoft Kinect, a camera) which will limit our range space and capabilities for the experience
- . These interfaces have not eliminated the interaction learning process, it just introduced new models and methods, we still need to learn gestures and adapt them to the “naturalness” in order to establish a proper communication with the system;

3 METHODOLOGY

Practice-based research

The main chosen methodology for this study was a practice-based research. As described by Candy[45], a research in which “a creative artefact is the basis of the contribution to knowledge” is defined as a practice-based research. Consequently, such method is often used in arts and design researches for it “reflects their particular discipline-specific expertise.” [46]. As my expertise is strongly related to art practices more than to academic research, the goals of this thesis would be better served if faced from a practical point of view.

- 36 The practical research encompasses a two year period, being 2015 and 2016. Two visual music pieces were composed, each with respective singularities and slightly different viewpoints around the topic. They both embody the main questions, goals and aims of this thesis, on having an ample view of the topics “gesture-based interfaces” and “visual music”. As the pieces were developed fur-

ther and then presented, I would go through an iterative cycle to rethink and improve elements of the research. As Zimmerman [47] describes, “Iterative design is a design methodology based on a cyclic process of prototyping, testing, analysing, and refining a work in progress”. The process of iteration over the practical work is a core concept in which this research relies on.

Analysis method

The aesthetic analysis tries to combine not only the form, composition and audiovisual aspects, but also the sensorial, conceptual, contextual and historical parts - as proposed by contemporary aesthetics. A holistic approach which considers artistic artefacts not only for their shape, outcome and existence but also for being experience enablers for audiences. And in the research, this is carried in an organic way even though I chose not to follow a specific guideline or framework for such.

The interaction design analysis, which covers the HCI topic, has a distinctive approach, for I clearly follow a guideline. The chosen guideline is the Interface Criticism, that called my attention for its holistic and critical access to such a vast topic. As described by [30], such method looks for stylistic references, standards, genres, representational techniques and challenges present in interface design. Also following the guideline proposed by Andersen et al[31], I discuss immediacy and hypermediacy and target possible development potentials on it. The analysis is made separately for each of the two practical works in a very didactic way.

In the following chapters a specific presentation from the results of the practical research is conducted. The results are divided between two chapters, one for each practical work, those being Ramshackle Dystonia and Conducting Senses. The analysis will dive into each of them separately, looking at the same viewpoints and elements on each. The structure follows the same order for each sub-section, aiming at establishing a clear defined way to present intriguing investigation points. Since the pieces were broad and would be overwhelming to encompass all the iterations and parts developed for each, a few examples from each artwork were chosen as study cases.

Each piece has a general introduction (4 and 5), in which prevailing goals, technical setups and investigation points are presented. In addition to this I indicate links for documentation of the pieces aiming at a better understanding of the overall results achieved. In 4.1 and 5.1, design specifications are presented, revealing the main structure in which the works will be presented and analysed.

38 Further on, examples of audiovisual mapping process are shown from each of the two pieces (4.2 for Ramshackle Dystonia and 5.2 for Conducting Senses), digging into some characteristic techniques and sonic-visual choices from elected excerpts of it. The option for narrowing down the analysis to only a couple of examples per artwork was done with the purpose of achieving a clearer structure with a deeper analytical

look in each. These examples are presented in accordance to a contextual explanation, bringing references from other visual music pieces and artworks.

The chosen general frame for structuring the analysis of each project is to some degree different due to the nature of the artworks. As it will be pointed out later, Ramshackle Dystonia is a 'closed' performance which is performed with the same basis, material, acts and content. Therefore, the aspects picked to frame the examples (4.2) in Ramshackle Dystonia are based on inter-playability and design choices. Conducting Senses consist of a diverse case, for the piece is conceived more as a platform to enable multiple variations of the aimed research. Pragmatically speaking, every time the piece was presented, was composed by different material, interaction and aesthetic motivations. Therefore, the chosen frame for this work were events and realisations of it (5.2).

This is followed by an analytical part that looks carefully into the interaction aspects and how they were implemented, taking as a base the same examples mentioned before. A series of findings (4.3 for Ramshackle Dystonia and 5.3 for Conducting Senses) is presented after each example's results in order to reveal friction points from each of them. Following the guidelines of Interface Criticism I try to address a broad analysis that take in consideration references, context and experience elements. At this moment I also present some schematics of the interaction paradigms, trying to make it less abstract

and text-based for the reader. These findings will later be deepened and re-discussed in chapter number 6.

Data collection via questionnaires

A complementary method used in the research was a qualitative survey[48] based in Fink's book entitled *The Survey Handbook* [58], in which is "recommended qualitative survey analysis for the exploration of meanings and experiences"[58]. During two realisations (one for each piece) of the practical works I decided to collect data from the audience via surveys (see appendix figures 9 and 10). The surveys consisted of a series of questions which embrace the topic from my analysis perspective and gave the option for the respondent to rate each question on a scale of 1 to 5 according to their subjective impressions. Some of the questions are found on both surveys, however, specific content-based questions were added and/or adapted to each. Apart from the multiple choice questions, on the bottom of the questionnaire, the respondent had the opportunity to give a written commentary on the piece.

40 One survey was made during the presentation of *Ramshackle Dystonia* in IN-SONORA IX, in Madrid. The eleven questions proposed, were elaborated based on literature regarding presence, immersion and engagement in audiovisual and interactive art. They also covered topics related to the interaction model and how the performer-system nature of the piece resonated in the audience. Nine people voluntarily answered the

questionnaire. The results and analysis of the data collection are presented in 4.4.

The second survey was carried out during the installation of Conducting Senses in AAVE Festival, Helsinki. The content of this survey was more focused on how the users connected to the interaction model proposed by the piece, for instance if they felt encouraged and comfortable with the vocabulary of the gestures. Other topics approached by the questions were related to immersion and presence of the audience when engaging with Conducting Senses. On such occasion, thirteen people answered to the survey. These results are presented in 5.4.

Even though it is not a core element of my method, the surveys work as a revealing strategy for communicating with the audience and users. Their main point is not to validate the topic statistically, but more in terms of quality. They are an alluring data set which bring new perspectives and impressions for my analysis as a practitioner and are presented among the results to reinforce and problematise points brought up by this research.

4 RAMSHACKLE DYSTONIA

Ramshackle Dystonia is an audiovisual performance developed during 2015 and 2016. The piece started as an assignment for the course held by Matti Niinimäki named *Bodily Interaction* in early 2015 and was later developed into a longer composition. In this work, inspired by many of the authors and artists already mentioned in the Literature Review chapter, I act as the performer controlling a synthetic palette of minimalistic music and visual elements which are generated and recomposed in real time. The composition is divided into different sections that wander through a vast exploration of several “plastic” experiments as it will be described in detail in the following sub-sections.

42

I make use of two different sensors to perform the piece: one infrared camera based hardware that tracks hands movements (*Leap Motion*³) in a three dimensional space; and one *MYO*⁴ armband which uses a set of electromyographic (EMG) sensors that sense electrical activity in the forearm muscles,

3

<http://leapmotion.com>

4

<http://myo-armband.com>

combined with a gyroscope, accelerometer and magnetometer. The performer's arms and hands movements then generate and control the audiovisual content in real time.

The technical setup is the same for every presentation: a stereo sound system and two screens - the main one (projected, revealed to the audience) displays the visual elements of the piece; the secondary one contains GUI elements and general parameters of the performance, such as a timer. This supplementary screen is only visible for the performer. The projection is always made in a rectangular screen, resembling a cinematic experience, whilst the performer is on stage.

Even though the choice for the hardware was to use “off-the-shelf” sensors, I decided to take care of all the software implementation. This deepened my detailed knowhow around the topic and gave me an understanding of the liberties and constraints for the realisation of such research. The chosen tool was *Pure Data*⁵, a visual programming dataflow software with main focus in audio synthesis and manipulation, but with a rich implementation for multimedia contexts as well. The hardware integration was also handled through PD.

5

<http://pure-data.info>

For better understanding of the piece I list links for video documentations available online:

<https://vimeo.com/121724892>

<https://vimeo.com/137231924>

Ramshackle Dystonia was presented in:

In-Sonora IX - La Casa Encendida, Madrid, 2016

Fade-Out Festival- Sesc Belenzinho, São Paulo, 2015

Live Electronic Room - PolyTech Museum, Moscow, 2015

Blackout Basel - Atelier Mondial, Basel, 2015

Sound Art Day - Magito, Helsinki, 2015

Demo Day - Aalto University Media Lab, Helsinki, 2015

4.1 Design specifications

In Ramshackle Dystonia, as I am both the designer/composer, developer and the executor, I tried pushing the boundaries of my topics of interest. This was a central element addressed by my investigation in this project: what are the benefits and constraints when the user is also the person who designed and developed the system and how does this influence the notions of control and representation in visual music pieces that make use of gesture-based interfaces. Another conceptual inherent investigation of this piece is how can the interaction models be appropriated by, or even expanded to, the realm of the performative elements of the artwork, as well as how this reflects and influences the composition process. This allowed me a great number of attempts to explore my own gestures to control audiovisual content in real time

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It was a wide blank sheet, free, in which I could experiment several kinds of ideas, being either in the interaction design side or in the visual music composing aspects. Thus, the piece embraces several techniques for mapping visual and sonic content. As from the compositional side, I aimed at a different paradigm for each part, navigating through

minimalism, complexity and different levels of control. I went through an iterative cycle of development, allowing myself to adapt, change elements and redesign parts of the piece between one and another presentation.

Therefore, the design specifications followed in this project can be described by the following list, which will also structure the next sections:

- . Interface exploration: Performative aspects, expressiveness, a tool for improvisation. Establish a comprehension of the interface for the audience
- . Composition: Rich, different quests for each part
- . Audiovisual mapping: Explore different techniques
- . Sonic content: Rhythmic X Still
- . Visual content: Simplicity X Complexity
- . Immersion/Engagement: Sensorial and/or triggered by the inherent compositional process

4.2 Processes and Design

4.2.1 Step-sequencer music visualiser

One of the examples which deserve a deeper look is the technique of *music visualisation* within the piece Ramshackle Dystonia. Such technique was used in different parts of the performance and I selected one of them to be analysed, being the first ‘scene’ of the act. The choice was made based on the fact that it has particular characteristics which I consider extremely relevant to the discussion of this thesis.

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This first part created for Ramshackle Dystonia was produced still during Niinimäki’s *Bodily Interaction* course in 2015. It is an audiovisual step-sequencer controlled via a gestural interface. Very closely related to

previous works I composed in the field, it consists of a 16 steps linear sequencer with several sounds over layered and following the same beat - and fractional rhythmic figures of the main tempo. These sounds are synthesised in a real time basis and allow the live control of parameters for each. Every sound has a visual representation that is also synthesised in a real time manner.

Audiovisual mapping

The chosen procedure here was to follow a commonly used technique of audiovisual mapping, in which the sounds are generated and manipulated in prior and then the visual representation interprets parameters of the latter to be created and animated. This technique relate to, for instance, music visualisers which are commonly used in media players to generate animated imagery based on audio parameters it explores. The relationship between the audio signal's amplitude and parameters of its relative graphical elements.

Visual and sonic content

46 The elected general guidance for the “plasticity” of these elements was a very minimalist one, resembling works made by artists from the minimal German scene - such as the already mentioned Carsten Nicolai from the record label *Raster Noton*⁶. At that point I had been exploring how *Lissajous curves*⁷ could work as sound visualisers and I chose this as a core element to guide the audiovisual mapping. Such technique can be seen in, for instance, analog oscilloscopes and harmonographs. Lissajous curves create cyclic symmetrical patterns when ‘fed’ by

6

<http://raster-noton.net>

7

In mathematics, a Lissajous curve, also known as Lissajous figure or Bowditch curve, is the graph of a system of parametric equations $x=a\sin(at+\delta)$, $y=b\sin(bt)$, which describe complex harmonic motion. This family of curves was investigated by Nathaniel Bowditch in 1815, and later in more detail by Jules Antoine Lissajous in 1857. https://en.wikipedia.org/wiki/Lissajous_curve accessed on Feb 15 2017

non-complex, harmonic, repetitive and smooth audio signal oscillation, such as sine-wave and sawtooth wave. Complex sounds tend to, due to its complex harmonic proportion, turn the Lissajous curve technique into a more chaotic and blurry visual result. The sequencer created for Ramshackle Dystonia was, therefore, using extremely simple sound waves that have a very characteristic timbre and physical properties. This was intentionally incorporated into the “plasticity” of the piece, for the concept of symmetry was widely explored.

Three of the sonic events of the work have one black and white Lissajous each, representing and animating in accordance to its amplitudes. These representational elements are placed on the screen in a very formalist way, being one on the right, one on the centre and one on the left of the screen - following the panning of the sonic outcome in the stereo system. As the step sequencer moves forward (in loop) one could hear a sinewave wrapped by an envelope (ASDR - Attack, Sustain, Decay, Release) and see its visual representational graph modulating in congruence to its attack and decay. This was conceived to give a very direct relation to the mapping process, exploring the concept of synchresis in a recurrent manner. These three elements were, concerning the composition, playing the role of a quasi-melody in the piece.

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On the top of these three cyclical elements I composed three other layers, also connected to the same step-sequencer to form the

rhythmical part of the piece. Extremely low frequencies (from 40 to 50Hz) sinewaves are used for the bass line, also using the Lissajous curve style for its visual representation. Square wave clipping sounds are used for emulating the snare drum. The visual representation of this element consists of flickering horizontal rectangular shapes which scale according to the sound's amplitude; the position of these rectangles vary in a random manner, as well as its shades of grey, each time the sound is heard. Both sound and visual in this case created a glitchy atmosphere, as if the speakers and graphics card had gone broken. White noise played the role of the hi-hat and a group of thin white lines rotated in the centre of the screen, varying its length according to the sound's amplitude.

As a general effect for the piece, a delay line was added. This delay was able to process the three "melodic" sequences and is used as a juxtaposition effect, to contrast to the linearity and repetitive general aura of it. The time of the delay and its feedback brought fluidity to the sounds and also shaped the visual elements in a less rigid, symmetric appeal.

Interface exploration

The chosen paradigms of the interface exploration were carried in a way which consider not only the usability, but also the performative aspects of it. I make use of the two already mentioned sensors, Leap Motion and MYO armband. For each sound attached to the sequencer I was able to define the ampli-

tude of the attack at each step by introducing my hand to the Leap Motion sensor at a given step of the sequencer. The more distant (in the Y-axis) from the sensor my hand is, the loudest the attack of the sound would be in that specific step of the sequencer. To switch between one and another sound, I defined as an interaction asset the amount of fingers put in front of the sensor, e.g.: one finger referred to “melodic element 1”, two fingers to “melodic element 2” - see table 5 interaction flow of 4.2.1. The only exception for this rule was for triggering the bass line, which was enabled by placing two hands in the range of the sensor (its melodic and rhythmic sequence is, in this case, predetermined).

The delay effect is controlled via a combination of both sensors. By placing two hands in front of the sensor I switch the delay effect on and by lifting the right hand (Y-axis) I am able to adjust the delay duration in real time. The pitch shift of the delay line is controlled by the same hand but in the X-axis of the range of the sensor. The gyroscope orientation in the armband is in charge of determining the amount of feedback in the delay chain. At the moment that I remove one of the hands from the Leap Motion’s range, the delay was immediately shut down.

FINGERS	X-AXIS	Y-AXIS	Z-AXIS
1		"Melodic Sound 1"Amplitude	
2		"Melodic Sound 2"Amplitude	
3		"Melodic Sound 3"Amplitude	
4		"Hi-hat" Amplitude	
5	Delay feedback	Delay amount	Delay Pitch shift
10	Bassline on-off		

Table 5: Interaction flow of Music Visualiser Step Sequencer in Ramshackle Dystonia

The iteration process in this part aimed mainly on adjusting mapping processes and a few content-related aspects of the piece. It is, from the cases here analysed, the one which carries the most structured form in terms of composition, with few significant variations for one to another presentation. Before each performance I review some aspects of it, trying to improve technical and stylistic details.

4.2.2 Visual sonification

Audiovisual mapping

50 A second elected example is the third ‘scene’ of Ramshackle Dystonia. Specificities to the audiovisual mapping and interaction model are intrinsically different from the previously analysed example, which makes it an alluring study case for this research. The paradigm for the content creation is another one, a process of *visual sonification*. Machines like Wilfred’s Lumia have followed to produce either compositions from animated

colours, dubbed colour music, or moving compositions of colour and form. The works of the abstract films artists, when using the optical soundtrack, also had a similar approach. In the digital era we find several attempts to explore the generation of audio by visual data. From very simple to highly sophisticated software like *Metasynth*⁸, which reads images from left to right, maps the colours to stereo placement (pan) and brightness to volume.

In the case of the third ‘scene’ from Ramshackle Dystonia, the performer manipulates in real time a videoclip and the software constantly analyses parameters of the pixels on the renderer and map them to characteristics of the audio synthesisers. Pragmatically speaking, I could filter, distort, re-arrange and re-scale the pixels of a video channel following different image-processing techniques; complex sound synthesisers use the data from the visual analysis to create the sonic composition in real time.

Visual and sonic content

Several techniques are used to process the video manipulation. I control switching between them and also by manipulating parameters of each in an improvised way during the act. One of those techniques is *pixel sorting*. Pixel sorting is a visual effect created by taking the rows, columns of pixels in an image and ordering them according to a chosen value of those pixels. For instance: how much red is in each pixel, their luminosity or hue. The result is a very abstract,

fluid blur of colours and stains in which the pixels are redistributed along the renderer. From this new distribution of the pixels, the system analyses, in realtime, all the pixels of the renderer (1280x720) and send the results to specific parameters of complex-sound synthesisers, such as, FM, additive and granular synthesis. Since those synths (the amount of and its qualities changed for every performance) are all mixed together, the sound outcome consisted of a continuum, a dense web of long duration, constant complex sounds.

Composition

From a compositional viewpoint, overall this section has a freeform approach, without a present rhythm - so quintessential to the previously mentioned example - or linearity. Its duration and arrangement are chosen in an improvised way during the performance. This aspect of continuity is broken by abrupt gestures from switching to one visual effect to another. With intentional sharp drops in the development of the piece, the “plastic” elements radically change from one instant to another. Leaps from one element to a different. This generates an atmosphere of unpredictability which opposes to the stillness of the very content of the piece. The result is a loud, dense drone with slowly moving abstract colours and shapes which suddenly break, changing the “plasticity” radically.

Interface exploration

Regarding the interaction implementation, the aim was to establish a slightly more theatrical reference to the relation perform-

er-interface-real time content. Gestures which are more expanded, visible and exaggerated. Thus, I make use only of the MYO armband to control all the parameters - see table 6 interaction flow of 4.2.2. By tapping my hand twice I can switch between one visual manipulation and the next - which is chosen randomly every time I perform the gesture. Apart from the mentioned gesture, by rotating and moving my arm up and down, I control different parameters of this visual manipulation. Using the pixel sorting example, the more I would lift my hand, the more the re-arranged pixels would distant one from the other according to their luminance. The resultant analysis of the pixel placement would then vary the carrier signal of a FM synthesiser.

GESTURE	MANIPULATION
Double tapping	Change image processement
Arm rotation in X-axis	Distance between pixels according to luminance
Arm lifting/lowering	Alpha value

Table 6: Interaction flow of Visual Sonification in Ramshackle Dystonia

4.2.3 Other examples

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Ramshackle Dystonia is constituted of other parts. The exact amount varied from four to six, depending on the performance. Among these other parts, some deserve attention, for its alternative audiovisual mapping processes. Strongly based on the concept of synchresis, a different approach implemented in the piece was the simultaneity of events.

Such technique consisted of using the interface to control both the visual and the sonic elements in a synchronised manner, even though they are not intrinsically connected as the above mentioned cases. An example of this is the 'fourth scene' in which the projection reveals a 3d polygon-alike shape. Freely moving my hand in front of the Leap Motion sensor, I can, dynamically, change the vertices' positions, colour and emitting light of the shape, as well as rotate it. Each of the three axis of the sensor is attributed to one of the mentioned parameters and the rotation of my palm provides the orientation of the polygon in the X-axis. This enhances the three dimensional feel of the visual part, as if the performer is actually touching and manipulating this 3d object in physical space. The sound element co-exist with such shape and it is also manipulated dynamically in accordance to the three axis of the sensor. It consists of a mix of synthesisers and sample-based system. The interaction actuates over bandpass filters and by recomposing the mixing of all the sound layers.

54 This results in a more static visual outcome, which does not explore the idea of motion. What the audience sees is a geometric shape placed in the centre of the screen, morphing, rotating and changing colour without moving anywhere. The visual appearance of it is of an intentionally poor design, a simple 3d object, opposing to the ultra-realistic graphics available now a days in realtime GPUs. To achieve such result I made use of a simple GLSL shader programming which handles vertex positioning and lights in a very lightweight way.

The sonic composition also works with this idea of stillness, though in a less simplified way. One can hear, just as in 4.2.2, a very dense ravelled patch of intense sounds being filtered, re-mixed but shifting almost constantly. No rhythm, tempo or directionality is noticeable, but ‘change’ becomes a constant truth around this excerpt, which contrasts to its visual representation varying in a more subtle manner. The exploration of contrast as an audiovisual standard was the exercise around the composition of this part.


The interaction is based in iconic gestures as it tries to mimic, or establish a direct relation between gesture and manipulative result. It is, within the range of this study, an interesting case of the interface being the most transparent. What the performer does is what the visual element gets, resembling Bleu’s work in terms of direct representation of the intended control by the user. And this is clearly visible for both the audience and performer, establishing a meaningful feedback and enabling immediacy.

4.3 Findings

4.3.1 *Step-sequencer music visualiser*

Compositional aspects

The overall aura of this ‘scene’ is of a minimalist, simplistic black and white composition. It explores notions such as ‘repetition’, ‘rhythm’, ‘symmetry’, ‘non-narrative’. A conception of a slowly developing work in progress. Thus, it suggests for the audience a focus on the internal development of the piece itself, instead of following a narrative.



A more subtle approach, not focused on goals, milestones and directionality - which are canonic notions of motion -, elements so inherent to western music and cinematic arts. It suggests a slow immersive process to the audience.

The predominance of a very syncretical composition, in which sounds and visuals are subsequently co-related, promotes an attention trigger to the audience. No sound in this moment of the piece exists without an equivalent visual representation. And the very own quality of this mapping process generates a cause-effect relation adding another layer of immersion into the compositional development of the performance. It was conceived as if the process of audiovisual mapping is a deployment of the compositional process itself.

Performative Aspects

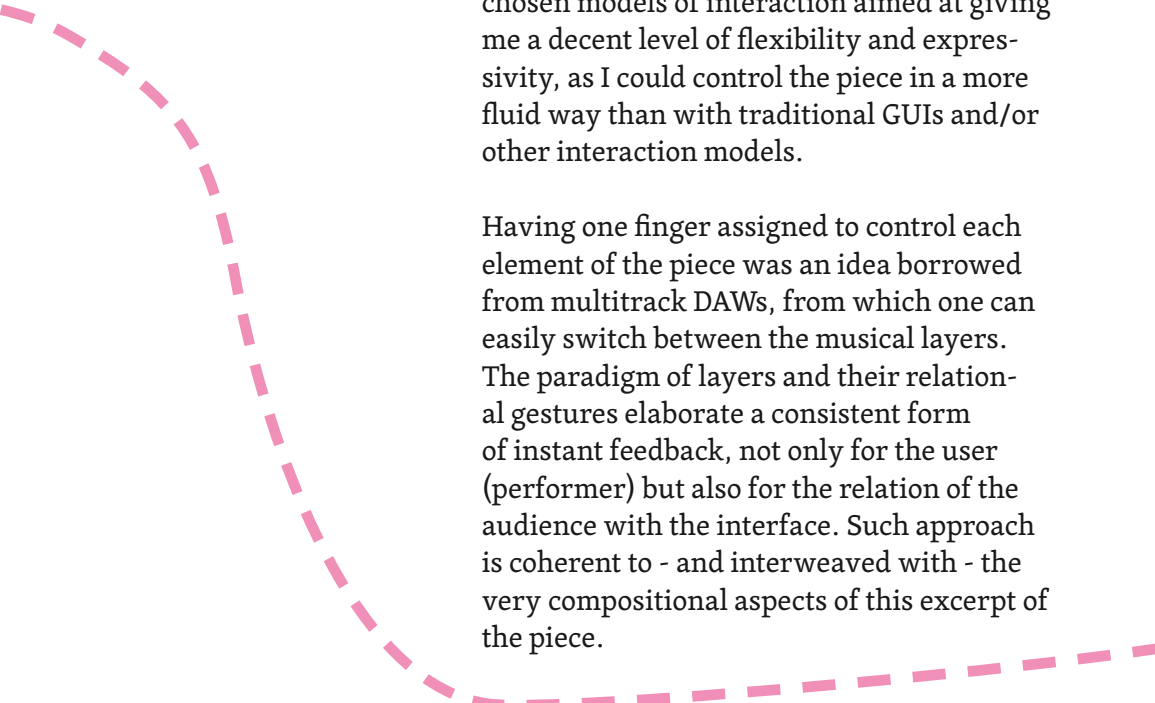
The performance allows me to improvise with the audiovisual layers, recombining them each time presented. This is a relevant aspect for the performative, temporal existence of the piece. A vocabulary - one which extends even to '*muscle-memory*'⁹ - around these elements was naturally created and internalised as I get more intimate with it, although the realisation was never precisely the same.

9

Muscle memory is a form of procedural memory that involves consolidating a specific motor task into memory through repetition

Interface exploration

The interaction process enables a control of all the elements in an independent way, without the need of any other interaction command to switch between the intended



sounds and parameters to be controlled. The chosen models of interaction aimed at giving me a decent level of flexibility and expressivity, as I could control the piece in a more fluid way than with traditional GUIs and/or other interaction models.

Having one finger assigned to control each element of the piece was an idea borrowed from multitrack DAWs, from which one can easily switch between the musical layers. The paradigm of layers and their relational gestures elaborate a consistent form of instant feedback, not only for the user (performer) but also for the relation of the audience with the interface. Such approach is coherent to - and interweaved with - the very compositional aspects of this excerpt of the piece.

Deictic Gesture  Sound  Visuals

Figure 1: Interaction paradigms of Music Visualiser Step Sequencer in Ramshackle¹ Dystonia

4.3.2 Visual Sonification

Compositional aspects

This specific excerpt from Ramshackle Dystonia is, in several aspects, dissonant to the other part of the performance. Its lack of a linear rhythm is one of these aspects. The piece suggests a more constant, fluid atmosphere with very harsh and noisy “plastic” materials. In this sense it could resemble works from the Japanese experimental music scene, such as the afore mentioned Rioyichi Kurokawa. It invites the audience to con-

templatively gaze into ever-evolving vivid audiovisual ‘texturescape’. The experience is not extremely focused on following the compositional progression and its inherent mechanisms, but something closer to engaging to each of these different “webs” for an unknown duration, since there is no assumption of tempo whatsoever. The cut in between these atmospherical states is what surprises and, in a way, moves the piece forward.

It consists of a sense of immersion different from the one proposed by the previous example. It clearly is a more sensorial immersion, of intense sounds and images characterised by lack of perception of time. Such aesthetic approach may be commonly noticeable in several practices of contemporary visual music.

58 The selection of the videoclips used for this part are a compositional component of this section of the piece. Even though the visual treatment given to it made it not so easy for them to be recognised, those clips added an important conceptual layer for the piece. They are fragments of videos from other artists, a process of appropriation and re-signification over other author’s works. All those excerpts were taken from seminal video art pieces that deal with the notion of imagery and visual representation in video format, exploring and comprising reflective images of the sublime. Selected clips are created from snippets of *True North*¹⁰, *BlowJob*¹¹, *An Ocean Without a Shore*¹² and *Ever is Overall*¹³. The chosen video for each

10
Isaac Julien, 2007

11
Andy Warhol, 1964

12
Bill Viola, 2008

13
Pipilotti Rist, 1997

performance varies (iteration cycle), creating a new audiovisual result every time it has been presented.

Interface exploration

The interface and interaction paradigms make themselves also very present in the part of the performance and its exploration continues to be a core component of it, though in a different manner. As already mentioned, the interaction at this moment is more exaggerated, consisting of longer, slower and more evident gestures. This establishes a more expressive model, which enhances performative aspect of the piece.



Figure 2: Interaction paradigms of visual sonification in Ramshackle Dystonia

4.4 Audience study

The survey given to the audience of this piece was done in the presentation of Ramshackle Dystonia in Madrid, on the 4th of March 2016 in La Casa Encendida. A total of nine respondents answered the survey and the results show directions and possible interpretations of the aesthetic elements of the piece, as well as its interaction.

In total there were twelve questions to be rated from 1-5 and two free-form commentary questions. They were conceived with the design specifications in mind, in order to grasp how the audience related to the topics proposed by the research after experiencing the performance. They were divided in groups according to the design specifications: Immersion/Engagement, 5 questions; Composition, 3 questions; Audiovisual Mapping, 4 questions. The two extra questions covered Engagement and Audiovisual Mapping topics.

60 In the following paragraphs, some highlights of different questions proposed in the survey, and its answers, will be described in detail. Such highlights were chosen in order to transversally dialogue with the findings presented by the author. A table with all the answers can be found in the appendix, as well as the survey with the questions.

One revealing result of it is that 72% of the respondents consider that they were “Completely absorbed by what was happening” in opposition to “My concentration was won-

dering”. This reveals the successful attempt of enticing the audience to a process of sensorial experience, in which the audience tends to be carried away by it. Regarding the congruence of the medium used by the performance, it was interesting to notice that 100% of the answers were rated 3 to the question “I was most of the time paying attention to the sonic elements - I was most of the time paying attention to the visual elements”. The fact that the answers were all set to the middle range show the effectiveness of the chosen audiovisual mapping processes.

The question which resulted in the most diversified answers was the one that focused on the narrative and compositional aspect of the performance. “The different parts of the piece made my sense of concentration wander through different levels - The way the parts were arranged enhanced my focus of during the whole duration of the performance” received answers in all the possible fields, depicting a lack of consensus whether the overall composition and narrative curve of the piece was able to keep up the audience’s engagement.

From the free-form commentary session, it was compelling to notice how some people wanted to understand more the interaction apparatus and vocabulary. Comments like “would be nice if the performer could give a brief introduction to the interaction system before/after the piece” and “still wondering how you were controlling the piece?” stresses how interaction paradigms play

an extremely important role in the piece. Other comments arched the diversity of the composition of each part, as some of the respondents shown clear preferences to one or another part of the performance.

14
<http://mediafacadeshelsinki.fi/en>

5 CONDUCTING SENSES

Conducting Senses is an audiovisual installation created in collaboration with André Vicentini in the year of 2015. It was first commissioned by the *Media Facades Helsinki*¹⁴ festival and then further developed for other contexts. The design and “plastic” composition was done in an intense collaborative process with André, while the software development and implementation was made by me, simultaneously to the composition process. Differently from the previous work, *Conducting Senses* has an installation format that enables multiple users to interact with it simultaneously. The technology of choice for gesture interaction was the Leap Motion sensor.

63

The technical setup would vary according to the context and location in which the work was installed. As it will be detailed in the following sections, the setup varied in amount of sensors (and therefore possible simultaneous users), sound and video channels, as well as the projection surface and context in which it was presented.

This challenged us and gave the opportunity to seek for different touch points around the topics in this research. Therefore, the software side had a slightly different approach from the previous work. Each implementation of Conducting Senses had varied requirements and I, who was in charge of the software development/implementation, chose my tools accordingly. I used Pure Data and Ableton Live¹⁵ for sound generation and manipulation, and Pure Data and OpenFrameworks¹⁶ for the visual content and hardware integration.

15
<http://ableton.com>

16
<http://openframeworks.cc>

For better understanding of the piece I list links for video documentations available online:

<https://www.youtube.com/watch?v=ZoCmRtJFjLE>
<https://www.youtube.com/watch?v=d4V5vmqaklk>
<https://www.youtube.com/watch?v=K90kmpZUyFw>
<https://www.instagram.com/p/BHVjxuJgLqj/>

Conducting Senses was presented in:

Helsinki Media Facades - Public space, Helsinki, 2015
AAVE - Vaapan Taiten Tiila, Helsinki, 2016
SystemsIII - Exhibition Laboratory, Helsinki, 2016
Visio Festival - Teurastamo, Helsinki, 2016

5.1 Design Specifications

64 Although the work started as a spin-off from Ramshackle Dystonia, the thought behind the piece was to test the audience's reaction and interaction to visual music pieces controlled via gesture-based interfaces. In this sense, this project complements issues risen by the latter, such as multiple users, audience as performer and 'first time triers' - users who did not know the system could experiment it.

Conducting Senses exists more as a platform for experimenting than as a final, unique composition. We consider it to be a multifaceted tool that allowed us trial and error more than a work with a very well defined shape. The iteration process was, in this sense, more free than the one from Ramshackle as we decided to conduct its implementation over different paths each time the piece was shown to the audience.

So, following this condition, we radically changed the content of it each time we presented it. The core ideas remained in the piece, but the visual and sonic elements were designed specifically for each of the contexts that we presented, allowing us to broaden our horizons in this topic. Also, the amount of possible simultaneous users and the interaction paradigms varied in each realisation - more detailed description will be elucidated in the following parts of this chapter.

Therefore, the design specifications followed in this project can be described by the following list, which will also structure the next sections:

- . Interface exploration: Usability, simplicity. Instrument alike
- . Composition: Rich, different processes for each realisation
- . Audiovisual mapping: Explore different techniques
- . Sonic content: Rhythmic X Still
- . Visual content: Simplicity X Complexity
- . Immersion/Engagement: Sensorial and/or triggered by the inherent compositional process
- . Arrangement: Suitability to the site and context

5.2 Processes and Design

5.2.1 *Media Facades Helsinki*

The first realisation of Conducting Senses was presented in August 2015 as part of the Media Facades Helsinki festival. In collaboration with André Vicentini, we reacted to their open call proposing an interactive public intervention for the festival, which was later accepted and presented. The proposal made by us aimed at engaging local citizens into different unexpected behaviours in their familiar landscape, rediscovering it through the mediation of urban computing and media intervention. It made use of the site as a multidimensional canvas that reactivates and resignifies this urban space.

Overall, the design and production process of it took a time span of almost two months with intensive meetings that followed the iteration cycle process notion: designing ideas, prototyping them directly, testing it and restarting the cycle again until the desired results were achieved. A rough mockup for testing was prepared in Media Lab. Tests were made in situ only a few hours before its premiere due to technical difficulties involved in its setup.

This realisation of the piece was a large-scale interactive projection located in the region of Merihaka bay in Helsinki, and the canvas on which the projection was mapped was a gigantic pile of coal pieces that belongs and it is used for the local power plant. In the opposite side of the bay a 40K ansi-lumen projector beams the light onto the “coal mountain”

and two Leap Motion sensors stand on a table. The participants approached the sensors in groups of four to engage and experience the piece. Each one controls a part of both the visual and sonic elements. By moving their hands inside the sensor range, the interaction agent can instantly perceive their action and how it influences the piece. The audience is then empowered to control and navigate these abstract audiovisual patterns around this surface. The work was installed for a period of two hours and during this time there were more than one hundred people interacting with the work, plus an additional twenty or so, who went there just to watch it. Since this installation was a multiple simultaneous user setup, it carried specificities in technical, compositional and interactional aspects, as this section shall investigate.

As a core decision for the work's development, we chose that each one of the four participants would control - *see table 7 flow of interaction for 5.2.1* - by using one hand each, an independent audiovisual element, instrument or cell of the piece. These four 'instruments' were given for the audience to try out together, in a collaborative improvised a composition - a "jam" if borrowing from jazz vocabulary. As a result, we gained a lot of freedom to experiment, since we had a large buffer for material development, both in "plastic" and interaction design realms. And as for the audience, this enhanced a feature of a more instrument alike than a composition, since it turns into a medium of expressivity in which users can recompose and rearrange according to their own will.

Within this range of possibilities, several different strategies were thought. The audio-visual mapping techniques, for instance, explored sonic visualisation for two of the four “instruments”, visual sonification for another and simultaneous control for other element. For structural reasons, I will present the results by dividing into each of those instruments and looking at “plastic” and interaction aspects of each.

HANDS	X-AXIS	Y-AXIS	Z-AXIS
1	Instrument 1 pitch	Instrument 1 Amplitude	Instrument 1 reverb ammount
2	Position of particle emitter X coordinate	Position of particle emitter Y coordinate	
3		Sample to be triggered	Instrument 3 reverb ammount
4	Grains' pitch shift	Grains' Amplitude	Grains' Panning and duration

Table 7: I interaction flow of Conducting Senses in Media Facades Helsinki

Instrument number 1

Interaction exploration

This instrument consisted of a synthesiser which could play melodic sequences within a scale according to the user’s hand position in the X-axis. Once the hand of user number 1 is placed within the sensor range, the synth started playing the key in accordance to the hand’s position. As the hand moves in the X-axis, the note would change; once the hand was removed, it stopped. The attack of each note was controlled by the position on the Y-axis and wetness of a reverb adjusted by the position on the Z-axis. The amount of fingers placed in front of the sensor also changed the scale in use, varying from

pentatonic, whole tone scale, phrygian or aeolian.

Audiovisual mapping

Its visual representation was a colourful quad which moves on the X coordinate according to which note of the scale is being played. For each step the quad would move its relative position in accordance to the musical scale. The arrangement of its vertices also changed in every new note, re-shaping the overall geometry of this polygon. The colour of the polygon and its emitting light changed dynamically in a random manner at each step of the scale.

The approach for this audiovisual mapping was the one of simultaneity, for there was no direct correspondence between sound and visual elements apart from the synchronicity of control caused by the interaction. Similarly to Soft Revolvers, the interaction paradigm is a very direct one, based on dietetic gestures and clear control feedback.

Instrument number 2

Audiovisual Mapping

Consisted of a complex chain-process of visual sonification. A particle system was developed and combined with a gravitational simulation that could be manipulated in real time. The idea was to navigate the emitter of the particles around the screen and with gravitational forces and attraction applied over it. Depending on the position of the emitter, its parameters would vary, such as amount of particles, lifespan and colour. Eg.: the more to the right and top, the more

particles and with longer life duration the emitter would beam.

Interface exploration

The user could control it in a very direct manner, by moving the hands in both X and Y axis and watching the emitter change its position accordingly in the cartesian coordinates. The moment the user removed their hand from the sensor, the emitter would fall down (due to gravity attraction) and fade out. The result is a lively (partially autonomous) particle system wandering around the screen and leaving traces behind it.

The sound was generated by reading the parameters of the particle system and assigning them, equivalently, to a generative arpeggio synthesiser, with a chime-alike timbre and the addition of effects. This correlation was conceived in a very straight forward way, being the position of it in Y-axis the volume of the sound; the lifespan of the particles the time of the delay line; and the position of it on X-axis the intensity of an overdrive effect assigned to it.

Instrument number 3 and 4

70 Were both sonic visualisation elements and played the rhythmic part of the “jam”. One set of four drum samples could be re-arranged and manipulated in one of them. Its visual mapping was an interpretation of the incoming audio-streams as values for the red, green, blue and alpha channel of an image. The image corresponds to an audio-block (signal-vector) of 64 samples. The result is a 8x8 pixels square image in which

the colours vary in real time according to the audio incoming. Since its resolution is very low, it produces a pixelated simplified coloured shape, resembling a vintage graphics processor. The user interacted with it by moving the hand on Y-axis (which selected the sample that would be played) and on Z-axis (which processed the reverb amount on the sample signals).

The last instrument consisted of a constant low frequency soundscape, a 'cloud' of generative sounds. By moving the hands in all the three axis the user could recombine the values regarding pitch, amplitude, speed, duration and panning of a realtime granular synthesis that sampled the soundscape on the fly. Visually, this soundscape was sending signal to four long vertical black and white stripes distributed on the projection. The amount and duration of the grains determined the width of each stripe and the amplitude of the resulting sound would define the transparency (alpha channel). The stripes would then blink and get wider as the user interacted and controlled parameters of the sound.

5.2.2 AAVE Festival

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<http://www.aavefestival.org/>

The invitation to present *Conducting Senses* in the *AAVE Festival*¹⁷ in April 2016 fulfilled our wishes to re-arrange the piece and experiment with new aesthetic and interactive paradigms. The context in which the installation was presented was completely distinct from the first time as the venue was Vapaan Taiteen Tila, an exhibition place located in

an underground bunker, cave-alike space in Helsinki. Differently from the previously mentioned example, this time the piece was in a confined space, with low ceiling, low light and in conjunction with other artists' works, as it was a collective exhibition.

We chose to make use of the curved walls as our projection canvas, beamed by one video-channel. The sound system was again stereo and this time we elected that only one person at a time would interact with it, thus we only had one Leap Motion sensor. The sound and hardware integration was handled over Pure Data and the realtime graphics on Open Frameworks. It is a relevant information that we had a shorter schedule to design and execute the piece, so our iteration cycle had to take place in the timespan of approximately ten days.

Compositional aspects

Aiming for a distinct aesthetic experience from the first time, me and André looked for strategies that would offer us new - and why not say opposite - approaches to the piece in all aspects. As for the composition process, we sought for a less musically-oriented and more atmospheric environment in which both plastic materials (sound and visuals) co-existed equivalently in a horizontal hierarchy. The audiovisual material was constantly in execution, even if no interaction was happening, and the users gestures manipulated parameters, some of which would be incorporated to the algorithm rules and be used after the interaction was over.

Visual content

Visually, this installation consisted of a black and white organic abstract shapes, without a well defined separation of the compositional layers - so characteristic to the Media Facades Helsinki realisation. On the top layer a particle system and on the back a fluid simulation animated grid. The two visual elements were hardly possible to be distinguished for they were thought and disposed in a very blended manner. A new feature experimented on this study case was the clear addition of generative aspects on the piece: the fluid shape on the back had a constant wobbly animation; the particles were automatically re-triggered every minute, meaning the cycle of emission and lifespan of the system restarted periodically.

Sonic content

The sound composition also explored the notion of an atmospheric feel, a soundscape alike strategy. Two layers composed by a generative chime synthesiser and a dense drone consisting of multiple sine wave and sawtooth waves oscillators, constantly varying in amplitude. The first layer had a rhythmic aspect, for the bells sounds had an envelope with clear duration, adding a transient characteristic to it. The melodic sequence of it was constantly being recomposed following a set of predisposed rules. The drone sound also followed an algorithm for its generation and remixing.

73

Audiovisual mapping

The chosen paradigm for the audiovisual mapping was the one of simultaneity and not

any correlational aspects between the two materials. There was no direct exchange of data in between the mediums and the constituent of the mapping was the interaction aspect: as the inter-actor reached the range of the sensor, the reading of the hands' positions on the three dimensional field were assigned separately to different parameters of the visual and the sonic composition - see *table 8 flow of interaction for 5.2.2.*

HANDS	X - AXIS	Y - AXIS	Z - AXIS
1	Particle emitter position X coordinate	Particle emitter position Y coordinate	Input for generative rules of melodic sequence
2	Vertices position	Mixing of synthesisers and transparency of the grid	Vertices distortion

Table 8: Interaction flow of Conducting Senses in AAVE Festival

Interface exploration

The right hand of the user controlled the “layer number 1”, being the particle system and the chimes sounds. The user’s movement navigated the emitter of the particles along the screen in a very direct coordinate-based relation. The Y-axis controlled the amplitude of the attacks, the X-axis the amount of reverb on it and the Z-axis fed the algorithm behind the melodic sequences, being able to recompose and recombine the order. The left hand controlled “layer number 2”, being the drone and the fluid shape. The sound parameter available for realtime manipulation was the general amplitude of the mix of all the synthesisers (Y-axis) and the variables assigned to the algorithm composing the amplitude variation of each single synth (X-axis-

is). The visual element had two parameters controlled in a live manner, its vertices position (X-axis) and its transparency (Y-axis).

5.2.3 Other Examples

The other two opportunities in which Conducting Senses was installed opened space for experimenting, specially with the visual medium and projection. In *Visio Festival*¹⁸ the piece was installed in a closed room with low ceiling. It was the only time in which this work was dealing with visuals only, not having sound. This was decided due to logistic issues and, thus, it is off the scope of this research. However, it is an interesting finding that, by using two projections (one video channel) the projection covered all the walls and part of the floor, establishing a very immersive environment. The content was mirrored in each projector creating a sense of disorientation. Only one inter-actor at a time could control a fluid colourful shape on the background and a ever-changing polygon shape, a similar approach to the one described in 4.2.1 “instrument number 1”. The two layers were controlled simultaneously by moving the right hand on the three dimensional range of the sensor.

18

<https://www.visiofestival.com/>

19

[https://www.uniarts.fi/en/
events/mon-23052016-1459/
systems-iii](https://www.uniarts.fi/en/events/mon-23052016-1459/systems-iii)

In *Systems III*¹⁹ we chose to go back to the original setup with two sensors, however, at this time, inviting the audience to interact individually one person per sensor. Two separate video channels were projected in white gallery walls with radically different content. In one of them the same content used for Visio Festival was adapted and re-articulated, added with a layer of rhythmic elec-

75

tronic music; and in the other a flickering music visualisation based system generated intense noisy sounds - mainly wide spectrum synths and white noise with realtime band-pass filtered. It was also the only opportunity in the scope of this research that we experimented with four channel sound system, being able to mix the different sound sources among the space. Similarly to the first realisation, this installation opened to the audience an opportunity to collaborate in pairs to generate and manipulate the content of the piece. The two “layers” were controlled separately and, by being so different from each other, created a strange sense of composition, an approximation of both by their singularities. The result was a one piece which, clearly on the formal aspects, was composed by two different cells and connected on the audience’s sensory perception.

5.3 Findings

5.3.1 *Media Facades Helsinki*

Suitability to the context

76 An important part of understanding how people experienced Conducting Senses is to have a closer look at the interplay between the interactive media facade, the surrounding space, and the actual architecture, its representation and value incorporated within its context.

The site (Merihaka, Helsinki) is a bay in which, in one side there are residential buildings and a small pier, and on the other a functioning power plant (Hanasaari Power Plant B) that contains this “mountain”

made out of coal pieces. Since Helsinki is mostly a flat city, the “coal mountain” stands as a peak, a somewhat unusual landmark. Even though its presence is remarkable and seeable from different parts of the city, it is known to be a non-pleasant element on the neighbourhood - which even led to a devaluation of that specific area - that walkers-by tend to ignore. During the evenings, the place is mostly empty and unused, with only a few people crossing it to go to other destinations. All this lack of interest around that landmark was an important factor for choosing it as a canvas for the installation of *Conducting Senses*: how can a new unexpected use of it could make the local community see it from a different perspective? How much would their attention to that specific spot change through the mediation of an aesthetic experience?

The first step for the locals was to try to make sense out of this unusual intervention in the urban space, this creation of a “reality within reality” and this never seen apparatus. Try to understand why does that black mountain that is seen on a daily basis was now used for something new, never imagined before. This character of surprise and curiosity - commonly explored in media interventions - was a key element for people that were walking by to stop and experience the piece. It was noticeable the formation of new patterns on that specific location during the active hours of the work. Even if only for a short period, that site was radically different from its daily routine in terms of flux of people, presence, engagement and social

interaction. The comments about it were extremely positive especially from the residents of the buildings nearby the site. A local resident of a building whose window face the pile of coal claimed she started crying once she saw this new perspective from her old landscape.

Several challenges were encountered when preparing this media facade intervention. In order to integrate it into the physical structures and surroundings, we had to adapt our setup to the existing conditions of the site. As well, the whole setup had to be robust and stable due to light and weather conditions, which we had very little or no influence on. The content had to be adapted to the medium and conditions of the site. Since we could not test in advance how bright the projection would be, we decided to narrow down our colour palette to a safer range. We also had to prepare a video mapping system in order to fit the content into the canvas being used. Another challenge was to balance interests, negotiating with the stakeholders (production and staff of the festival, Helsinki municipality, local residents) to have a successful result in the end.

78 *Audiovisual mapping*

The melodic approach with a discrete “pitched” visual representation in ‘instrument number 1’ resembles and was inspired by colour organs: the idea that each pitch of a given sound has a direct representation in the visual field. Differently from colour organs, that made use of ‘colour scales’, the approach here was to create a fixed position

and motion to each pitch. Our experience of reality tend to reveal us that objects in motion produce sounds. And establishing a correlation between linear trajectories and pitches, although not completely objective, can act as a connection which is nevertheless perceived in much the same way by multiple people, regardless of their background.

Interface exploration

The interaction models chosen here proved (mainly because of its direct manipulation standards and recurrent use of dietetic gestures) to be very effective creating an illusive sense of mediated control and enabling the user to engage in an extensive way. This relation between sense of control and engagement ignites an immediacy connection between the user and the installation.

A revealing aspect regarding instrument 2 was the potential and efficacy of its mechanics, read the gamification elements inherent to it. Not only because it used techniques so common to game engines (particle systems and gravity simulation) but by providing (simple) challenges and a learning curve on its operation, this instrument created a narrative sense to the user, thus enabling engagement and immediacy.

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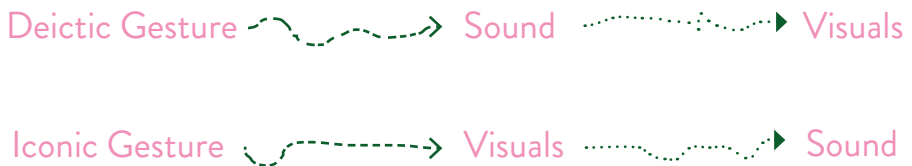


Figure 3: Interaction paradigms of Conducting Senses in Media Facades Helsinki

5.3.2 AAVE Festival

Compositional aspects

A clear distinction to be stressed from this realisation to all the previously mentioned examples was the prevalence of generative conditions ruling the audiovisual elements. This created a singular paradigm and instance to the interaction with the piece. The relation between user and the system turned out way less direct, for several of the parameters being controlled by the inter-actor had no evident causality effect. For instance: the idea of controlling parameters of the algorithm rules do not bring any instant feedback to the user, and one can barely be sure whether their actions are indeed operating the system. Also, a couple of events related to animation and sound were triggered automatically, generating a misleading impression to the user that it was actually caused by them, without their understanding. This proved to be non-effective in regard of some of the usability questions investigated in this research. In one hand this caused issues to the user experience, but on the other hand it was a key element for the compositional process proposed by the piece, constructing an almost ethereal connection between space, interface, system and user.

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Another element closely part of the specific composition of this realisation was the incorporation of digital artefacts in it. The video mapping technique was quintessential for the installation due to the curvature of the wall in which we projected and due to the place in which the beamer was positioned. As we started mapping the images on the

wall we encountered an issue with image distortion which caused some visual artefacts. It was noticeable on both sides of the projection canvas several distortion points of the lines of the fluid shape. Instead of trying to fix it, we intentionally decided to incorporate it in the visual realm. Although we had no control on the way such distortions looked, we embraced it as a visual element on the piece, following the idea described by Iman Moradi[20] as found glitch, which is non-domesticated and accidental and still it constitutes the plasticity of the artwork.



Figure 4: Interaction paradigms of Conducting Senses in AAVE Festival

5.4 Audience studies

The survey was carried out during the realisation of Conducting Senses in the AAVE Festival in Vapaan Taiteen Tila. One beneficial element of it was the fact that the audience had a chance to answer the questionnaire right after interacting with the piece, suggesting a very fresh impression from the experience. In total, thirteen persons replied the survey, and the amount of input in the free-form comments was higher than the one from Ramshackle Dystonia. 81

There were eleven questions to be rated from 1-5 and two extra free-form commentary questions. Since this survey was an adaptation of the one carried on Ramshackle Dysto-

nia, it follows the same guidelines. In addition to the same groups of questions, some were replaced to cover the interface topic, in order to grasp how the audience related to the interaction aspects after engaging with the installation. They were divided in groups according to the design specifications: Immersion/Engagement, 4 questions; Composition, 2 questions; Interface, 3 questions; Audiovisual Mapping, 2 questions. The two extra questions covered Engagement and Audiovisual Mapping topics.

In the following paragraphs, some highlights of different questions proposed in the survey, and its answers, will be described in detail. Such highlights were chosen in accordance to the design specification of the piece, in order to transversally dialogue with the findings presented by the author. The survey, as well as a table with all the answers can be found in the appendix.

82 The results of the survey collected during this realisation point to some insightful aspects. From thirteen persons who answered it, 54% claimed to be “very unclear to me what the interaction was doing and how to use the technology” and 15% answered “extremely unclear”, showing the difficulties of the interactive control on offering a simple to use interface. Even though it is noticeable the lack of user-friendliness, the model still works as an engagement element. 46% of the respondents claim that “the use of my body gestures made me really focused on the piece” while only 7% answered the use of my body gestures did not help me connect to

the work”. Such revelation indicates a wide acceptance of the public to gesture-based interfaces.

The success of the engagement with the piece, even if there were clear barriers in the interaction aspects, is also revealed when looking at the results of the question number one of the survey. 85% of the respondents claimed to feel ‘very’ or ‘extremely’ “lively and enthusiastic” while engaging with it. One of the respondents commented “The work mixes the senses in a way that make more aware of my body and power. Very amazed and enthusiastic about my power”. An analysis of these results point to the potentiality of the audiovisual mapping processes, as well as how interaction in art is welcome by a great part of the audience. A conclusion of it is that empowering people with the notion of control over an artwork is per se an attention-getter for the exhibition visitors.

Comments reinforced the difficulties with the interactive system: “Visuals should react better to the movement of my hands” and “I tried hard to understand the control mechanism and this “frustrated” me a little.” On the other hand, the impressions indicate that this was not a barrier for immersion in the experience, as comments say “I was immersed into the piece” or “The visual imagery is extremely interesting and it kept me there trying to understand the experience”. The sonic outcome was also highlighted as an engagement aspect by the comment “In fact the sounds helped my confidence with the system”.

6 DISCUSSION

The structure of this chapter follows the guideline shown in the previous two chapters, organising clusters of topics in accordance to the design specifications of the pieces. Aiming on a feasible degree of freedom to discuss over these topics, they were not mapped in a one-to-one relation with the specifications, but clustered into tags that embrace and connect more than one of the afore mentioned in the design specifications. Such decision enables a transversal discussion between what was presented in the results presented in chapters 4 and 5 and the literature review.

- 84 Tracing a parallel with the design specifications, “Interface Exploration” become 6.1, *Usability*, which is subdivided into distinctive topics. The “Composition” and “Immersion/Engagement” were fused into 6.2, *Performative Aspects and Audience*. 6.3, *Audiovisual Mapping*, comprises all the topic related to “Sonic” and “Visual” Content and “Audiovisual Mapping” processes. In the

end, two additional topics are discussed, aiming at pushing the discussion a step forward from the literature review and practical research; 6.4, *Technology*, briefly highlights the state of the art of the sensors used for gestural interfaces. And 6.5, *Interface, Mediation and Aesthetics*, proposes an analysis of the practical work from the viewpoint of merging interface issues with aesthetic premises.

6.1 Usability

A main topic to discuss when designing interfaces - despite of its actual final purpose - is its usability and technical aspects. From what the user benefits, what are the affordances and constraints that a chosen interaction model suggests in each scenario and what are the successful and unsuccessful applications. When speaking about gestural interfaces such topic is extremely relevant for the novelty characteristic of it - at least from the technological point of view it is only recent that gestural interfaces can be explored with a decent level of fidelity in HCI.

Learnability

Gesture based interfaces are, regarding usability and learning curve, still a model which relies a lot support from other media. And several authors, such as [56] stress the fact that the best use-case for gestural models are in multimodal interaction contexts. Rarely are - even in product scenarios - the cases in which the user can intuitively dialogue with the interface without the need for further instructions. Simple tutorials, being either

descriptive of diagram based, are required. One important aspect, as brought up in [36], is to establish a standardised vocabulary which would migrate from platform to platform. Not only in gestures themselves but also regarding how to instruct the users, guidelines for first triers. Another solution which relies on user of other media would be to have a GUI based interface which provides meaningful feedback for the user - as the one implemented for Ramshackle Dystonia.

And such issue was faced during the practical research. How should we instruct the users about the interface and its interaction vocabulary? It is, after all, a defined, a limited space, within a specific framework in which people are required to work on. This was evident in the case of Conducting Senses, since the users were not familiar with the system. It came clear to us, in an early stage of the research, that without instructions users would have difficulties to understand the interaction model and this could create an antipathetic connection between user and interface. This was proven to be true already in the preliminary tests with users (still with the prototype in Media Lab) when we noticed test-users trying several unexpected gestures - such as sign language - and sometimes not being able to recognise the range of the Leap Motion sensor. The solution was then to design a series of graphical instructions to represent the vocabulary of the system. We tried several layouts for designing such and still, the most efficient way to transmit was verbal orientation. Luckily, the authors of the piece were close by it in most

occasions and could help the users to learn the vocabulary.

Ramshackle Dystonia is a different case in such aspect, because as the designer and developer of the system, I have absolute acknowledgment of what it is capable of and how to control it in order to achieve desired results. A bias tester for the interface. Hence, this part of Ramshackle Dystonia is conceived as a visual music composition and not instrument; its intentions are to explore aesthetic and performative aspects of this interface and not to test its usability elements for 'first triers'.

Feedback

As suggested by [40], feedback (being either instantaneous or in advance, as instructions) is a key element for designing and implementing gestural interfaces which are friendly, usable and effective. The very own characteristics inherent to gestures (its fluid, continuous, non-discrete aspects)[35] provide, on one hand, the aimed expressivity, and on the other hand the challenges to be surpassed by designers working in such realm.

It is unlikely (there was never such test) that a person without prior knowledge about the system would be able to fluidly interact with the system implemented for Ramshackle Dystonia. A series of instructions would also be needed. There is very little feedback information in the supplementary screen (GUI) and one can only access the result of the interactions once they are already pre-

sented to the audience - on the main screen and speakers. This uncovers revealing aspects which could be apprehended from this exploration, as well as points into possible development directions.

Stylistic references and new attempts

Generally speaking, the practical research has indicated that in the specific context of visual music, gestural interaction has a lot to offer - and a lot to be developed. One cannot help but wonder what would the pioneers of visual music think of the state of the art of this technologies. Its capabilities of representing the user's expressive[35] intention are enormous, specially because it carries the flexibility of borrowing interaction ideas from other interfaces but also allow many new unique attempts. These "new attempts" were a big part of my practical research, trying to investigate what new offered by such paradigm could be specifically interesting for visual music pieces.

88 An example of borrowing stylistic references[31] from other models proved to be quite efficient because it offers the user a comfort zone. The Y-axis as the control for the amplitude of a sound event is an stylistic reference to common music related vocabulary, such as of an orchestra conductor or sliders, commonly used in digital and analog sound mixers. It consists of a deictic gesture which can be found in the act of lifting/lowering or placing something higher/lower in our physical world. Such gesture proved to be reliable enough to become a constant in the realisations of the pieces. The audience

perception of the cause and effect is specially interesting when controlling the delay line of 4.2.1, for one can clearly see my hand lifting and the sound (and consequently the visuals) being manipulated. An element which caused an immediacy quality for the ‘performance-audience’ relation. Also very effective on establishing a direct connection between user and manipulation parameters, in the case of 5.2.1 and 5.2.2.

One of the models following the “new attempts” notion, which also suggested interesting results, is the one of complete abstraction. An example is 4.2.3, in which the user manipulates a representational version of the geometric shape seen on the screen. An illusionistic engagement[22] is suggested to the user and that works efficiently for interactive scenarios with a narrow palette of functionalities. Interestingly, despite of its efficiency, it is very particular in its existence since it does not resemble well-known interfaces. But it shares with traditional interfaces the illusionistic sense of control, a deeply mediated interaction. Nevertheless, again, the lack of constant feedback brings a sense of inefficiency in terms of absolute control over the material. And in this sense, the intentional simplicity of the interaction and even the awareness of lack of control over parts of it are coherent to the compositional process.

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Generative aspects

Addition of generative media and events proved to be misleading for the users in terms of usability, such as in the case of 5.2.2.

It confused and suggested lack of control even for users that had learned a few basic rules of the interaction model. This is also caused in 4.2.2 by the fact that part of the content is also in a generative manner, since the videoclips have their own inherent properties (pixel qualities, movement, luminosity etc) which are not defined by the performer, but given, predisposed.

Best practices

Willing to share my findings and learnings for other practitioners of audiovisual arts - and why not other co-related practices - who may be willing to make use of gesture-based interfaces, I provide a brief guideline of useful or desirable usability aspects:

- . Design an easy and effective way to introduce and instruct the users to the gestural vocabulary in use
- . Provide constant feedback to the users so that they are able to keep track and understand their gestures and its relation to the interface
- . Borrowing references from other interfaces is most probably a wiser choice than creating new interaction paradigms. This situates the user in a comfort zone
- . Avoid use of generative and auto-regulated elements in the system. Allow the user to be in control of all the parts of the system

6.2 Performative Aspects and Audience

- 90 The performance elements are a core theme for this research. And this is not only in the case of Ramshackle Dystonia, which is clearly a performative act and follows many of its archetypes - e.g.: happens on a stage, has a clear beginning. The very own nature of gestural interfaces carry performative aspects[49] which may be enhanced or diminished depending on the case, but will always

be somewhat present. This statement is true not only in artistic uses of gestural interfaces, but as well in product-centred cases. Within the art realm, the specificities of it are quite distinguished in a “performance” context and in an “installation” context (and even within each), being both a fount of revealing aspects around the topic.

In performances

Performative aspects of Ramshackle Dystonia were, indeed, a personal challenge. As I am not a practitioner of performative arts, the idea of using my body as a medium for expression and the connotation this aspect enhances in the piece were barriers for me to surpass. Aware of my role in the performative context, I chose not to make the gestural interaction, in general, large and theatrical, for I do not intend the piece to be a dance-alike performance. They consisted mainly of reduced, fast, short, almost timid gestures. A contrast, in this aspect, to Soft Revolvers. This took me to a more comfortable place as a performer, but it also made it, in some moments, ambiguous for the audience to perceive which were the correlational aspects between my gestures and the evolution and manipulation of the content..

An exception is in 4.2.2 where the performative elements are more enhanced. Thus, the audience is able to see the performer exploring gestures in a more expanded, theatrical manner, even though the connection between the gestures and the audiovisual outcome are not so constantly clear. The cause-effect relation between gestures

and content manipulation is less noticeable for the audience - this is also reinforced by the fact that the material is not so consistently “syncretical” as in other parts. But the act gains in terms of use of the space and body expression. The one gesture which establishes a more directional correlation to the content manipulation is the mentioned double-tapping to switch between one visual effect and the next. After the performer executes such gesture a couple of times, the audience is capable of perceiving that every time it happens, there will be an abrupt change in the piece - even though they would not be able to tell what exactly would be this change. It establishes a common vocabulary, one which the audience can make sense of.

92 The general reduction of the theatrical aspect of the piece did not compromise with the expressivity aimed on the control, for even though they were mostly confined subtle gestures, they still provided me a decent space to control the software in a dynamic way. In a way, would be to compare a sax player who has a strong stage presence and explores this, to a more timid one: the instrument saxophone still is as expressive in both cases, the difference relies more on how one is able to captivate and entice the audience to perceive the piece.

In installations

On the installation case there are a few distinct points to be looked at. Generally, in interaction design focused in the experience, a central facet of aesthetics of interaction is rooted in the user's experience of herself

“performing her perception”[49]. It consists of a very unique moment in which the user is not only an operator, but simultaneously a performer and audience. These three roles are constantly being played when one engages into an interactive piece in a public context, such as *Conducting Senses*. This multi faceted role is constantly shaping the very experience of the user and it is a fundamental element for understanding their perception. The awareness that other people (spectators) are also experiencing your interaction is an important part of the research described in 4.2. And this suggestion of playing simultaneous roles (as we do in many situations in our everyday lives) is a conceptual notion highlighted by *Conducting Senses*.

The various realisations of *Conducting Senses* had in common the idea of setting up a “stage” in which the user is invited to interact with the system. This made not only the user to engage with the piece, but also the audience, as very often they were making comments on the user’s gestures and the manipulation of the content. So, in this case, the setup and the interaction design intentionally enhanced the notion of “perception performing”. If there is an actual spectator, the user is highly likely to not only be engaged in a focused interaction with the system but also with the spectator. Specifically in 4.2.1, the multiple users collaborating for a common result intensified the constant flux of exchange between user’s performance and audience. It is as the piece invited the user to play a part, or, even more precise, parts. The

majority of gestures designed for this piece had exactly this dramatised aspect in order to set clear the role playing aspect.

The performative aspects are important to be taken in consideration when dealing with gesture-based interaction in any circumstances. Considering the awareness of the user's perception and role playing is key for designing better models. While acceptable and desired in the case of Conducting Senses and many other art installations, an interface which may suggest or force the user to play a role in circumstances which they are not comfortable to, is an aspect that may create antipathy for the user in relation to the system.

6.3 Audiovisual Mapping

On the quest for a definitive answer

The results of the practical research were insightful to identify and understand possible directions for mapping sonic and visual content. The experimentation with the concept of combining mediums in an attempt to achieve an 'objective' fusion of both was indeed one of the most fruitful aspects investigated in this thesis. Each of the three methods explored in the pieces have their particularities and pursue a different mediation of realtime audiovisual content for the audience. Such specificities have their own friction points with the afore mentioned concepts of synaesthesia and synchresis and those are relevant topics to be discussed in depth.

In what possibly is a conceptual disagreement with what some of the predecessors of visual music believed, I suggest that it is unlikely that will ever exist an objective real representation for sound and abstract visuals. Even if considered real cases of synaesthesia, it still involves subjectivity matters. Historically, artists and scientists focused on the physical correlation between sound properties, colours and/or shapes, to pursue such objective answers in a very pragmatic way - a quest to conceive an absolute intersection between sonic and visual content. An illustrative example of such is the Helmholtz research introduced on chapter 2. The investigation here presented also pointed to similar directions

However, it is important to bare in mind that those are always a very unique framework designed by the researcher/artist. It is relevant to rethink whether the task of this (or any) artistic expression is to create absolute paradigms over representation. Freedom from desire of an answer is essential to the understudying of a problem. The modernist trust in the combination of art and science has, by now, become historical and this results in a shift of conceptual motivations to explore both disciplines. Although, this, by absolute no means, eliminates the reasons and interest on developing such practices - as this thesis aims to prove along its crooked path. The exercise of practicing over varied possibilities and analysing them is essential in any discipline, therefore art forms shall do so, even if it does not have as a goal to yield deterministic answers.

Sonic visualisation

Sonic visualisation is the method which establishes a very efficient and reliable representation of sound in another medium. It allows extremely precise level of control over the mapping process. Therefore, it is the one (among the examined here) that induces the audience to an immersive state the most. A metaphoric synaesthesia which invites the audience to perceive the two mediums as a one “plastic” and sensorial element.

The tests performed in this realm varied, exploring amplitude translation into length or width of a shape; mathematical formulas for creating harmonic curves from sound pitch; and realtime analysis of sample blocks to be converted into pixels. Despite of the technical differences and the nuances of the results achieved in each part, it proved to be the most efficient way to possibly create a so desired multimedia congruence. Overall, all these techniques resulted in a dynamic and reliable graphical representation of the sound source, being able to create rich and engaging visual elements. Such conditions allowed the connection between both mediums to be very direct, being perceived, although not in an absolute objective way, very similarly by multiple people.

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Visual sonification

The idea of translating data from one medium to another is a core one for visual music compositions. Visual sonification is probably the best example of such. The singularity of appropriating from ready-made video samples, manipulating it to only then have a

sonic outcome, indicates less control intention from the composer/performer's perspective. The notion of "openness" in art as suggested by Eco[50] plays an important role at this stage and as in my artistic research in general. The intentions are not on the result, the outcome, but on experimenting how this mapping process can happen. Regarding this aspect, it is a freer, less rigid, approach than the one of sound visualisation. Unlike the latter, its main aim is not an objective representation of one medium over the other, but on a metamorphosis process, presenting a unique way to amplify data transfer into an expressive "plastic" material. As in the case of music visualisation, it also consists of a framework of arbitrary mappings designed by the composer, but it allows more space for liberties and less relational causes for the events. It is, at least in this specific case, a process less based and inspired by the synchresis concept from Chion.

6.4 Technology

The choice made from the beginning of this research to develop all the software myself was profitable in this sense. It allowed me to understand the flows of data from the hardware and optimise it for the intended results. In an abstract manner, getting in touch with all the raw data provided by the sensors was also an investigative way to understand how gestures behave, try to make sense of them and look for possible patterns among different users.

On the hardware side, the decision for ‘off-the-shelf sensors’ is a controversial topic. Not having access to how the sensors process and compile the information grasped from the physical world, narrows down the possibilities for its use. It is, as any closed product, a limited framework in which the designers and software developers have to incorporate and learn to work with the limitations. And these limitations become a factor which steers the development of a system. Since the purpose of this research was never hardware implementation, the use of ready-made sensors was, in an overall balance, beneficial. It fasten the process of development of the work. In other cases, which require more precision of the data begin read by the sensors, those sensors are definitely not the most optimal option.

6.5 Interfaces, mediation and aesthetics

98 Artistic practices can incorporate and investigate interfaces from a different perspective. The practices of contemporary art explore, since the Dadaist Movement, the mediums inherent to artistic disciplines as part of their concepts, using it as a tool for rethinking and questioning established paradigms. Digital art practitioners have the freedom to incorporate interfaces as one of their discussion topics and not necessarily be caged by the canons of usability and invisibility. It is a chance to investigate the social phenomenon which mediates our experience with reality, the interfaces. An opportunity to “foreground the interface in ways that traditional software normally does not.”[22]

In this sense, the interface of Ramshackle Dystonia is a protagonist, an evident manifestation acting as a medium between audience and experience. It is an opaque, a present medium - opposite to the “invisibleness” present in the term “NUI” - for the audience to experience the piece. All the manipulations between user and system are not only revealed, but intentionally amplified, incorporating the idea of hypermediacy as a conceptual tool. It is almost as if it entices the audience to constantly exercise and try to understand the vocabulary behind the performer’s gestures and see the connections to the “plastic” elements. An invitation to decode the vocabulary of the interface. And such notion extrapolates the mere practical deciphering exercise. It is incorporated as a core concept of the piece, suggesting touching points with idiom creation and establishing multiple layers between performer and audience. The audience does not simply ‘gets what it sees’, it is required more from them. A constant undulation between the rationalist interpretation of the interface and the immersive sensorial experience. A play of proximity and distance, in which the medium, in a pendular motion, gets closer and further from the audience’s perception.

A similar example in this research is 5.2.2. The user experience implemented to this realisation of Conducting Senses turned out to be extremely inefficient. The users’ lacked sense of control to the point that one questioned me whether it was a conceptual joke and, in fact, the sensor was not manipulating the content at all. In this sense, the interface

came (even though not completely intended by the artists) to be a barrier between user and experience. And this elevated its role not only as a medium, but as a conceptual layer of the artwork, an aesthetic property of it. An exploration over its materiality and roles of interface's representationality. It proposed a question - which is in agreement with the so called Post-Digital concept shown in chapter 2 - around the notion of functionality, whether society has or has not control over the technologies mediating our tasks and how it reconfigures our real world.

The addressed discussion around this research and the so called New Media Art in general is extremely relevant. It opens paths to new holistic point of views around the mainly engineered-based HCI field. But one should not omit the engineering and cognitive elements of the interface. In order to understand the bigger picture of the interface phenomena and its consequences, hence to be able to place digital art and its relevance to development and feedback of HCI, both studies shall be balanced. This research aims for such combination, of critical analysis and poststructuralist aesthetic theories balanced with elements of the pragmatic realism of the engineers.

7 CONCLUSION

This thesis presents an investigation into the history, design, compositional processes and technology of visual music pieces which make use of gesture based interfaces. In this chapter, I try to briefly summarise the conclusions of this thesis and offer some possible directions for future studies and developments.

Overall

The development of transmedia artworks dealing with simultaneity of sonic and visual elements has arched over the last centuries, embracing different techniques and motivations. As the social and technological contexts changed with time, so it did the intentions, design and composition of those pieces. The proliferation of production in this realm, in combination with the technical development, drastically changed the pallet of expressivity tools for artists. Its manifestations in the context of the 21st century, with the overload of digital information and culture, a society mediated by digital inter-

faces, is one of a very singular moment for the development of such kind of artworks.

Notions such as audiovisual mapping and real-time correspondence between graphical and musical parameters are key elements behind visual music. Even though some of these mappings are less arbitrary than others, still seems to be a distant goal to generate an objective and absolute representation in between these two mediums. Synaesthesia and synchresis are examples to explain and try to achieve this objective answer. The thesis tries to explore, not only by exemplifying but also producing different experiments over audiovisual mapping processes.

102 Gestural language is a natural form of communication for humankind, being in a constant development with contextual specificities. Its branch in the HCI discipline, gestural interfaces, aim to offer an expressive way to interact with and manipulate software artefacts. Although such idea has been existing for a long time, only more recently the technology enabled to create a sturdy and stable use of it. Such condition opened space for designers and developers to experiment a wide pallet of vocabulary and techniques for gestural interfaces. The implementation of this model clearly relies on the creation of a vocabulary around it, an easy degree of learnability as well as a reliable constant feedback between interface and user. It is noticeable a distinction between the use of gesture based interfaces in a multi-modal context and when it is the only interaction model in use.

This thesis presents two artworks which combine both elements in a very intrinsic manner, aiming to answer the question How can gesture based interfaces be represented in visual music compositions? The design principles and challenges which structure the two artworks are carefully described and analysed, searching for the friction points between interaction and aesthetics, and then evaluated and discussed.

The use of such interaction model in the context of visual music indeed unlatches the expressivity of the interaction agent. In terms of usability, its implementation suggests great directions not only for expressivity, but also in engagement and immersion, as suggested by the audience studies of the practical work realised in this research. It is important to keep in mind the good practices of usability to be able to achieve positive results. In 6.1 I identify a number of design and implementation patterns which may be useful or desirable for such kind of compositions. At the same time, I also intend to identify possible challenges which may difficult the design of such systems.

The use of gestural interface in this context also builds, in a conceptual level, performative elements to the artwork, resignifying the inherent qualities of the interface itself. Also in the conceptual realm, the use of interface in digital art of the 21st century have a very peculiar characteristic: they can suggest and foreground the interface elements in ways that traditional software normally does not, making use of it to question and

disrupt paradigms of our contemporary society. A process of incorporation of the interface as an aesthetic entity of an art piece.

In conclusion, this thesis presents an investigation over the paradigms which combine visual music compositions aesthetic premises and the design of gesture-based interfaces. These paradigms, which comprise the long history of visual music and the more recent development of designing for gestural interfaces, are a complex web of aesthetic and interaction elements which have to be investigated deeply in a holistic way. On the one hand, framing the interaction aspects only from the usability and cognition viewpoint, is not deep enough for evaluating an artistic experience. On the other hand, to look exclusively at the aesthetic premises of the artwork also lacks a fundamental contextualisation of the interactive features of it. Therefore, the representation of gestural interfaces in visual music consists of a blend between conceptual/performative entities and usability/interface design issues, which the artist may choose to highlight more one or the other side

Future developments

104 The two artistic pieces presented in this thesis are, in terms of usability and expressivity, still extremely primitive and constrained if compared to musical instruments or to a paintbrush - tools that have been refined over the last centuries. Even though the recent technology improvements enabled a great leap towards expressivity, the sensors and frameworks available for it are still

constrained and fairly restricted. Developing hardwares which are made specifically for the purpose is definitely one of the future directions of the research. A second relevant topic that would demand improvement for the sake of expressivity is the way in which the input signal is analysed.

A promising investigation path would be to collaborate with artists from the field of dance and/or performative arts. Once the collaborator would understand the system, their knowledge in body expression as a language could stretch the boundaries of the piece's performative elements. In this sense, a complex and expert study over gestures and body language would expand the barriers of this research.

As for the methodology, the research development proved to be of extreme importance to document well the practical realisation process. This helps not only to look back and review the work, but also to improve the iteration cycles used in the methodology of the practical research. For the same purpose, the use of surveys and questionnaires with users and audience, is a tool that could have been used more during the process of this research. It would have been extremely enriching if the surveys were to be carried out on all the presentations of the pieces along the two past years. Since the piece exists in a temporal frame and each realisation has opened variables, it's hard to grasp any consonance from a one-time survey. Other methodologies could be added to understand the audience's relation to the works. There-

fore, to collect data and impressions from the audience, other methods such as user tests, interviews and workshops could be used.

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APPENDIX

La performance Ramshackle Dystonia

Esta encuesta se realiza con la finalidad de entender la percepción e implicación de la audiencia en la performance Ramshackle Dystonia de Fernando Visockis. Por favor, evalúe cada situación con un valor del 1-5. Si Ud. tiene alguna pregunta o comentario, puede expresarlos en las dos preguntas extra que se encuentran al final de la página o bien puede acercarse al propio artista después del concierto para discutir cuestiones relacionadas con la performance y el formulario. Los resultados pasarán a formar parte de la investigación del artista sobre cómo la audiencia se relaciona con diferentes performances audiovisuales.

Su colaboración será gratamente apreciada.
Fernando Visockis.

Edad: _____ Género: _____

En los últimos 12 meses, ¿aproximadamente cuántas veces ha asistido a performances audiovisuales?

0 1-3 4-10 11+
☐ ☐ ☐ ☐

	1	2	3	4	5	
01- Era consciente de lo que pasaba a mi alrededor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Me sumergí completamente en la realidad de la presentación
02- Mi estado de concentración era disperso	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Estaba completamente atraído/a por lo que estaba pasando
03- El tiempo parecía eterno	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Perdí la conciencia del paso del tiempo
04- Me sentía cansado/a y desinteresado/a	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Me sentía con energía y entusiasmo
05- Estaba dentro de mi zona de confort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Me sentí intimidadx y provocado/a
06- Las distintas partes de la pieza me provocaron diversos niveles de concentración	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	La manera en que las partes estaban conectadas me permitieron mantener un mismo nivel de concentración durante toda la performance
07- El público no parecía involucrado en la performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Había una fuerte sensación de involucramiento entre el público
08- No me siento estimulado/a para discutir esta performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Mencionaré esta performance en otras ocasiones
09- Durante la mayor parte del tiempo estaba prestando atención al apartado sonoro	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Durante la mayor parte del tiempo estaba prestando atención al apartado visual
10- La correlación entre imagen y sonido no me ayudó a mantener la atención	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	La correlación entre imagen y sonido cautivó de forma positiva mi atención
11- El apartado sonoro perturbó mi implicación con la pieza	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	El apartado sonoro potenció mi implicación con la pieza
12- El apartado visual perturbó mi implicación con la pieza	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	El apartado visual potenció mi implicación con la pieza

13- En general, ¿cómo se sintió durante la performance? En cuanto a concentración se refiere, ¿tiene alguna otra observación que le gustaría comentar ?

14- ¿De qué manera piensa que la correlación entre sonido e imagen fue un factor que contribuyó a su concentración e implicación durante la performance?

QUESTION NUMBER/ANSWER	1	2	3	4	5
1		2	3	2	2
2			4	5	
3		2	5	2	1
4	2	3	4		
5	2	1	3	2	1
6	1	3	2	2	1
7	3	3	2	1	
8	2	3	1	2	1
9			9		
10	1	1	2	4	1
11	1	2	2	2	2
12		5		2	2

TOTAL OF ANSWERS (9 RESPONDENTS) FOR EACH OF THE QUESTIONS FOR THE
RAMSHACKLE DYSTONIA IN IN-SONORA IX

This questionnaire aims at understanding the audience perception and engagement while interacting with the installation conducting Senses, by Fernando Visockis, and Andre Vicentini.
Please, evaluate every question by giving a rate between 1-5. If you have any further questions and/or comments, you can use the two extra questions in the bottom of this page to express it or also approach the artist himself after the concert to discuss issues related to the performance and the questionnaire. The results will be used as part of the artist's research on how the audience relates to different audiovisual events.
Your help is highly appreciated.
Thank you for the contribution, Fernando Visockis.

Age: _____

Gender: _____

In the past 12 months, approximately how many times did you go to see audiovisual installations?

☐ 0 ☐ 1-3 ☐ 4-10 ☐ 11+

	1	2	3	4	5	
01- I was aware of the real world	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I completely dived into the instalation's reality
02- My concentration was wondering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I was completely absorbed by what was happening
03- I felt like time was passing slowly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I hardly felt that time was passing
04- I felt tired and uninterested	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I felt lively and enthusiastic
05- I was mostly on my comfort zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I felt challenged and provoked
06- The different parts of the piece made my sense of concentration wander through different levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	The way the parts were arranged enhanced my focus during the whole duration of my interaction
07- The use of my body gestures as an interaction form did not help to connect me to the work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	The use of my body gestures as an interaction form made me really focused into the piece
08- I felt comfortable when interacting with the technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	The interaction form made me frightened and uncomfortable
09- I really learned and understood the way my hands and work were connected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Its still unclear to me what my interaction was doing and how to use the technology
10- The sound aspects disturbed my involvement with the piece	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	The sound aspects boosted up my involvement with the piece
1- The visual aspects disturbed my involvement with the piece	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	The visual aspects boosted up my involvement with the piece

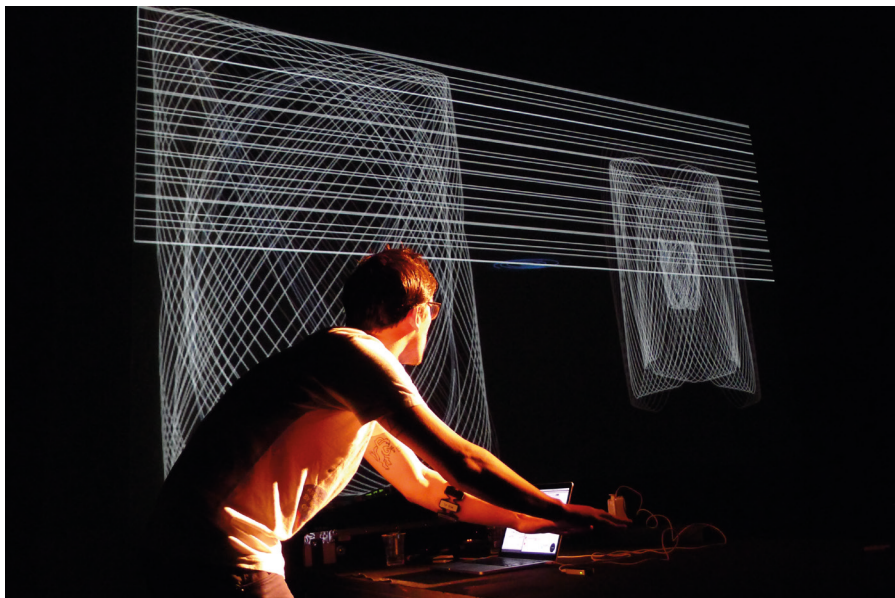
13- How did you, in general, felt while interacting with the installation? Any other remarks you would like to make about your focus and concentration?

14 -How do you think that the use of correlated sounds and imagery was a factor that contributed to your concentration and involvement while watching the work ?

SURVEY GIVEN TO THE AUDIENCE OF CONDUCTING SENSES IN THE OCCASION OF
AAVE FESTIVAL

QUESTION NUMBER/ANSWER	1	2	3	4	5
1		3	3	5	2
2	1	5	4	3	
3		2	8	2	1
4			2	5	6
5		2	5	3	3
6		2	4	3	4
7	1	1	2	4	5
8	4	2	3	3	1
9	1	2	2	6	2
10			4	6	3
11	2	1		4	6

TOTAL OF ANSWERS (13 RESPONDENTS) FOR EACH OF THE QUESTIONS FOR CONDUCTING SENSES IN AAVE FESTIVAL



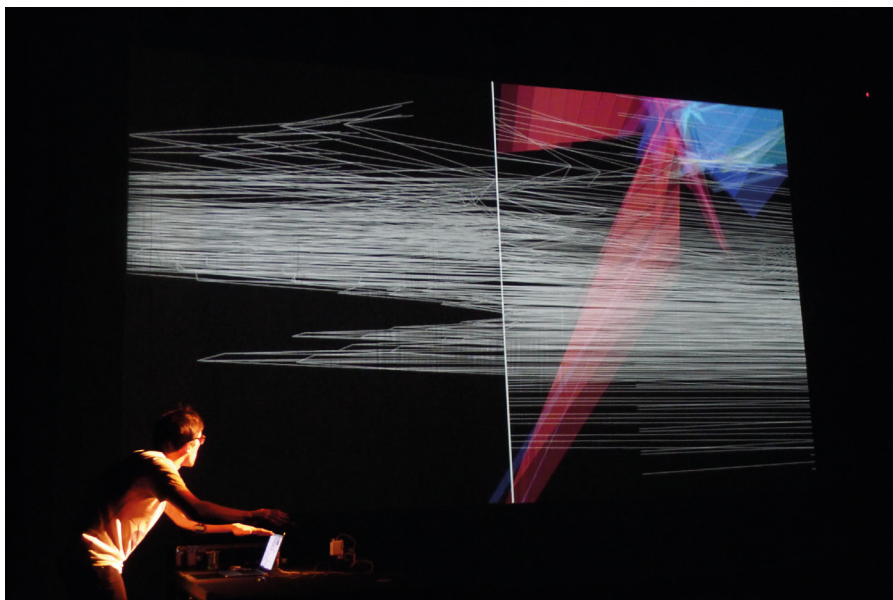
SCENE 1 FROM RAMSHACKLE DYSTONIA DURING FADEOUT FESTIVAL IN 2015



SCENE 2 FROM RAMSHACKLE DYSTONIA DURING FADEOUT FESTIVAL IN 2015



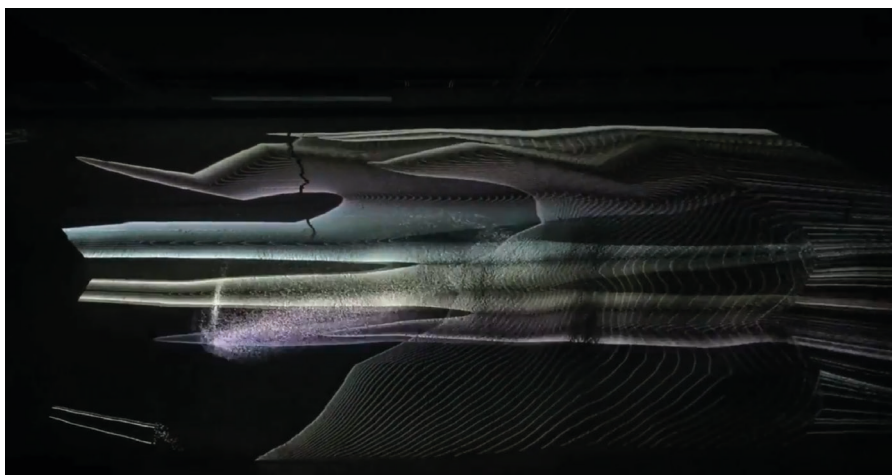
SCENE 3 FROM RAMSHACKLE DYSTONIA DURING FADEOUT FESTIVAL IN 2015



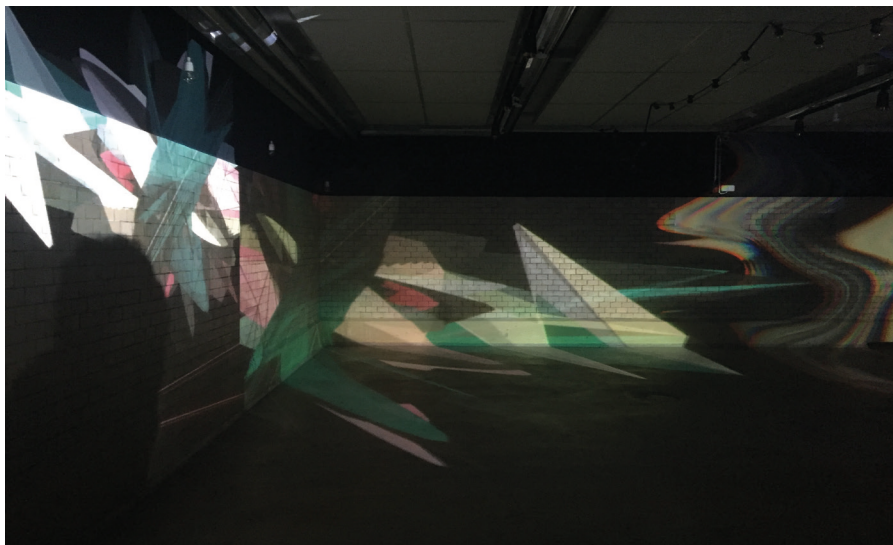
SCENE 5 FROM RAMSHACKLE DYSTONIA DURING FADEOUT FESTIVAL IN 2015



CONDUCTING SENSES DURING MEDIA FACADES HELSINKI IN 2015



CONDUCTING SENSES DURING AAVE FESTIVAL IN 2016



CONDUCTING SENSES DURING VISIO FESTIVAL IN 2016



CONDUCTING SENSES DURING SYSTEMS III IN 2016

