AALBORG UNIVERSITET - KØBENHAVN

MEDIALOGY

MASTER THESIS

INTERACTIVE ART

AS A SOCIAL BINDER

Supervisor

Stefania Serafin

Student

Theodor-Bogdan Lancor

2012

INDEX

1 INTRODUCTION

1.1 ABSTRACT

The present project sets out to investigate whether modern art installation using the audition modality as the primary means of delivering emotion can be used within small groups to imprint a sense of unity and promote group flow. Several studies have shown that there is an inherent characteristic in humans to enter trance-like mind-states under the influence of music, and act as one under these trance states. These studies are the foundation on which the current research is based.

A theoretical analysis which is then materialised in several incarnations of a final product under the form of an interactive art installation indicates that although remaining an open question, there is strong evidence that at least in groups of younger people, unity and group flow can be achieved under the influence of music.

In order to validate the problem statement, a larger study allowing proper testing using of several music aspects, on a more diversified age group is necessary, but the present research indicates great potential.

Keywords: art installation, interactive art, flow, group flow, connectedness

1.2 STRUCTURE

The current paper is structured in chapters, which are furthermore divided in subchapter.

The first chapter is the Introduction, which starts with the abstract, and continues with a general concept for the current work. Afterwards, the personal motivation for the current research is given and the problem formulation, as well as the need for such a research.

The second chapter with the theoretical aspects of the research, including literature review, and is ended by presenting a hypothesis.

In the third chapter a problem solution is offered, analysing both the design aspects which are taken in consideration and how the implementation will be mad.

The fourth chapter deals with the testing and validation of the hypothesis, describing each step taken within the four tests which have been used.

Next, the findings are presented in the form of the fifth chapter, analysing the results; finally, the paper is concluded with a short discussion and a personal opinion, with suggestion for applications of the art installation, followed by the references.

1.3 CONCEPT

"All art is autobiographical; the pearl is the oyster's autobiography."

– Federico Fellini

Art surrounds us, and is within us. Without delving too much into the field of aesthetics, one can see art as the subjective perception of an observer, projected in a distorted manner on the canvas – be it an easel, sound speakers, or ones' own mind. I say distorted, as the interpretation achieved through one's senses lacks absolute objectiveness, and with each filter (as applied first by the sensing organ and afterwards by interpretation) a subtle modification of the observed is noticeable. It must be noted that this distortion does not make the experience less real or lacking authenticity; merely it serves in giving perception a more personal and human-like quality.

The simple act of observance can be thus considered an act of creation of art, as the canvas can become as needed, either the consciousness, the mind, the soul, or even the cerebral cortex, based on one's own interpretation. It is now up to the observer to decide whether there will be a sharing of what they have envisioned – fulfilling the role of an artist, or whether they will move on, unaffected.

In my experience, the process of creating art happens during a state of full concentration and involvement (or immersion) in the creative aspect, without much concern about the thinking process – similar to the mental state described as flow, by Mihály Csíkszentmihályi in [1] [2]. It is within this state that art can be purely achieved and transmitted further on. As such, a focus on obtaining such a state and maintaining it

is paramount to the creation of art, and in my opinion, is able to offer a deep connection to the inner-part of each person that deals with the artistic aspect.

Furthermore, I consider art being intrinsically rewarding, and as such, it can be performed or created without effort, having the property of giving constant fulfilment to the artist.

"You know the sound of two hands clapping; tell me, what is the sound of one hand?"

– Zen koan

The soundless sound of one hand clapping – to this must be compared the process of externalisation of art, conception in the material realm, if there is no witness, no observer aside from its creator to notice it, art is not complete. While on the canvas of the mind art can exist by itself, I believe there is a need for art to be observed, if it was delivered in the external world, in order to avoid a selfish manifestation of the artist.

Just as two hands become unity when clapping and producing a sound, the same should happen between the artist and observer, when it comes to art: observer and artist should be as one in front of the masterpiece.

But why should there be such a separation be made when one refers to the interaction of the two? Why name them observer and artist, or name them creator and observer when they can be both artists? Either way, when such a situation occurs, the interest lies no more in what they are *called*, (the names becoming a linguistic triviality) but in what they *do* and how they *act*.

When the observer is considered an artist himself, or when a second artist interacts with the initial creator, such a unity between two entities can (and most likely should) result in a non-verbal dialogue. This non-verbal dialogue can be conceived as the confrontation between multiple perceptions (as each entity has its own point of view). As such, art generates itself: new art is created by the manner in which the initial artist perceives their now modified creation.

I believe the simplest medium allowing the unfolding of such dialogue is the auditory modality, simply because of its versatility and its almost *instant-ness*.

Albeit farfetched, one could compare the *dialogue* between the sound of the wind and the sound of the leaves to the *dialogue* of a string quartet. The difference is that while the wind and the leaves come to have this *interchange* naturally, without having an a priori knowledge about *singing*, the string quartet requires trained musicians to begin with, and most likely plays the work of a composer, becoming a living "record player". Even if this is not the case and everything is improvised, the fact that the players in the string quartet most likely required a long training to reach the needed skill to play their instruments still supports this argument.

Nature simply knows how to *sing*. One could point out that the trees had to grow in order to have leaves with which it could make sounds, but I would consider this aspect as the mere "fabrication" of an instrument; afterwards, it plays itself. Wind simply exists and makes sounds. I'm using this metaphor to emphasize the quality of nature creating sounds; the direct interplay of its own elements without a prior need for training or for having a composer occurs.

The concept is to create a place that makes it possible for people to create art in an instant – a virtual environment that draws from the characteristics of nature, where people are trees and their movements are the leaves; if such a place could exist, then music could be spontaneously and simultaneously created, observed, enjoyed, and transformed, allowing the existence of a *natural dialogue* between sources. In this place there is no need for prior training. So why not create it?

Just as nature is the *architect* of the trees and the wind, a medialogist could be the architect of this virtual environment.

1.4 MOTIVATION

My initial interest in the field of live electronic music came as a personal quest, as I was trying to understand the current methods, and to seek an improvement, as the current general approach seemed to be lacking involvement, being more of a hybrid between DJ-ing and simple loop mashing; even the term used by the press denotes lack of involvement and/or enthusiasm from the musician: Live Personal Appearance [3]. Personal. Appearance. Nothing more, nothing less – a cold, sterile presentation of a human being, on a stage, in front of a desk, pressing play on a turntable / CDJ / MIDI controller. It should be understood that this isn't an attack towards of the DJ scene, but merely a personal disappointment in the means in which an artist presents their own work.

What stirred my attention was the novelty of a new term (and movement), coined by a musician named Moldover [4] – *controllerism*. Reminiscent of turntablism, the controllerist replaces the turntable with modified MIDI controllers in order to aid him in the search of a better way to create, modify, improvise and mash sounds and music on-the-fly. This novel approach is inspiring and in my opinion it expands the *live PA* to a nice level, in which music is performed, and not simply *reproduced*.

Delving in this field with a small independent study during my first master year, I came to the conclusion that more can be achieved as I shifted my focus towards interactivity within audio-video-dance exhibitions. While leaving the controllerism-world into the background for a while, I was researching the possibilities of human movement and action as a means to express sound and music. Through those findings I came to the conclusion that the human body and its gestures have the potential of becoming a really nice musical instrument, using external controllers and sensors to interface with a sound source.

Resuming by studies about the controllerist scene, I quickly came to realise that while the approach was working nicely, there was still something missing – there was

still a separation between the performer and the audience, a rift I didn't feel content with.

As such, my interest rapidly rose in this direction – how can the discontinuance between the audience and the artist be erased? How could the artist be put in the middle of the dance-floor (metaphorically speaking)? How the artist be made a part of the attending people?

At the same time I had realised that while I am an electronic music aficionado, the dance-floor can feel empty and stark at times, with each individual focusing perhaps too much on their own square meter on which they dance blindly, isolating themselves from the others, unless in search for a mate. To me, this attitude lacked depth and felt too shallow to simply ignore.

While pondering the problem, I became aware that the entire time I had been asking the wrong questions. Just as when a drop of water falls into the ocean, the drop becomes part of the ocean, from a different perspective one could say that the ocean becomes part of the drop. So the proper question is: how can the audience become one with the artist? How to make each individual of the audience, artists themselves?

Perhaps it is a difficult question. Nonetheless, the answer to this question came in the form of art installations. Although it is a departure from the dance-floor, I strongly believe it is a good starting point for research, and perhaps the results could be then further directed to a separate quest: to bringing unity to the dance-floor.

1.5 PROBLEM FORMULATION

Could one create an interactive art installation which would bring its participants together as unity? And could this art installation be created in such a way that no prior training is required? Can the results produced by said art installation be of the same quality as “traditional art”?

The purpose of the current research is to investigate whether interactive art installations focused primarily on the audition modality can be used to increase the sense of “connectedness” within a given group. I define the sense of “connectedness” as a state of group flow in which individuals lose focus on their identity, and focus on achieving a sense of unity, in which their identity is a part of the group, whilst the group being as one.

The secondary objective is to verify if a given group without prior knowledge or experience with composition, sound creation, or audio synthesis is able to create a high quality sound piece using the art installation.

1.6 NEED FOR RESEARCH

In a world dominated by desire for power, love for money, in which consumerism appears to be the main life-style, a radical orientation towards unity, closeness, connectedness, and rapture can be in my opinion a healthy attitude (and perhaps part of a cure) to what I consider an ill-driven system that depersonalises and confines one to a mindless state, perpetually in search for a goal that never really existed. I hope that the results will fore mostly help the transformation from an *I* to a *we*, using interactivity and art to help one become detached from misleading issues.

What has led me to have this perhaps harsh (hopefully not insulting) opinion is the constant bustle demonstrated by people who constantly seek more gains. As put by both economist Victor Lebow [5]: *"Our enormously productive economy demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfaction and our ego satisfaction in consumption. We need things consumed, burned up, worn out, replaced and discarded at an ever-increasing rate"* and philosopher and social critic Bertrand Rusell [6]: *"It is preoccupation with possessions, more than anything else, that prevents us from living freely and nobly."*. Furthermore, consumerism in its current form is non-sustainable, since there is a limit to how much one can constantly purchase. Simply put, consumerism is a form of positive-feedback that will eventually collapse, if not stopped in time.

It should be noted that my stance is not against technological advance or technical prowess, but mostly against but mostly against what I believe to be a senseless desire to be on the bleeding edge of luxury and materialism.

To contrast this, art (from the perspective previously presented) is an endless resource that can be easily harnessed by anyone willing to do so. From this social point of view I wish this research could help surpass these shortcomings and bring a new dimension on what can be attained through art and *connectedness*.

From an artistic point of view, the current research wishes to push the boundaries of an already well-known style of art (art installations), which in my opinion has not been sufficiently explored, nor publicised enough to gain the proper recognition it deserves. I consider this to be one of the future directions art will take, where it will flourish – a direction in which the border between art, artist, and observer are blurred, where the artist becomes an *architect*, and the observer becomes the artist.

The current work searches for new methods of creating music; the purpose is to conceive new ways for capturing the moment by bringing towards expressible reality whatever emotion or feeling existed in said moment. This will be done by the auditory modality as a means of delivery and body movement and gestures as the bridge that interfaces the imagination to the sound source.

From a scientific point of view, the research intends to shed more light on group flow and on how interactivity and art installations could be used and attained (if possible) within a given group. There is also a need to question whether the state of group flow is be beneficial (if and when achieved) to each individual, but also to the group as a whole. Furthermore, if the effects are positive, how can they be harnessed more often?

The overall context of the research is within both art and technology. It aims at a harmonious blend of the two in which the final product can be viewed as emergent.

1.7 SUMMARY

This concludes the introduction chapter. The abstract of the whole work has been presented, followed by an overall structure of the paper, including a short description of each chapter. A conceptual explanation of the work has been given, explaining the relationship between the artist, the work-of-art, and the observer, as well as the need to blend these three and to have the lines between them blurred, followed by a motivation for the research.

The motivation explains how the current research came to being – from a personal interest in live electronic music which further expanded into a wish to create a dedicated environment in which music simply exists. Afterwards, the problem statement has been formulated; the term of connectedness has been defined, a central term on which the research is based. Briefly put, the research aims to investigate whether audio-interactive art installations can be used to create and/or enhance unity within a given group.

Finally, the need for such a research has been explained from the author's point of view, using a social, an artistic, and a scientific context.

2 THEORETICAL INVESTIGATION

2.1 OVERVIEW

To get a deeper understanding of the underlying concepts regarding the effects of music as a human experience and the relationship between music and emotion, a theoretical investigation of these aspects is necessary.

Firstly, it is central to our research to return the roots of music and analyse its purpose in human evolution, verifying whether it can influence human interactions in the way previously presented; moreover, it is important to contextualise and then extract the information as to be applied in a present-time context.

It is important to find the implicit characteristics of creating, listening, and enjoying music and use the findings to conceptualise the optimal method of delivery to the public through the art installation in order to maximise the possibility of obtaining group flow.

Another important aspect is the *flavour* of music to be used – an analysis which deals with aspects such as melody, harmony, timbre, rhythm from an ensemble point of view. This is the foundation on which the subsequent design and implementation of the art installation will be based.

Finally, an appropriate method for testing the functionality of the art installation needs to be developed.

2.2 MUSIC IN HUMAN EVOLUTION

As presented by Ian Cross in his analysis of music in [7], from an evolutionary point of view *"music appears as a direct and necessary correlate of the architecture of the modern human mind, facilitating the development of individual minds and affording structures for their interactions in society"*. He continues to say that it is *"an identifiable human pursuit"* and that it *"emerges from its developmental precursors as a distinct and socially-conditioned activity in the particular processes of human evolution"*. He concludes by stating that *"At the very least it may have contributed to the emergence of one of our most distinguishing features, our cognitive flexibility; at most, it may have been the single most important factor enabling the capacities of representational redescription to evolve"*.

His analysis is based on two general theories of cognitive evolution and also on three interpretations which try to place music in human evolution. The conclusion he came to indicates that music is deeply rooted in our evolution and helped us tremendously through our evolution; it is perhaps an important contributor to what makes humans what we are today. As such, it is safe to assume that music is an important element of each human being.

Joseph Jordania explains in [8] that music had an adaptive function which helped early hominids achieve an altered state of consciousness, namely battle trance, which helped diminish the effects of pain and fear; this state facilitated the possibility of losing individuality and function in a collective identity.

The universality of music as a human activity is discussed in [9]; although the definition of music differs from culture to culture and the characteristics and conceptualisations varies, there is a unifying aspect in regards to *"human sound communication outside the scope of spoken language"*.

It should be noted that music is a more relaxed term in traditional cultures; non-musical sounds are re-contextualised *"to become "musical" sounds in healing and exorcism practices"*. This is in opposition to what music is defined in modern West,*" formalized melodic and rhythmic sounds produced by the human voice or other instruments*"

Additionally, "traditional music is associated with the supernatural — with a non-mundane time or realm or state that is frequently created, sustained, or reaffirmed by its performance".

Ellen Dissanayake continues in [9] analysing the effects of music on emotions and feelings form the perspective of ritualised behaviours: *"Rituals compel participants to feel (or "go through the motions of feeling") emotions appropriate to the purposes of the ritual—e.g., confidence, pride, joyfulness, well-being, resolve, release, and unification."*. She continues saying that salience has the potential of being emotional, and that *"formalization, repetition, exaggeration, and elaboration are all ways of giving salience"*.

She considers that musical emotion can be explained by four situations:

1. There is an appeal to the sensory experience
2. There is an association of music to moments of *"beauty, laughter, and enjoyment"*
3. There is the possibility of entering an intensified trance state which can result in transcendence
4. There is an inherent state of "anticipation and uncertainty that can be manipulated along what might be called an emotional trajectory"

2.3 MUSIC ELEMENTS

2.3.1 Music and Trance States

As the concept of connectedness used throughout the paper implies indirectly an altered state of consciousness, there is a necessity to study the relationship between music and trance state as defined in [10]: *"a state of mind characterized by intense focus the loss of the strong sense of self and access to types of knowledge and experience that are inaccessible in non-trance state"*.

The article points out that there is a relationship between certain kinds of music (such as heavy drumming and repetitive melodies) and specific types of trance states. While music is not necessary to enter a trance state, the two are often associatively linked.

In Balinese and Javanese gamelan ensembles "short, loud temporal cycles with no melodic elaboration indicate the presence of demons and fighting" while "long, slow temporal cycles with much melodic elaboration indicate refined characters and peaceful scenes".

There is evidence that there is a synchronisation between the firing of specific networks of groups of neurons, and the gamelan rhythms and the body of the trancers. There is also a supposition that the rhythmic driving may in fact facilitate the entering of trance states, while not necessary.

It is important to note that it is not the music per se, or the hearing of the music is the element that generates the trance, but the synergy between participation in the ensemble and the music that alters the mind state.

The article is conclude stating that both the "dream" state of trance and the "dream" state of what one perceives as reality is constructed internally; a trance state is thus a *"a particular neurological and chemical configuration within the brain"*. As

such, music is helping establish a specific neural configuration by means of aural stimulation which can in turn result in a state of trance in some individuals.

2.3.2 Patterns

The idea of pattern has been predominant throughout music history: although having different names based on context, such as: ground bass and the contrapuntal textures in classical music, the cross-rhythms in African music, the guajeo of Afro-Cuban melodies, the lehara of Indian classical music, the riff and vamp found in jazz, rock, and R'n'B, the loops in hip-hop, and the patterns of electronic music. The motivic repetition of themes throughout music appears to be widespread.

As presented in [11] and [12], musical patterns are deeply connected in mathematical structures and are intuitively accessible representations of thematic figures.

2.3.3 Timbre

As far as timbre goes within modern electronic music, not much research has been done to correlate the effects of the timber of synthesiser to music emotion. As such, the timbre aspects of the art installation will be made based on purely speculative assumptions based on personal experience

2.3.4 Ensemble

As the current approach to connectedness requires a lack of leadership or dominance within the group, an analysis of how this dominance arises is required. In [13] it is shown that there is a dominance in a string quartet of the first violinist, followed by the second one. It could be interpreted that such an occurrence exists due to the importance accorded to the roles of these two players within the musical piece.

It can be also observed that in several musical forms there is a tendency to emphasise the individualistic nature of a specific entity over the whole group. An example of this can be found in the concerto form, where there is a highlighting of the composer's proficiency and virtuosity over the orchestra, the stressed importance of a lead singer in pop and rock music, or the lead guitarist solos of hard rock which shadow the rest of the band.

These approach must be avoided and instead use a style well all the participants have equal access and importance, such as in some traditional music ensembles.

2.4 VALIDATION

There is a necessity to use a tested framework on which to confirm or infirm the hypothesis. For this, an analysis of related work in regards to art installation is done.

In [14] there are several frameworks which are suggested in order to study: presence measures, flow experience, positive affect negative affect schedule, self-assessment manikin, dimensional models, and the pleasure arousal dominance model.

From these, flow experience is the one most suitable for the current research.

Other means of validation will be to interview the participants and trace the body movements and controller data for further analysis.

2.5 HYPOTHESIS

Based on the analysis of the previous sections, I can finalise the hypothesis as follows:

Based on the works of [7] [8] [9] it is safe to assume that there is a natural capacity within humans to work as a unity and to enter such states using music. The fact that this capacity appeared in early hominids and continued to hunter-gatherer societies up to this day implies that this capability can be harnessed Furthermore, the fact that humans can enter trance states through music, coupled with the previous aspect makes the problem formulation stated in the previous chapter plausible.

In order to obtain such a state it is important to make heavy use of drumming and repetitive musical patterns and to minimise the dominance of a single player in order to focus the attention on the unity of the group. The consequences of not doing such create a separation between an individual element and the rest of group which can break the flow experience resulting in a loss of connectedness.

2.6 SUMMARY

Within this chapter an overview of the work to be reviewed has been presented, followed by a detailed description of the literature used: first the relationship between music and human evolution has been presented, concluding that humans are capable of working as a unified group.

Afterwards, the musical elements to be used and implemented within the art installation are presented: the important aspects of music that can induce trance such as repetitiveness, patterns, rhythmic drumming; another aspect which will promote the unity within the group is the lack of dominant players within it.

At last, a validation method has been proposed, followed by the hypothesis on which to base the art installation.

3 PROBLEM SOLUTION

3.1 GENERAL DESCRIPTION

Based on the presented theory and the hypothesis, the problem solution comes in the form of an art installation which aims to allow the expressivity of its participants to be manifested, while internally controlling hidden aspects such as scale, timbre, and safety methods.

Simply said, it aims to be a versatile art installation without being *too* versatile. The constraints mostly deal with musical scales, tempo resolution and control and timbre manipulation while maintaining enough responsiveness and freedom as to appear non-existent.

Based on my previous work within the field, I have discovered in [15] that it is important to use body energy to generate sound, and keep both a one-to-many and many-to-one relationship between the input parameters and sound generation.

The art installation will revolve around patterns and loops, being the *de facto* standard in electronic music. In order to avoid ennui, variations will be created mostly in the timbre domain, while musically, the state of boredom will be avoided using algorithmic modification of the input data.

Technically, the art installation will use Wii Remotes (from now on referred to as Wiimotes) as a human computer interface, as they offer good motion, acceleration, and rotation tracking response.

Sound-wise, digital synthesisers will be used, as they are both versatile and robust, and have the capability of delivering consistent sound quality and variety.

3.2 DESIGN

The approach to the art installation is based on a user centred design approach which focuses on maximising inductivity and ease of use. The reason to do so is based on the concept that the prehistoric humans did not have the proper technique to create complicated musical instruments and as such used whatever means they had at hand. In other words, there is no necessity to create a complicated interface, and the means in which sound is generated should come off as intuitive from short interaction with it.

It is important for the installation to be "newbie" safe and "troll" safe, as to avoid ruining the experience for others if a completely un-experienced participant or a malicious participant would participate.

The design will be split in two parts:

1. The design will be first implemented using simple sound and melodic design, focusing mostly on the interface; in order to improve this prototypical design, a usability test with expert users will be made, as it is the optimum testing method when it comes to both design and evaluation. Subsequent usability tests will be made depending on the results obtained.
2. Afterwards, the art installation per se will be created, having multiple incarnations in which several aspects are tested from each incarnation to the other, finalising with the best art installation which will be the final design

3.2.1 Intuitiveness

As far as intuitiveness goes, there is no user manual or prior training required in order to generate sound by hitting objects with one's own hand; this is in my opinion the proper way in which expressivity can be captured in the moment and is the best method to be used when the aim is to directly express what the artist feels. The shorter

the path between the emotions felt to the result, the more authentic the resulting piece will be.

Based on the previous example, an intuitive instrument which functions similar is the theremin, which requires the user to only move their hands close to it in order to produce sound; while it is indeed an instrument hard to master, the interface is easy to use and intuitive.

Using these two examples, the interface of the art installation should have their characteristics. The options are either Microsoft Kinect or Wiimotes; I personally prefer Wiimotes as they are more versatile in regards to hand movement and can provide the user with a sense of touch and direct feedback. Another important feature of the Wiimotes is the built in motor which can provide the user with kinetic feedback in regards to rhythm and tempo.

3.2.2 Musicality

Since there is the possibility of the users having no prior knowledge of how melody and harmony function, there is a need to constrain the possible pitches to a given scale. For this reason, the key of C minor has been chosen due to Ludwig van Beethoven's preference for its use when it comes to powerful, heroic and emotionally stormy pieces, according to [16].

In order to provide an intrinsic method to patterns, either a step sequencer will be used, as it is an commonly accepted method in electronic music, ranging from dedicated analogue step-sequencers to built-in patterns (such as the ones in groove-boxes and drum machines), or an arpeggiator, as it provides basic functionality to motivic generation of music while keeping a pattern feel to the final result; moreover, the use of an arpeggiator is reminiscent of their heavy use in psychedelic trance, which suggests that they might be of important use in achieving a trance mind-state.

In terms of harmony, an auto harmoniser will be used based on the root-note, as having only one controller per person cannot provide complex voicing options without sacrificing intuitiveness.

Rhythmically-speaking, the possibility of drums loops and drum machines are of appeal, as they provide the necessary rhythmic element required in order to achieve the states described in the theory which could result in group flow; a secondary option could be generative drum elements. However they are not the preferred method as they add another layer between music interface and sound generation which might prove confusing.

3.2.3 Sound and Timbre

As far as sound design is concerned, the "standard" elements found in electronic music will be used

1. Pad sounds: ambient sounds reminiscent of strings and brass sections, but which have the possibility of evolving into complex soundscapes. Can have nature sounds and drone-like brooding sounds.
2. Bass sounds: standard electronic bass sounds, such as deep sub-basses consisting mostly of sine waves, saw-based squelches (referencing to '90s acid-techno scene), and heavily distorted and detuned reece sounds, conferring a heavy atmosphere which remind of the rave and drum-and-bass scene. The choice for this type of sounds is based on the fact that they are easily recognisable and popular within the electronic music scene.
3. Lead sounds: standard saw and square based lead sounds will be used; for variation, trance-gates and arpeggios will be added.
4. Percussion: classic drum machine samples will be used (such as the TR-808 and TR-909), coupled with ethnic and cinematic loops.

5. Other sounds: for added variety, piano, music boxes, guitar, and other miscellaneous sounds are used, thus avoiding any possibility of limiting the art installation by enclosing the timbre within a given genre.

3.2.4 Interface

In order to translate the movements of the artist into sound, several approaches can be used:

1. Waving the Wiimote and/or the Nunchuck – this will be used to emulate drum stick hits and bowing movements
2. Shaking the Wiimote and/or the Nunchuck – this will be used as a means to generate expressivity, the amount of energy generated by the shaking having direct control over the dynamics of the sound
3. Axes rotation (yaw, pitch, and roll) – this will be used to control several parameters of the sound (e.g. pitch, timbre)
4. Nunchuck joystick – same as the axes rotation
5. Buttons – can be used to trigger, switch, or modify sounds

All of these approaches will be tested and tried to be used simultaneously in order to obtain the most efficient and fluent use.

3.2.5 Creating Variation

While repetitiveness is an important aspect of the current art installation, it is also important to maintain interest and keep the group focused on the experience.

In order to provide a motivic style of melodic lines, the key scaling of notes has been used. However, since the effect obtain is similar to scale runs, one way to obtain the necessary variation in the music is by externally controlling the number of steps

which can be used, by selecting between 1 through 7 steps (i.e. only the tonic to full scale).

Both the second and third implementation used this approach, adding excitement and surprise to the piece being created.

3.3 IMPLEMENTATION

3.3.1 Platform

For the implementation of the art installation, Sensomusic Usine has been used as it is a robust platform which allows both visual programming and modular style synthesis, having been optimised (but not limited to) for audio installations. It is a balanced platform suited for rapid development, having a strong implementation of MIDI and OSC, and also having integrated the interfacing with the Wiimotes, allowing a maximum of four Wiimotes to be connected.

3.3.2 Basic Modules & Algorithms

1. Hit detection: a custom algorithm has been developed in order to detect the emulation of a drum hit made by the Wiimotes, similar to how air drumming is performed. Due to how the accelerometer works based on the rotation of the Wiimote, there has been a need to calibrate and neutralise the effect of the rotation.
2. Sequencer: a simple 16-step sequencer which synchronises to the tempo, allow the recording and playing of motifs, and can be overruled by real-time playing

3. Degree to float conversion: a simple transfer function which converts the output degree of one of the three axis rotation as a floating-point value between 0 and 1
4. Drum machine: a four sound drum machine with selectable sounds (which includes a kick sample, a snare sample, a hi-hat sample, and a clap sample) based on the buttons pressed
5. Pitch conversion: takes a value between 0 and 1 and outputs a MIDI note value between 0 and 127; this is restricted by the key (C minor), the starting note, and the range of notes it should convert. Furthermore, it scales the notes based on how many steps of the key it should use (i.e. dividing the full range of motion into steps) as follows:
    - 1 note: only the tonic
    - 2 notes: the tonic and the dominant
    - 3 notes: the tonic, the dominant, and the submediant
    - 4 notes: the tonic, the dominant, the subdominant, and the submediant
    - 5 notes: the tonic, the dominant, the median, the subdominant, and the submediant
    - 6 notes: the tonic, the dominant, the median, the subdominant, the submediant, and the leading-note
    - 7 notes: the full octave
6. A built-in four voice auto harmoniser which outputs a chord based on an input note and a selected scale (the scale used was minor classical, with C as the root note)
7. An effects bank, which is used to modulate the sounds coming from the synthesisers, based on the controller rotation on different axes and the Nunchuck joystick.

3.3.3 First Implementation

The first implementation has been made as a means to test the interface in the usability test (which will be described in the following chapter); as such, focus is on functionality and intuitive use, rather than on sound quality.

The implementation consists of two instruments which are to be used separately, as part of the usability test.

The first instrument is a drum machine which features four tracks for each sound. A simple swing (or hit) of the Wiimote will trigger the kick drum (or bass drum) sound. Pressing a key (and keeping it pressed) on the Wiimote will select a different sound as follows:

1. Pressing A will select the snare drum
2. Pressing B will select the hi-hat
3. Pressing both A and B will select the clap

The second instrument is a bass synthesizer using a standard reece sound (made with Sylenth). The pitch axis of the Wiimote controls the output pitch of the sound.

Both of the instruments are equipped with a sequencer which is controlled by the Nunchuck and can be controlled as follows:

1. Pressing Z will record the input of the pitch from the Wiimote on the current step of the sequencer
2. Pressing C will clear the current step of the sequencer
3. Holding both Z and C will allow to perform freestyle using just the Wiimote
4. Doing nothing will simply play the recorded sequence

The Nunchuck also controls the parameters of the effects:

1. The joystick controls the blending of each effect, with four possible positions for each of the four possible effects (up, down, left, right, with the centre position sending only the dry signal, similar to how vector synthesis works).
2. The pitch and the roll of the control the parameters of the effects in the effect banks

The effect bank for the drum machine consists of the following:

1. A frequency modulated band-pass with a low-frequency oscillator controlling the Q of the filter for the kick drum
2. A delay for the snare
3. A delay for the clap
4. A built-in "Freezz" which consists of a beat-synced pitch-shifter / delay / beat-masher for the hi-hat

Both the drum machine and the bass synthesiser use a kinetic synchronisation by triggering a short vibration in the Wiimote on every beat.

The sounds were played with the built-in sample player.

3.3.4 Second Implementation

Based on the findings from the first usability test, the sequencer and the drum machine were dropped, modifying the interface to a simpler control, consisting of the pitch of the Wiimote / Nunchuck to control the pitch of the synthesizer and the roll of the Wiimote / Nunchuck to control parameters of the synthesizer and/or effects. The triggering of sounds was synchronised to the current beat, while the energy within the Wiimote / Nunchuck (generated by shaking or waving it) controlling the dynamics.

The second implementation used the Nunchuck by mirroring the functionality of the Wiimote.

Three versions have been created (all keeping the same interface) with different sound characteristics, aiming to test how several timbral characteristics and stylistic differences can influences the relationship between users.

This implementation consists of each user controlling two separate instruments (one for the Wiimote and one for the Nunchuck) simultaneously, giving a total of four instruments.

All the sounds were generated using Spectrasonics Omnisphere.

3.3.4.1 Abstract - Ambient

The first variation uses ambient sound sources, long evolving pads, nature sounds and morphing soundscapes, buzzy drones and subtler kinds of noises, to create an abstract, otherworldly atmosphere which at times can be delicate, yet eerie. No vibration synchronisation has been used.

The four instruments consist of:

1. A combination of bowed guitar strings, bowed bowls, and scraped thick metal strings / bars.
2. A combination of a detuned trance lead, a unison PWM lead, ambient-like string ensemble, and boys choir
3. A dark and heavy reece combined with a softer string-like pad and an orchestral string ensemble
4. Cold sounding chimes and an underwater like evolving soundscape

3.3.4.2 Rhythmic

The second variation focuses on rhythmicity, relying heavily on trance-gates, rhythmic loops, percussive hits, and powerful accented arpeggios. Vibration synchronisation has been activated.

The four instruments consist of:

1. A percussive arpeggio made of synthesised string plucks
2. A trance-gated sound typical of uplifting trance
3. A combination of an analogue sounding arpeggio with a complex and evolving rhythmic pattern
4. A complex trance-gated arpeggio motif, reminiscent of the melodies found at raves

3.3.4.3 Melodic

The third variation is based around melodic instruments and traditional sounds, using a blend of both melody and rhythmic aspects. Vibration synchronisation has been activated.

The four instruments consist of:

1. Two square-based soft leads with a slow low-frequency oscillator controlling the filter frequency cut-off.
2. A deep, soft partially musical partially rhythmic loop
3. A combination of a lush, orchestral string ensemble and a classical guitar sound with a percussive glass sound on the initial attack
4. An ambient drum loop with reversed samples, giving a breathing feel, with an added deep house trance-gate melody

3.3.5 Final version

The final version of the art installation uses only the Wiimote; the pitch angle controls the pitch of the synthesiser and the roll controls sound parameters (if any). Each Wiimote belongs to one of four categories of sound styles (chords – stacked or arpeggiated, leads, bass sounds, and drums / percussion loops). Each of the categories

has four separate sounds, which can be selected by pressing one of the four buttons on the Wiimote D-Pad. The vibration synchronisation was kept on for all Wiimotes.

The sound design was made in such a way as to avoid the overpowering of a certain instrument over the others, keeping both volume / loudness, sound quality, and importance in balance. One should be especially cautious not to be misled by the use of the term “leads”, as this only refers to a specific *style* of sound and not to the situation where the sound represents the leading voice or melody in a musical piece.

Although the sounds per se are balanced by default, it is not automatically implied that the final result will be this one, as it is up to the performers / artists to control this aspect; one could for example allow a single instrument at a time, switching places and taking turns, thus creating a melodic interplay.

3.3.5.1 Chords

The purpose of the chords is to provide the harmonic background and to fill any possible gap on the frequency spectrum, resulting in an overall full and cohesive sound.

The sounds for the chords were created using Omnisphere and consist of:

1. A bell-like sound blended with pitch controlled arpeggiated water sounds
2. An arpeggio of a blended sound originating from a music box and a classical Spanish guitar sound
3. A metallic scraped sound and a rhythmic ambient loop
4. A mix between a male choir and a flute / woodwind ensemble.

3.3.5.2 Leads

The lead sound works in relation to the chordal structure and creates the upper melody, filling the higher part of the frequency spectrum. The sounds were created using Sylenth, PG-8X, and Absynth, and are all variations based on saw sounding dance leads.

3.3.5.3 Bass sounds

The bass functions similarly to the lead, but taking the place of the lower melody, filling the lower part of the frequency spectrum.

The sounds for the chords were created using Sylenth and Absynth, and consist of:

1. A deep tone, with heavy sub-bass, emulating a dark bass guitar
2. A heavy distorted reece sound
3. A 303 acid-techno arpeggiated sound, using saw waves and heavy distortion
4. A softer 303 acid-techno arpeggiated sound, using saw waves

3.3.5.4 Drums / Percussion

The percussive elements take the necessary role of the energy driven element, as it has previously been proven that heavy drumming can help enter trance states.

The drums consisted of synchronised cinematic loops, one focusing on more acoustical / tribal sounds, and the other using electronic sounds.

The variation were created by taking the initial sounds and further processing them using resonant filters and synchronised low-frequency oscillator modulations.

3.4 TECHNICAL ASPECTS

The art installation was installed in a large classroom, allowing enough space for movement and interaction, such as dancing, in the opportunity that such a feeling would arise.

In order to assure the best sound quality, an external soundcard was used (Focusrite Saffire) connected to two Event ASP-8 active monitoring speakers.

3.5 SUMMARY

The current chapter deals with the problem solution to the problem previously formulated.

It begins by explain the general concepts to be used in the design of the art installation, such as intuitiveness, musicality, musicality, several aspects of sound design and the main interface to be used. It also describes the method employed to create musical variation.

It continues by explaining in detail what software platform was used, what algorithms were developed, and how the art installation what was implemented in each of its incarnations; it gives details on the synthesisers used and it explains how each of the instruments sound.

4 TESTING

4.1 FIRST USABILITY TEST

For the first usability test medialogists were used, as they are considered expert users and it would be fairly easy to get competent opinions regarding the overall experience.

The test consisted of a short experience with both the drum machine and the bass synthesiser, focusing mostly on how intuitive the interface feels.

The test was taken by five medialogists, out of which only one had previous experience with art installations and considered himself to be an expert within the audio field.

The test consisted of four scenarios:

1. One in which only the drum machine was used with free performance
2. One in which only the bass synthesiser was used with free performance
3. One in which the drum machine was connected to the sequencer
4. One in which the bass synthesiser was connected to the sequencer

The use of a sequencer was considered an optimal method for the implementation of patterns and loops.

Afterwards a short interview followed in which the participants were asked to describe in each scenario what they experienced, how intuitive it felt (on a scale of 1 to 10, 1 being the least intuitive and 10 being the most intuitive) and how can it be modified to increase the overall intuitiveness. At last, they were asked to rate themselves based on their previous experience with art installations.

Although there were only five participants, the results were conclusive: the only intuitive method was the second one (the free performance bass synthesiser) scoring an average of 7.8.

The other scenarios were considered less intuitive, the least intuitive being the sequencer, scoring an average of 2.3, which I consider to be a really low score, given that the participants are considered expert users.

These results concluded that the best interface to be used for the installation consisted in a simple, yet intuitive control, where the pitch rotation controls the pitch; in order to add more expressivity, this prototype was modified by using the amount of energy generated by the shaking and moving of the Wiimote to control the dynamics of the sound. It was pointed out that using the vibration to synchronise to the tempo greatly improves the experience.

A second usability test is therefore necessary to confirm this decision.

4.2 SECOND USABILITY TEST

As a consequence of the finding in the first usability test, this test came to existence to verify the viability of the interface, this time using non-expert users, aiming to use a public as similar as possible to the target group of the final art installation. There were a total of five participants in this test.

Only one scenario was used, as opposed to the previous test; after the experience, an interview followed using the same questions.

The instrument was switched from a simple reece sound to a complex combination of pads, strings and arpeggios, bringing the participants closer to what it would become the final experience of the art installation.

The average note of the intuitiveness was 8.2, which in my opinion is sufficient, given the technology involved, the novel interface and the fact that it was a complex sounding instrument which at times was described odd to predict.

4.3 FIRST ART INSTALLATION

Using the results obtained from the two usability tests, a simple art installation was created which allowed two participants to interact with each other through music. Each participant was given the opportunity to control two instruments simultaneously, giving the opportunity to express oneself in multiple dimensions.

A Latin square method was used to cycle through the three scenarios (Abstract, Rhythmic, and Musical). There were a total of 20 participants aged 15-19, resulting in 10 groups. Out of the 20 participants, 5 were female and 15 were male.

Before the art installation to be started, the participants were explained the nature of the test and were given the clear goal to use the remotes and their movement to create music or sound, based on their personal view upon the subject. They were explained that the buttons do not work (in order to avoid any possible confusion), but were not explained the functionality of the remotes.

After the three experiences, the users were asked to describe their opinion about what they felt, the interaction with the remotes, the interaction with their partner, if they felt any moment where the interaction was heightened and if so, when. Finally they were asked to describe the most pleasant of the three, to rate the overall experience (using a scale of 1 to 10, 1 being the worst and 10 being the best), and to comment whether they had any previous contact with art installations.

The participants were filmed during the entire time in order to have the ability to analyse their body movements without direct observation in order to avoid any possible intimidation which might occur.

The motion of the remotes was also recorded in order in order to observe whether any similarity or synchronisation between the movements might appear.

In order to test if any disturbances occur, there were two tempo switches in the middle of each scenario; none of the participants showed any modification in their behaviour.

The overall results indicated that the groups that self-described as being naturally synchronised, or that explicitly collaborated with each other aiming for synchronisation had an overall similar level of remote energy, trying to balance each of the sounds into a harmonious melody.

It is also indicated that the preferred scenarios were the musical and rhythmic ones, with equal results for both: 6 out of 10 found both musical and rhythmical scenarios as better for higher interaction and synchronisation.

In regards to personal preferences 8 out of 20 preferred the musical scenario and 10 out of 20 preferred the rhythmic scenario.

Out of the 20 participants, only 2 responded as having previous experiences with art installations.

The average grade given is 9.15 out of 10.

From these collected results, the final art installation which aims to be the solution to the initial problem was created.

4.4 FINAL ART INSTALLATION

This final version is strongly based on the previous version having almost the same conditions, with the following differences:

1. There are now four participants per group
2. Each participant controls only one instrument
3. There is only one scenario
4. There are no more tempo changes (as they appear to have no effect)
5. They were explained that only the D-Pad works as an instrument / sound switcher

There were 32 participants aged 15-19, resulting in 8 groups. 17 of the 32 participants were female, while the rest of 15 were male.

Out of the 32 participants, only 1 reported as having previous experience with art installations.

The overall results are consistent with the previous results, indicating that users that felt or aimed for synchronisation showed an increased similarity between the overall levels of the energy in the Wiimote.

The average grade of the experience is 9.53 out of 10.

4.5 SUMMARY

In this chapter a description of each part of the testing process has been given, along with minimal information on the subject of the results, necessary to justify the decisions taken to advance to the next scenario.

Two usability tests have been made, the first using expert users and the second using non-expert users which resulted in a preliminary installation with three possible scenarios out of which the best elements have been taken resulting in the final scenario which is considered the optimal solution to the given problem.

With each advance there has been a qualitative increase in the results, further and further refining the installation to better suit the concept and the demands.

The final version of the installation is considered to be in presentable form and can be used to obtain the state of connectedness formulated in the hypothesis.

5 FINDINGS

5.1 ANALYSIS

Due to the highly subjective experience art is, most of the results are based on the qualitative and personal experience of the participants and their answers. The data and videos which have been recorded are used only to confirm whether the feelings and emotions of the participants are externalised through their bodies.

This decision has been made based on the fact that flow is an internal personal experience and each individual has their own way of expressing this; the implications are that although an observer could consider the participants not entering a state of group flow, the internal feeling of the participants themselves might be quite the opposite. As such, there is a need to have faith in the honesty of the participants and use their answers as the primary means to decide the results of the present research. While highly speculative, I believe it is the only way which can be deemed acceptable to be used.

The video analysis is however useful in the specific situations where verbal communication exists within the group, as such communication (mostly under the form of directives or suggestions given to the others, but also as personal reactions) can hint what and how a specific individual feels at a given moment, and wishes to impart or share that emotion (or idea) with the group.

The recorded movement is the least reliable, as some of the participants described entering a trance state, while *not* moving or generating sound, letting themselves float to the music created by the others and taking turns in enjoying the subtleties of the others' instruments.

5.2 INTERVIEW RESULTS

The following results were translated from Romanian to English, as the interviews had been done in Romanian.

5.2.1 First Installation

On the overall experience, the users commented as being new, nice, beautiful, awesome, funny, interesting, unique, hypnotising, and unusual. Some of the participants reported that they enjoyed themselves that they felt like being on stage, that they were intrigued by how they controlled multiple instruments. Some were amazed by what they perceived to be as unusual sounds. Three out of the 10 groups specifically pointed out that they synchronised, finding they own rhythm and feeling that their dance created the music, but simultaneously that the music was controlling their body movements. On the downside, one group reported the experience as unintelligible, that the instruments lack feedback and that there is too much pre-rendering in the sound.

In regards to the interaction between themselves and the Wiimotes, most felt that it was quite versatile, that the sounds synchronised perfectly, that there was an obvious feedback regarding dynamics and that playing with the Wiimotes can easily manipulate the sounds. On the other hand, 2 out of the 10 groups reported bad feedback and weak interaction; a user considered the use of a Kinect to be a better option.

On their interaction as a group, most of the groups reported as either synchronising automatically or that they intuitively tried and worked as a team in order to create a harmonious song. All groups reported that there was a slight period of accommodation at first.

It is interesting to note that one group specifically mentioned that they entered a psychedelic state through this experience. Said group have reported as having no previous background, nor experience with such states or installations.

5.2.2 Second Installation

Regarding the overall experience, the participants considered it was better and easier than expected, fun, creative, engaging, interactive, weird, nice, and interesting. Some wished to be able to own such an installation for personal use. One of the users reported as feeling as Skrillex. The same feeling of being on stage has been reported as in the previous installation.

When it came to the interaction with the Wiimote, all users reported that there was a 2-3 minute period of adaptation, but afterwards the interaction was highly intuitive and fluent. Some users enjoyed the vibration; one group reported that there was a need to try all of the sounds at once, feeling as if they wanted to press all the buttons at once. Another group considered the Wiimote to represent the conductor in a traditional orchestra.

Although the groups were now larger and it has been reported that there was a need at first to focus on each sound (due to the inherent curiosity regarding each of the sounds), all groups reported that during the middle and end of the experience they felt the need to synchronise and create their own personal song, feeling a higher degree of interaction than usual.

5.3 VIDEO RESULTS

5.3.1 First Installation

Except for the group that didn't understand the experience, all the groups synchronised their movements to a certain degree, following the tempo.

While some preferred faster movements, moving the controllers as if trying to do a rush of 16^{th} notes, others opted for longer, wider movements, as if waving a bow, changing direction on every 4^{th} note.

This effect was specifically noticed on the rhythmic scenario and to a similar extent in the melodic scenario. On the other hand, in the abstract scenario there was a lack of synchronisation (from the point of view of the observer); this could be explained due to the fact that there was no "metronome", as the vibration was turned off. The overall feeling given by the movements of the users were as if they were floating in empty space with wide, deep movements; while not really synchronised, it left the impression as if they were moving to some extent to slow, imaginary waves.

There were no differences in regards to movement or synchronisation between genders.

5.3.2 Second Installation

The results of the analysis of the video recording of the second installation are less conclusive, as the participants spent more time discovering the sounds; when focusing on creating a cohesive melody, their attention was directed mostly towards the sounds, some remaining completely still and only moving their hands.

At first the movement appeared to be completely chaotic, but under a careful analysis it resulted that the same feeling of trying “to hit” on time existed, although more subtle and less energetic.

Most of the groups avoid any sorts of dancing; however two of the groups focused specifically (after the adaptation period) on synchronising every movement to the beat.

One of the more interesting exceptions to the previously stated was a participant who enjoyed the experience so much as to take another Wiimote from one of their colleague and start dancing frantically in the space.

In regards to gender differences, the male participants seemed to be more willing to experiment and move, although not necessarily feeling the need to express themselves through dancing.

5.4 OTHER RESULTS

- The recorded data in the first installation indicated that there was more activity with the Wiimote than with the Nunchuck.
- Although it appears to be a relationship between the recorded Wiimote data and the feeling of synchronisation, I would consider this data inconclusive and will focus more on the reported feeling and the body movement. I made this decision based on how the accelerometer works in the Wiimote and how the data from the accelerometer has been used to generate the sound: the focus was primarily on sound generation and ease of use and not on accurate measurements. Furthermore, the impossibility to use the MotionPlus module is another downside to analysing this data. In other words, the Wiimote reacts nicely as a musical instrument, but cannot be used in the current implementation as a tool for data analysis.
- The post-experience reactions noticed in the users were of pleasure, relaxation and calm, the participants showing feelings of happiness and enjoyment.

5.5 SUMMARY

This section describes the results obtained through the testing process. It starts by explaining how the results will be evaluated, noting that the focus will be on personal experience and less on external observations.

It then continues by elaborating on the results found through the interview, grouped separately by the first and second (final) installation. Afterwards the video recording are analysed and the chapter is ended with other miscellaneous observations.

6 CONCLUSION

6.1 DISCUSSION

Based on the interviews and the grades given it would be safe to assume that the installation has achieved its desired purpose, bringing at least a sense of synchronisation to some of the groups, while to others, even if not expressed as such, a state close to what I defined as connectedness.

The participants themselves described they tried to achieve a common goal –in most cases a harmonious song, which based on one's own interpretation can be suggested to be a sense of unity, or oneness.

There has been a slight shift in focus when switching from two to four participants within a group; initially the users spent more time focusing on them-selves, but afterwards were more dedicated to the unity of the group. Another aspect is that switching from using both hands (as in the case of Wiimote and Nunchuck) to only one hand resulted in more mechanical moves. My suggestion would be to simplify each instrument, and allow all four users to use both hands, as it seems that it allows more fluency within the body movement.

While remaining an open question, my overall impression is that art installations can and should be used to bring unity amongst small groups of people. However, at this point I consider that it is unfeasible and confusing to apply the current method in a larger context, such as a rave or a club's dance-floor, where a different approach needs to be used – perhaps simplifying each sound source, or making the complexity of the sound source scalable, based on the number of active participants.

6.2 APPLICATIONS

Based on the findings I would suggest using these kinds of art installations firstly as a free public entertainment device, with the possibility of placing such installations in parks and/or popular streets. In order to simplify the process, the Wiimote can be replaced with an optical tracking device such as a Kinect.

A second application of such installations could be as a tool in therapy sessions, as the participants showed a high degree of enjoyment, lack of stress, living more in the present, and reducing the problems associated with worries, at least on a short term. More investigation is required to confirm or infirm such usefulness.

At last, the art installation can be used on its own, as I have previously stressed the intrinsic value offered by art.

7 REFERENCES

[1] Mihály Csíkszentmihályi, *Beyond Boredom and Anxiety*. San Francisco: John Wiley & Sons, 1975.

[2] Mihály Csíkszentmihályi, *Finding Flow*, 1st ed. New York: HarperCollins Publisher, 1997.

[3] (2012, May) LivePA website. FAQ. [Online]. http://www.livepa.org/faq/#what_is_a_Live_P.A.

[4] Moldover. (2012, May) Moldover's Approach to Controllerism. Video. [Online]. http://www.youtube.com/watch?v=L2McDeSKiOU

[5] Victor Lebow, "Price competition in 1955," *Journal of Retailing*, vol. XXXI, p. 7, 1955.

[6] Robert Andrews, The Routledge Dictionary of Quotations.: Routledge, 1987.

[7] Ian Cross, "Is music the most important thing we ever did ? Music, development and evolution," Seoul National University Press, Seoul, 1999.

[8] Joseph Jordania, Why do People Sing? Music in Human Evolution, 1st ed.: Logos, 2011.

[9] Ellen Dissanayake,. Oxford and New York: Berghahn Books, 2006, pp. 31-56.

[10] Judith Becker, "Music and Trance," *Leonardo Music Journal*, vol. 4, pp. 41-51, 1994.

[11] Jeanne Bamberger and Andrea Diessa, "Music as Embodied Mathematics: A Study of Mutually Informing Affinity," *International Journal of Computers for Mathematical Learning*, pp. 123-160, 2003.

[12] Jeanne Bamberger, "Music, Math and Science: Towards an Integrated Curriculum," *Journal for Learning Through Music*, pp. 32-35, 2000.

[13] Maurizio Mancini, Nadezhda Rukavishnikova Donald Glowinski, "Analysis of Dominance in Small Music Ensemble," InfoMus Lab, Genova,.

[14] Giulio Jacucci et al., "Bodily Explorations in Space: Social Experience of a Multimodal Art Installation," International Federation for Information Processing, 2009.

[15] Theodor-Bogdan Lancor, "Merging audio, video, dancing, and space for the creation of a dynamic unified performance," Aalborg Universitet - København, Copenhagen, 2012.

[16] Charles Rosen,. New Haven: Yale University Press, 2002, p. 134.