RESONANT FIELD:
A CRITICAL ANALYSIS OF USER INTERFACE DESIGN IN DIGITAL MEDIA

A Master's Thesis

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Media and Design.

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ABSTRACT

RESONANT FIELD:
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This thesis analyzes user interface design process in digital media. New methodologies, new perceptions, new approaches and new technologies help unfolding new understandings within this paradigm. Within the shifting nature and definition of art and design, a work has become something that gains value and importance as the audience of such works are transformed into users or participants. The core of this thesis is on the user experience through the interaction of the user/participant with the interface designed by the artist/designer. It probes into the levels of interaction and user interface design through analysis of works from the domain and a designed interactive installation.

Keywords: Digital Media, Installation, Interaction, Resonance, User Experience Design, User Interface Design

ÖZET

TINLAYAN ALAN:
DİJİTAL MEDYADA, KULLANICI ARAYÜZ TASARIMININ
ELEŞTİREL BİR ANALİZİ

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Bu tez, digital medyadaki kullanıcı arayüz tasarımını analiz eder. Yeni metodolojiler, algılar, yaklaşımlar ve yeni teknolojiler bu paradigmayı daha iyi anlamamızı sağlar. Sanat ve tasarımın değişen doğası ve tanımı içerisinde, bu tarz işler, izleyiciyiciyi kullanıcıya veya tasarımcıya çevirerek değer ve anlam kazanır. Bu tezin odağı, kullanıcının/katılımcının sanatçı/tasarımcı tarafından tasarlanan arayüz ile etkileşiminden doğan kullanıcı deneyimini üzerinedir. Alanda üretilmiş işler ve tasarlanmış etkileşimli yerleştirme analizi üzerinden etkileşim katmanları ve arayüz tasarımını inceler.

Anahtar Kelimeler: Dijital Medya, Etkileşim, Kullanıcı Arayüz Tasarımı, Kullanıcı Deneyimi Tasarımı, Rezonans, Yerleştirme

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CHAPTER 1

INTRODUCTION

My professional engagement in the field of visual design as a graphic designer, an art director, a UX (user experience) and UI (user interface) designer and as a creative director showed me that whether the product is for print media or digital media, everything that was designed actually is an interface for a specified target audience or a group of users to access a particular content. Hence, the core theme of this thesis is "user experience design". "User experience" is a phrase that was first used by Donald Norman (in 1998), in the field of human centred design, to "cover all aspects of the person's experience with the system including industrial design graphics, the interface, the physical interaction and the manual" (as cited in Merholz, 2007, para. 2, Retrieved from http://adaptivepath.org/ideas/e000862).

The thesis project *Resonant Field* depends on the critical analysis of *user experience design* in Digital Media. The research question is "How and to what extend the UX and UI designs effect the experience acquired by the digital media user?"

The definition of Art is shifting continuously, it has an ever changing nature. New methodologies, new perceptions, new approaches and new technologies help unfolding new understandings within this paradigm. Within the shifting nature and definition of art and design, a work has become something that gains value and importance as the audience of such works are transformed into users or participants. As suggested, the core of the thesis project is on the user experience through the interaction of the user/ participant with the interface designed by the artist/designer. The project fulfils its promise when the audience acts on it, thus, as she or he becomes the user. Thus, the project is an interactive installation. The user is asked to interact with the audiovisual content that is created by the artist/designer through a programming, which is written by the artist/designer. The outcome of the project is generated by the users as they experience the project through a designed interface. The possible audiovisual outcomes are formed via a deliberately designed UI, however, the generated outcomes are thought to be unique and unpredictable. Hence, each time a user interacts with the system, a new outcome is formed, making each experience cybernetically a unique one. The project forms a body of data that can be critically analysed based on the theoretical and practical works previously entered and shaped the digital realm.

The project consists of real time generated abstract video sequences by the help of *Max MSP,* a web camera, a projector, an *Arduino* board specifically created for conductive paint and stencilled/drawn images/icons. The user experience is aimed to be the final outcome of the project, hence, the moving images to be used are not from a video database but are generated by various compositions of the abstract shapes and the projection of the user to a virtual 3D plane as a texture, that are brought about with the

input gathered from the physical existence and aspects of the user at the installation space. The users send data to the system with their physical presence, while at the same time they are able to interact with the installation through images on a 2D surface which act as proximity sensors painted with conductive paint.

There are two main aims of the project. First and foremost aim is to create a more familiar experience to that of an analogue feel whilst dealing with the digital content. The analogue experience of the user is closely related to the theme of the project, which is resonance. The second aim is one on a more personal level, which is to challenge myself as an UI/UX designer, designing for the digital media for the past 15 years. There are apparent recipes for a successful user interface, which helps the user to reach the content, that most of the user interface designers use through out the field. How relevant are these recipes? Can one construct a better experience without using those recipes? Trying to remove the layer in traditional sense in the course of interaction is a confrontation for the UI/UX designer. Figuring out different modes of interaction will demonstrate the pros and cons of any user interface design and may have the possibility of offering different points of view for the UI design in general.

The thesis is formed in 5 main parts. The 2nd chapter focuses on the concept of "software culture", which was offered by Lev Manovich and discusses user interface and interaction design in accordance with it. The 3rd chapter analyses and investigates the concepts of "oscillation", "resonance" and the chance factor as they are integrated in digital media. The 4th chapter deals with the "play" concept, it tries to look at it from Johan Huizinga's and Roger Caillois' point of views and articulates these discussions

through examples created for digital media. The 5th chapter is the core of the thesis, where the project *Resonant Field* is documented and analysed, along with the discussions laid in the previous chapters. It is followed by the 6th chapter, conclusion, where the outcomes are evaluated and meaningful consideration of an afterimage is implemented.

CHAPTER 2

USER INTERACTION AND INTERFACE DESIGN IN DIGITAL MEDIA

2.1. The Software Culture and Its effects on User Interaction and Interface Design in Digital Media

To evaluate the state of interaction and interface design in digital media for the time being, one has to look back to where and how the first graphical user interfaces started to surface. A lucid understanding of their aims and intentions should be put forward and analysed.

The underlying fact for the transformations that took place in the human computer interaction design processes was structured on the questions of how these machines could be integrated into the society, what their roles and effects can be when the software running on those machines became abstracted by a more familiar experience through a layer of interface related with the cultural forms. Hence given to a wider range of individuals.

The liberalisation of the usage of computers was the first and foremost motive behind the communication layer to be implemented onto these machines. The mathematically constructed, calculative nature of the computer world had to fuse with the cultural structures of the society so that its use would become understandable and its area of effect would become widened. The whole interface design paradigm was constructed around how to create experiences between the human and the machine which constituted deep, familiar and effective communications. These motives gave rise to the formation of abstraction layers of interaction design through graphical user interfaces that stood between the user and the code of the software being interacted upon.

The foundations of the most recognisable works related to the graphical user interfaces of today's software culture came from the Xerox Parc from the 1970's to 1980's. The initials stand for Palo Alto Research Center. The developments made inside this research facility gave birth to the personal computer, the basis of the modern graphical user interfaces, the metaphor of a desktop on an operating system and other related software development interface paradigms like the object oriented programming and the basic interaction input point and click system which is called *WIMP*. WIMP is an abbreviation for windows, icons, menus, pointer.

One can not study human computer interaction without considering the effects of the ever changing software landscape that is influenced by our own culture and how the improvements in this field effects the ways in which we interface with the computers. The ways in which the algorithms of a software is defined affects the layers of the

whole interaction design process, the graphical user interfaces and as a result our understandings and manipulation techniques of the data being represented. This could be the reason why Manovich, in his renowned book *The Language of New Media* centres his approach on the interface, but then in his second book *Software Takes Command* he centres his approach on the subject around the cultural software.

> I think of software as a layer that permeates all areas of contemporary societies. Therefore, if we want to understand contemporary techniques of control, communication, representation, simulation, analysis, decision-making, memory, vision, writing, and interaction, our analysis can't be complete until we consider this software layer. Which means that all disciplines which deal with contemporary society and culture – architecture, design, art criticism, sociology, political science, humanities, science and technology studies, and so on – need to account for the role of software and its effects in whatever subjects they investigate (Manovich, 2008: 7).

While Xerox PARC employees were researching communication patterns the art world was also transforming and looking for ways to incorporate this new shift in culture. The *Software* exhibition that was held at the Jewish Museum in 1970 was such an example. Software, as its name suggested, was an exhibition that demonstrated various works based on software. One of the works was the first public demonstration of an interactive hypertext system where any user could browse through the catalogue of the works exhibited in the exhibition named *Labyrinth: An Interactive Catalogue* by Ned Woodman and Theodor H. Nelson. The user had access to a terminal (Figure 1), where he or she could input commands, browse and select portions of the text of the catalogue to finally output the selections through a printer (Burnham, 2003: 247).

Figure 1. *Labyrinth: An Interactive Catalogue*, Software, 1971

The organiser of the exhibition Jack Burnham stated that "the goal of the Software is to focus our sensibilities on the fastest growing area in this culture: information processing systems and their devices" (Nelson et al., as cited in *The New Media Reader*, 2003: 248).

What was actually happening? The artworks were considered as hardware until the machines were capable of running software powerful enough to handle the needs of an artwork to be represented and these artworks could be transformed by the media, which in this case, is the software and the interface culture into informative objects about the works themselves.

The computers are calculation machines. They let information to be reconfigured, measured and reinterpreted through algorithms. This means that, in order for the media presented on such a machine to be manipulated and organised, there needed to be a layer of control to be imposed upon this body of data, the media. The software accompanied by a user interface let the media presented to be taken out of its original boundaries. They give way for the model of the data to be represented in different structures. The interface becomes a gateway between the user and the content. It shapes the nature of the story being told. It controls the way the user perceives the data model structure of the media being presented.

What the research team at Xerox Parc found out was that the traditional tools that were simulated and integrated into software environments gave way to do much more with the media represented than they were used to do and create in the physical world or on older electronic media, where they were transferred and reconstructed from.

For the sake of the arguments that will be presented here, my intention is to focus on the scenery of software culture and its effects on the interface design and interaction especially from 2000 and onward.

In 2000's after the revolutions made in the hardware and software environments that were accomplished in the last 40 years, the computers were transformed into digital media generation machines. Digital media generation machines, where even the most computer illiterate users could actually create multimedia presentations, edit videos, construct web sites without writing a single line of code, as a result of the paradigm of Web 2.0. Social media web sites and the new software environments with user centered, data-driven and iterative interface design processes made editing, remixing, reshaping and publishing a breeze.

The term Web 2.0 was first used by Darcy DiNucci in 1999 in *Print* Magazine (32). This concept was later popularised by Tim O'Reilly in the Web 2.0 Conference in 2004. Darcy DiNucci had a vision of the web that would transform it to become a source of deep remixability. The users of the web would be transformed from information consumers to content generators, collaborators, producers, authors and contributors. The websites were being transformed from static information holders to applications that let users edit, alter and remix information by the help of the tools that this new shift in culture created. The users were being turned into participators of creation of the media in the world wide web rather than merely being visitors, whom only can access a body of information through it.

Web 2.0 paradigm created its own unique interface language in the World Wide Web. The bold big buttons accompanied by gradients and shadows to give depth, visible and consistent navigation structures, standard and easy to use web layouts utilising the F or Z pattern, the carefully constructed flow of information hierarchy, user funnelling in

order for the typical computer illiterate user to not miss out on any elements in the process and get the job done (Figure 2).

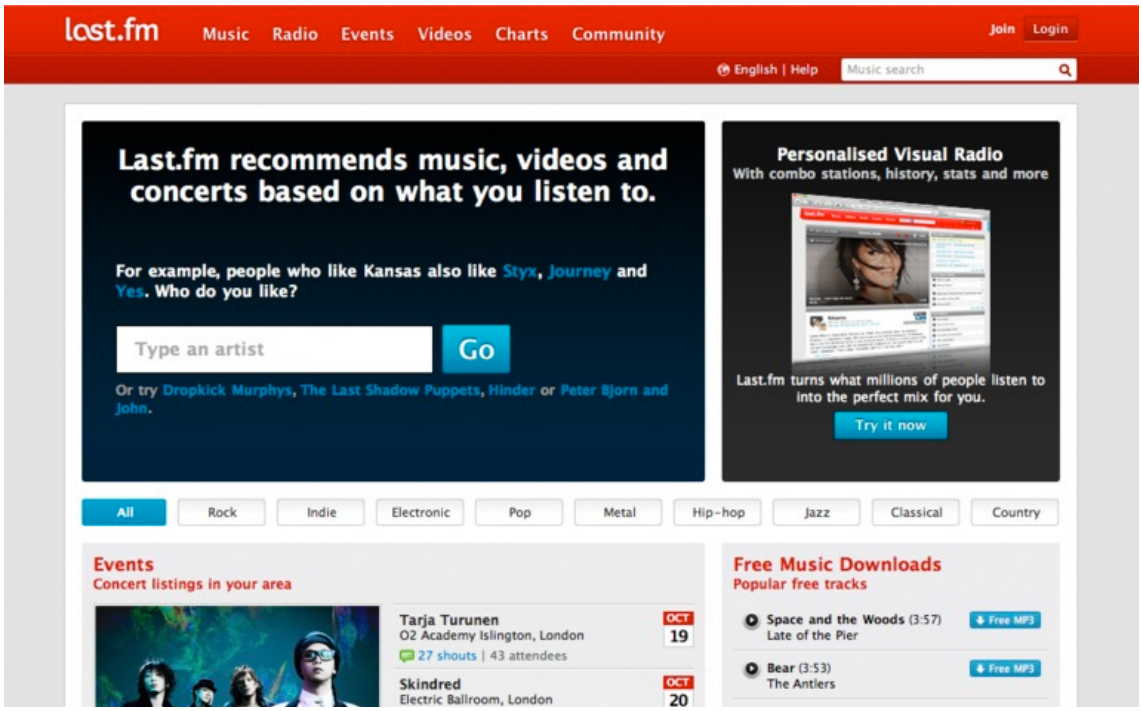


Figure 2. Web 2.0: last.fm, 2009

The usability matters were taken more seriously than ever before, because Web 2.0 services, the social media platforms that grasped this paradigm depended on the simplicity of content generation by the user rather than the aesthetics of the forms presented as interface layers. Functional interfaces, better flow diagrams, better user experience design became a concern for the software media generation machine to work intuitively and precisely on the World Wide Web platform. The passage from the static environment of the Web 1.0 to the dynamic and ever shifting Web 2.0 environment had turned the web sites into applications that could interchange their data with other web applications through their application programming interfaces, which deepened the

users' ability to mix different media contents together to create data mashups and new hyper media entities.

Web 2.0 was based on the interconnectedness of the web applications between themselves. This also brought about the need to create modular software and graphical user interfaces that could make data mashups possible from different diverse web applications. These interfaces had to support semantic relationships between their objects both as the structure of the hyper text mark up language, that would tell how the data would be seen and experienced online, and as stylesheets that described the visual properties of the data gathered.

The need for semantic relationships of the hyper text mark up language as document object models related to the information they contained rises from the popular search engines' way of crawling and gathering data through out the web. The mark up had to be semantic so that the search engine optimisation could be accomplished. This optimisation would then enable the search engines to index the data properly, and let the user reach the content easily and precisely.

The Web 2.0 environment also created dynamic data gathering algorithms a must, so that the generated contents could be updated asynchronously which led to the wide use of scripting languages. The interfaces had to be created in a manner which could gather the dynamic data generated and had to service the media in an flexible manner.

Analytics tools also became popular and a necessity in such an environment. These tools, for example Google Analytics, offered interface designers detailed funnelling data of the user's experience through out the website. For the first time, the user interface designers and user experience designers, had the tools to conduct multivariate testing, A/B testing and event tracking, so that they could understand the problems of navigational structures and content structures in their products by the help of statistical data poured in from the users themselves throughout a data-driven platform.

After the smart phone revolution, starting from the 2007 and onwards, the devices that the software resided in became fragmented into diverse physical shapes and sizes. This physical diversity of the screen sizes forced the interfaces to become liquid and flexible in nature. Now the interface designers and the application developers had to think of a system that would react to the physical media that their interfaces would live in. Every interface element on an *HTML* (hypertext markup language) page had to respond to the viewport of the device that it was presented in, which resulted in the wide use of media queries of cascading style sheets, which determine the description style of data in Web documents. JavaScript, which is a scripting language, was also on the rise to reshape document object models that contained the digital media. Now that the physical properties of the digital media landscape had changed, different approaches to design interfaces and the need to prototype the products emerged to the surface.

A very large sum of the user interface designers of the day started to think that popular interface design programs like *Adobe Photoshop, Adobe Fireworks* were not enough anymore to understand and evaluate the graphical user interfaces and user experience

designs that they have created. Most of the interface designers came to the conclusion that designing in the medium, designing in the web browser within which the interface came into existence could be the correct way to evaluate the qualities of the interface features that they wanted to achieve. One of the first frameworks that let the designers prototype and design in the browser was Bootstrap which enabled a designer to quickly sketch his or her ideas inside the browser without starting from scratch, and the major modern browsers like Mozilla's *Firefox*, Google's *Chrome* and Apple's *Safari*, had already started to incorporate inspection tools which let dynamic data, style and document object model changes possible on the fly.

Mobile application designers had already started prototyping their applications before they were handed to the developers to see how the experience of the end user would take shape. This meant that coding itself had become an interface for creating graphical user interface designs. Some of the popular prototyping tools include *Axure, Invision, proto.io* and *Pixate*. With Axure and Invision being a browser based application and Pixate being a desktop prototyping platform.

At the same time art students, the designers, the makers, the coders, the artists now had a plethora of tools to choose from. The software environments shifted its focus from supporting only the engineers, the computer enthusiasts and the coders to a wider ranging community encompassing the designers, the creators and the makers. Other than the main stream software of the industry for the artists and the designers like the Adobe Suite, which now had an accomplished and heterogeneous set of tools enabling the interchangeability of media created between its application spectrum by the help of

import and export commands, external plugins and the scripting features which widened the media hybridity possibilities. There were also platforms for visual artists, makers, coders, designers to create, investigate and research inside the software environments that the software culture offered to them.

One such example of this kind of software is *Processing*. It first appeared in the software development scene in 2001, which came with its own integrated development environment. It is designed and maintained by its creators Casey Reas and Benjamin Fry. (Retrieved September, 2015, from https://processing.org) The processing language is a simplified form of Java language and offers instant visual feedback through writing code snippets called sketches. This approach gave the designers, the creators and the makers to create their own interfaces in order for the users to interact with their creations. What the Processing language offered was the liberation of the software environment for the people without much coding experience and also opened the way to create interactive experiences by multidisciplinary teams composed of engineers, coders, designers, artists and makers.

Similar to this tool there is another programming application called *Max MSP* (Max Signal Processing). It deploys an interface paradigm for creating a visual programming language like the GRaIL (Graphical Input Language), from 1968. (Kay, 2009, Retrieved December 16, 2015, from https://www.youtube.com/watch?v=QQhVQ1UG6aM)

Max MSP was created by Miller Puckette in the mid-1980s. The current version of Max MSP is a visual programming language developed and maintained for the needs of the

artists, the makers, the designers, the educators and the researchers working with audio, visual tools by a San Fransisco company called Cycling ’74. This company was formed by David Zicarelli in the year 1997 (Retrieved December 16, 2015, from https://cycling74.com/company).

Why was there a need for this kind of software and interface in the first place? The artists, the designers and the makers were already aware of the fact that the media creation software interfaces were forcing the generation of the content through their own ideology about shaping and remixing media, because as Mark Stephen Meadows states in his book *Pause & Effect: The Art of Interactive Narrative,* interactivity needs to have sets of rules and constraints to create smoothly functioning experiences (2003: 38). The preconfigured media creation interfaces do not let its user to get deeply involved with the manipulation of algorithms that they use to structure different data models, these algorithms are present to create likely outcomes. In “Transforming Mirrors: Control and Subjectivity in Interactive Media” (1996), David Rokeby covers this issue with the example of the MacPaint program when the first Apple Macintosh surfaced into the market of home computers. He tells about how the first year, when the *MacPaint* program was released, made the designers create a massive wave of expressive posters utilising the interface environment of the program, only to understand that the textures and patterns that came coupled with the software made every poster look almost the same because the visual languages it offered were defined as a set of standard visual media databases (1996:144), I remember the same thing happening with the web design community when the domain http://subtlepatterns.com emerged back in 2010 where you could get to the source of tile-able patterns as

backgrounds in the form of a Photoshop plugin. After a year or so, the patterns published on that platform were everywhere, so one can say that the interface comes with a price. The interface comes with its own logic, its own set of data and forces the user to only manipulate the represented data in its own ideology most of the time.

Also, the mode of interactivity that Max MSP and Processing platforms enabled its users to experience generally landed into the immersive navigation category, while the mode of interactivity that was offered by the hyper text markup language (HTML), throughout the World Wide Web and mobile applications could be interpreted as hypertextual navigation for the majority of the entities created in this realm. Immersive and hypertextual navigation terms, were offered by Lister et al. in *New Media and New Technologies,* where they were discussing different modes of interaction through various models of navigation (2003).

The difference between hyper textual navigation and immersive navigation as modes of interactivity is that, in hyper textual navigation the user interacts with the medium to make reading choices within a database using the interface technology as a constructor of the customised and individualised data set, thus, offering an extractive procedure. On the other hand in the immersive navigation category, the interface offers more of a spatial, visual and sensory interactivity experience (Lister et al., 2003: 21).

These new interface and media manipulation programs also needed to supply new physical input interfacing techniques, which could give way to new modes of interactions. If we take the example of Max MSP we can see that it lets the

programmer/artist/designer to create interfaces, to manipulate media data with his or her own generative algorithms and hybridisation techniques, and it also interfaces with physical media to let the users give input through the use of physical input hardware which are not conventional. One can hook up an old joystick, a Wacom Tablet, a Leap Motion controller, a Kinect or an Arduino board without any hassle and start customising the experience he or she creates through the use of objects supplied by the programming environment, that lets users experience media content in new and innovative ways.

2.2. User Interaction Design

In order for any interaction to take place between the user and any interactive system, there needs to be a mutual relationship between them. The input of the user should be transmitted to the input of the interactive system and this interaction should create a change in that particular system, which becomes the output that can be observed by the user as an input to his or her sensory system. This is a feedback loop that is necessary in order for the interaction to make sense. This cause and effect chain should be seamless and the response time of the system must be fast enough so that the user gets immersed into what he or she is experiencing.

In “Transforming Mirrors: Control and Subjectivity in Interactive Media”, David Rokeby states that the interactivity of a technology is directly related to its level of responsiveness to our actions and decisions. He brings about the idea of a mirror and the refractions it creates (1996: para. 1). Our input is transferred into a machine, calculated,

recombined, restructured and transmitted back to us, but this time, it is edited by algorithms created by the author of the software, the artist or the programmer.

Interaction starts with an investigation of the user's observations of what his or her inputs shape and form in the environment he or she interacts with. It is the unfolding of a story, the starting point of a conversation between the inside and the outside. The outside source is only visible through an interface that is composed of metaphors created from the surrounding culture. It is the interface that frames the story to run around a particular plot, either linear or non linear in nature, and needs to have a symbolical structure in order to communicate the algorithms that run the story. The interface structure needs to be constructed with symbols in order to compress the meanings of the functions or processes that they represent. The results of the interactive processes are shown through the change in content, so the interface, in most cases, blends into the immersive experience, becomes invisible and shapes the whole model of data represented as a story.

The communication between the user and the system should become deeper as the relationship progresses. To create a depth of information exchange between our sensory systems and the interactive system, one needs to create a pendulum like structure that moves between the look and the feel, the interface design and the experience design, the symbol and its connotations. Once the user starts to feel that he or she becomes connected to the story after a couple of interactions he or she performs, the interactivity of that technology can be considered successful in terms of depth of relationship. This

also means that the system has created a collaborative platform where the user now has an intuitive knowledge about what his or her actions may create in the story.

Once this deepened relationship is accomplished, the system now should create variation in the construction of the data models that it has been fed in through the database of the author or the flowing data source depending on the nature of the narration structure of the software.

Stephen Meadows lines up the steps of interaction into four successive stages; 1. observation, 2. exploration, 3. modification, 4. reciprocal change (2003: 44). By now the observation, exploration and modification stages have been covered in the interactive system. The reciprocal change takes place inside the user's mind and in his or her actions. The system now has changed the users way of thinking, and the way he or she perceives the story being told. The interaction cycle is completed.

What exactly happens in the process of a human-computer interaction is a temporal moment, where the user finds himself or herself as the constructor of a virtual story made up of data. The computational data is a dematerialised form of a structure which means that it is intangible. The data presented has its base in the physical or cultural platform, but once it is converted into data and it gets dematerialised, it becomes transient rather than being persistent. When this body becomes transient in nature as data, it turns into an entity whose content is set free, and is converted into a body that has the properties of digital entities. The human computer interaction finds its space

between this tangible and intangible entities resonating on both sides as a connection between the user's input, the physical objects and the information, content.

This phenomenon is what gives the computers the properties of a metamedium. As Alan Kay and Adele Goldberg put it in *Personal Dynamic Media*;

> Although digital computers were originally designed to do arithmetic computation, the ability to simulate the details of any descriptive model means that the computer, viewed as a medium itself, can be all other media if the embedding and viewing methods are sufficiently well provided. Moreover, this new "metamedium" is active—it can respond to queries and experiments—so that the messages may involve the learner in a two-way conversation. (2003: 393).

The generation of Alan Kay and his colleagues created a shift in software culture where the focus of computing is diverted from bare bone simulation of data crunching to data as media. As this shift took place new ways of human computer interaction had to be accomplished.

Data by its nature on a digital platform is permutable. The physical entity transferred into a metamedium like the computer, can take any shape or form through the usage of algorithms. Data as media is a shift in the perception of data from a set of calculative information to a set of simulative information. As the computers rose to the challenge of representing physical properties of the objects that resided in the physical world, the way we perceive data as a concept also shifted. This shift in the perception of data

created the notion that any medium can be represented in multiple different forms and view models, through interaction can influence its inter actors.

Data as media stored and rendered in computer hardware comes with its own necessities. The users of such a platform would need software that had user centered interfaces which implemented new modes of interaction to manipulate, reshape, remix, recalculate and remodel these media data, in comfortable, understandable, functional and intuitive pattern structures that encompasses and utilises the abilities of computers as mathematical and logical machines. Which meant that the user had to be guided through the process of accomplishing the above tasks in a way that he or she can feel in control and the manipulation of the data of the media at hand could be achieved in a user friendly manner. Hence this accomplishment of the digital medium gave rise to the paradigms of user interface design.

2.3. User Interface Design

> … there is no essential difference between data and algorithm, the differentiation is purely artificial. The interface is this state of "being on the boundary." It is that moment where one significant material is understood as distinct from another significant material. In other words, an interface is not a thing, an interface is always an effect (Galloway, 2012: 33).

The interface is the abstraction of a gateway between the software and the user. It lets user inputs to be gathered from the physical realm into the digital realm while creating an abstraction layer between the code and the presented content. It is a means to familiarise the user to the mathematical foundations of the computer by creating layers

of messages, that can be transmitted to the user through the usage of metaphors, cultural elements by using the forms of audio, visual and typographic mediums in combination to clarify the overall message of the content that is being represented in the modern day computers.

The interface is an apparatus for the user to conduct temporal engagements over a body of data represented in a medium. It shapes the experience of the user and alters his or her perception of the content and is responsible from creating a navigable space.

Today we live in a society that actively uses a plethora of different computing devices, from mobile equipment to physical computing interfaces in the form of micro controllers, to devices which utilise different interaction models. Tactile interfaces, motion detectors, sensors are all over the place.

Since I am a graphic designer by trade, I would like to inspect and analyse user interface design from a visual standpoint, while taking into account how the trends of the graphical user interface design paradigms evolved in relation to the software culture and marketing paradigms that forced these interfaces to emerge as trends between the years 2004 to 2016 and what effects they created from a usability perspective.

The modern day web and mobile applications have to run on many diverse platforms, their data must be interchangeable between other applications inside this fragmented universe of computing devices. The interface language has to follow the shape and the form of the physical reality it lives in to be functional and effective.

When we look at the history of graphical user interfaces starting from the Web 2.0 paradigm around the year 2004, to the rise of mobile devices and device fragmentation, this pattern is quite easy to grasp.

Back when the iPhone was first introduced and became a commonly consumed mobile device in 2007 the graphical user interface designers found out that the applications were much more forgiving to the nature of graphics that could be introduced into the applications of that era when compared to the world wide web platform. There were still technical specifications that needed to be met, but the fact that the interfaces were localised on the physical medium itself and their assets did not need to be downloaded from a web server or were not streamed, so did not consume any kind of bandwidth, skeuomorphism became the buzz word.

The popularity of rich graphical user interfaces peaked between the years 2007, when the first modern smart mobile device phone the iPhone with its own operating system IOS and its own application marketplace the AppStore had emerged, and the years its competitor operating system Android matured in terms of popularity and physical quality of the device platforms it ran on, which can be marked around the year 2010 and onwards.

Rich graphical user interfaces introduced shadows, gradients, light sources that effected the whole application graphics, bevels, reflections that gave a sense of unity on the

visualisations of the applications and recreated some of the physical objects of everyday use, they were telling much more of a detailed story to the users of their software. Rich graphical user interfaces heavily emulate the physical interfaces of the objects on the outside world transferring their visual properties into the digital media. Skeuomorphism as a trend is not actually new. It has existed in the graphical user interface design field since the Xerox PARC research team had included the metaphor of a desktop environment as an interface paradigm, as well as finding its place in architecture and archaeology fields. We can still see the conventional uses of this paradigm in user interface designs like sliders, slider bars, tabbed browsing, files, folders, calendars, to do lists. But the first applications of this particular application marketplace the App Store from Apple, had used the paradigm so heavily that if you would open up say a calendar application, you would be greeted with drop shadows, wooden backgrounds, leather backgrounds, paper textures, metal spirals, gradients, digital clock emulators, lots of other textures and details with no significant function to justify their presence at all. A similar approach was delivered with Web 2.0 platforms of the era, like the overuse of gradients, big fat interface elements, legible and oversized font sizes, background patterns, but not in this kind of highly detailed quality and not in this kind of high frequency because of the bandwidth issues, scalability measures and other software related shortcomings that plagued that era of the world wide web (Figure 3).

Figure 3. A Skeuomorphic Calendar Apple iPad Platform

Although the intention was to create a more familiar experience for the user to complete his tasks in a more user-friendly, personal environment and create a deeper emotional engagement with the products, it became apparent that this kind of interfaces were bulky, cluttered and not transformable to different media screen sizes. This trend also required too much work to transfer the assets needed to create the similar experiences on multiple platforms, when the diversity of the screen sizes of different hardware products began to emerge, also the graphics on these interfaces were so heavily processed that this language leveraged the graphical user interface elements over the content and the user's experience itself.

While at the time Apple was pushing skeuomorphism into its application designs and influencing the interface design community and application developers to rich graphical experiences, Microsoft was onto something else. They were going after something much more functional and minimal in terms of graphical language.

Apple had taken the majority of the media player device market by its product iPod and Microsoft was creating a new media player device to capture some market share in the media player industry and pushed their product to the market in late 2006 before this rich interface phenomenon took over the interface design community. The device was the Zune media player. It did not become very popular and Microsoft did not pursue the visual language they introduced in this device's graphical user interface until they released their own mobile operating system dubbed Windows Phone 7, in the year 2010. They first called this graphical user interface design language the *Metro* and later named it *Modern UI*.

Modern UI took some of the characteristics and the principles of Swiss design and then brought it into the world of graphical user interfaces. Clean, sharp geometric shapes, bold and bright colours, readable and legible sans-serif typography. It is a visual language that removed all the unnecessary clutter that was brought with skeuomorphism and principles of rich design, which brought back the functional role of the graphical interface design (Figure 4).

Figure 4. *Modern UI*

This design trend that brought the important characteristics of the language of modern design into the graphical user interfaces also fit the needs of the fragmented physical devices and made todays responsive, light and minimal graphical user interfaces possible. These devices ran on multiple operating systems and encompassed the use of multiple web browsers with different engines. After the popularisation of the mobile devices world wide web had to respond to this device variety and the paradigm of graphical user interfaces shifted to a liquid, flowing form. The reflections of Modern UI and its characteristics were transferred into the world wide web and it was called the Flat UI (Figure 5).

Figure 5. Flat UI

The Flat UI was the continuation of the Modern UI design language from the operating system platform to the platform of the world wide web. It made responsive design possible, the graphical user interfaces became more and more simple to the point that they almost disappeared and fused into the content. Responsive design paradigm is not compatible with the skeuomorphic design language for a variety of technical reasons. Some of the mobile devices have different pixel density then the traditional desktop environment screens, this means that the resolutions of all the images in an interface had to be doubled in size and quantity which becomes a problem for the mobile devices in terms of the bandwidth restrictions of the EDGE, 3g or 4g networking platforms.

By this time many different coding, prototyping and design frameworks had emerged. These frameworks like Bootstrap, Foundation, Skeleton, Material Design had all embraced the fundamental principles of the Flat UI. All of them came with fluid grid structures, typographical frameworks, common user interface elements like tabs, sliders, calendars, select boxes, dropdown menus, accordion menus, font icons, advanced responsive media embedding classes, buttons, navigation bars, pagination styles, labels, progress bars, list groups, thumbnail classes, breadcrumbs, alert boxes encompassing html, css, javascript modules of their own.

Online code collaboration platforms like the Github emerged along with online code sharing platforms like JSFiddle, Codepen, CSS Deck enabling the code savvy graphical user interface designers to create code snippets, interface patterns, get inspiration and share it through the world wide web. This gave rise to another form of deep remixability in the interface design community. Deep remixability of code had emerged into the graphical user interface designers' scene.

While skeuomorphism was almost dead, outdated by its functional and clean counterparts Google announced its own graphical user interface framework dubbed *Material Design* in the year 2014. Its language is both clean and encompasses some forms of the skeuomorphic rich design languages. According to the Google Design Team the intended visual language of Material Design framework was explained as follows;

> A material metaphor is the unifying theory of a rationalized space and a system of motion. The material is grounded in tactile reality, inspired by the study of paper and ink, yet technologically advanced and open to imagination and magic (Retrieved December 16, 2015, from https://www.google.com/design/spec/material-design/introduction.html)

The new design language of Material Design embraced the traditional design trades from the print design, like space and scale, grid structures, typographic scales, negative spaces to guide the eye of the user, full width full height images and bold, big typographic treatments as a layer while taking the gradients from the Web 2.0 era and turning them into subtle indicators of dimensionality and applying shadows only when necessary to create a perception in the user that the elements with shadows actually exist as a form of control layer over the entire content of the canvas that they reside in (Figure 6).

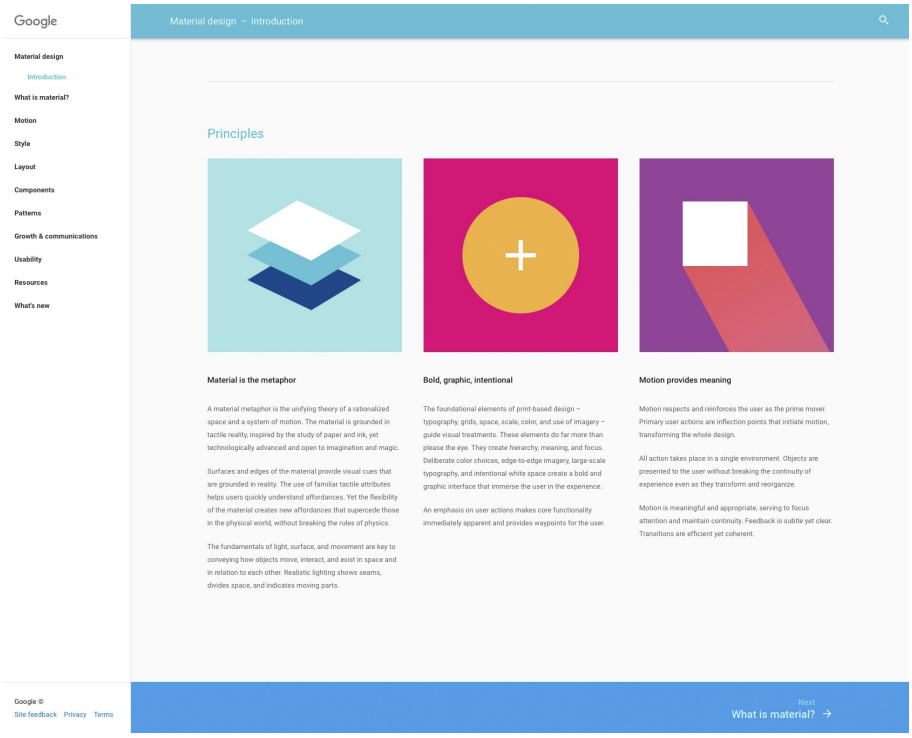


Figure 6. *Material Design*

Today the graphical user interfaces utilise every possible technology to compress and lighten the web and mobile application experiences of the software culture. Scalable vector graphics came onto the scene, icon fonts, web fonts were all created for the need to facilitate this new responsive paradigm. The graphical user interfaces of the day are light, liquid, transformable, elastic and scalable.

The languages of the graphical user interfaces come into existence out of the needs and necessities created by the software culture. The trends in these languages emerge from and are shaped by both the physical attributes of the devices and the cultural needs of the users, and their interaction modes.

Exploring interactive artworks created throughout the 2000's, one can see that models of interaction varies in contrast to the main stream interaction design paradigms used in the market. The usage of a range of unconventional input devices and materials allowing for different interactive experiences is common in the interactive artworks.

One such work is the *Interference Pool* which is an interactive audio visual installation made in 2014 by Annica Cuppetelli and Cristobal Mendoza (Cuppetelli and Mendoza, (n.d.). Retrieved January, 2016, from http://www.cuppetellimendoza.com/interference-pool). The materials that constitute the work are video projectors, elastic cords, plywood, a sound system, a computer and a custom software created for the installation. The work is made up from two sculptures horizontally placed on the floor. The sculptures are made of elastic cords that are attached to the base of the construction made of plywood which are one inch apart from each other like the strings on an

instrument. There are two projectors over the top of these horizontal constructions to illuminate the cords. The camera placed on the top accompanied with the software successfully tracks the users movements and the generative patterns emerge on the cords according to the directions of the movements of the inter actor. In addition there is a software synthesiser which reacts to the movements of cords and creates a reactive sound environment (Figure 7).

Figure 7. *Interference Pool,* by Annica Cuppetelli and Cristobal, 2014

The aim of the work according to Annica Cuppetelli and Cristobal Mendoza is the exploration of the tension between the rigid grid structure and the organic experience offered by the natural forces. The overlapping of the physical structure and the video projection as light creates an interference pattern. The pattern is a circular organic shape, yet it is superimposed on a grid of tightly placed cords by the help of a projector.

Another interactive audio visual installation is the *ClinK* made in 2015 by Markus Schuricht, Paul Schengber and Felix Deufel. The installation contains 30 speakers in a dome construction. 360° projection enables the inter actors to experience modulations and movements of visuals, sounds and shapes by moving their bodies. (Wisp — CLINK, (n.d.). Retrieved January, 2016, from http://wisp-kollektiv.de/clink-interactive-audiovisual-spatial-sound-installation). The aim of the project is to create a spatial experience where all the inter actors become architects in a temporal unit of time. The installation utilises 3D Sound, 360° projection and body tracking through sensors placed (Figure 8).

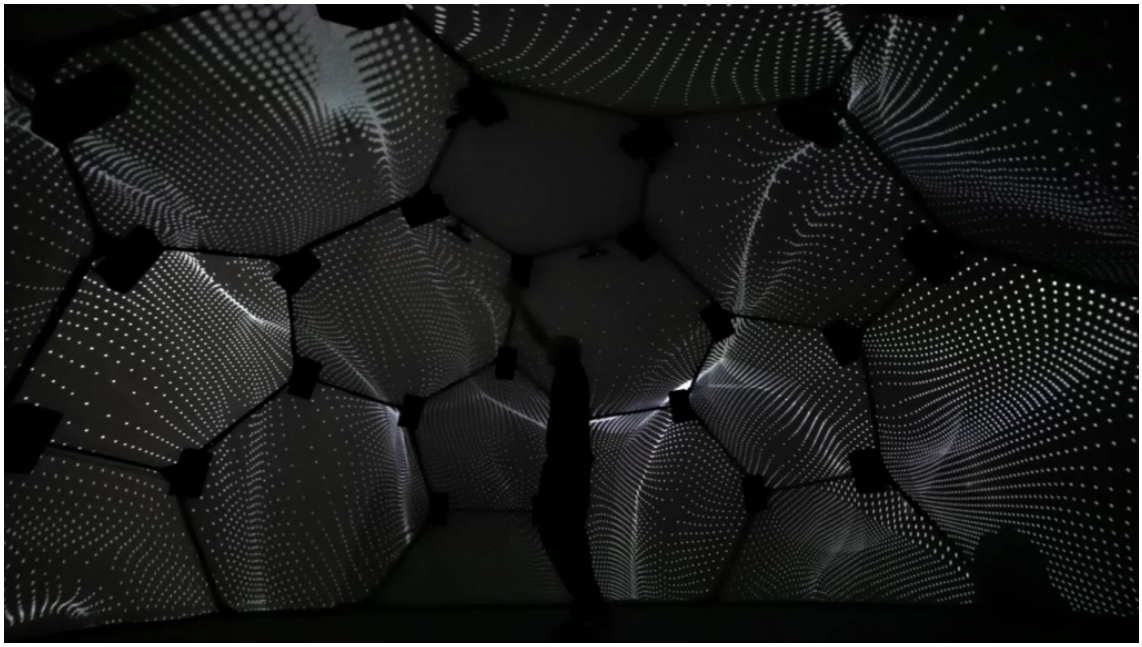


Figure. 8. *ClinK*, by Markus Schuricht, Paul Schengber and Felix Deufel, 2015

According to the artists Markus Schuricht, Paul Schengber and Felix Deufel the artwork is a blend of science and art. It is an attempt to incorporate the physical and the intangible properties into the process of interaction. The artists incorporate the physical

properties of the world by installing a large dome structure while the projection of lights, and the sound samples triggered by the body movements of the interaction achieve a tension between the tangible and intangible, the transient and the persistent (Wisp — CLINK, (n.d.). Retrieved January, 2016, from http://wisp-kollektiv.de/clink-interactive-audiovisual-spatial-sound-installation).

CHAPTER 3

OSCILLATION, RESONANCE, AND THE CHANCE FACTOR

In this chapter, I am going to investigate how oscillation and resonance relates to each other. How resonance is formed through two or more frequencies of vibration. How it effects the frequency amplitudes of the bodies in place and how this phenomenon can be related to a graphical language so that it can be visualised, why both of these phenomenons can not be thought without a sense of rhythm, and how they can be related to multimedia and hybrid media of the software culture.

3.1. Oscillation and Resonance

What is oscillation?

"Everything is rhythm, the entire destiny of man is one heavenly rhythm, just as every work of art is one rhythm, and everything swings from the poetising lips of the

god." (Hölderlin, cited in "On Rhythm, Resonance and Distortion", Aracagök, 2003: 127)

Oscillation is closely related to rhythm, the sense of vibration, the repetitive variation of a measure in time. In short; It is the measure of variation of an entity between its states of idleness and movement in time.

> One possible way of understanding rhythm can be found in a traditional appropriation of the word. Rhythm: division of a supposed continuum into intervals, an attempt at temporaliation? Yet, that which is known as a continuum of time is a continuum only when time is conceptualised as a succession of points – rhythm can thus be conceptualised as a division of a continuum of time into intervals only when time is made of points - of what? Of the experience of the one who experiences it? (Aracagök, 2003: 128)

In order to understand oscillation and rhythm, it should be thought together with sound. Everything we hear is about small fluctuations in the air pressure that were created because of the oscillations of objects that vibrate in space outside of ourselves. These fluctuations cause measurable chain reactions between the air molecules that push themselves in all directions when something vibrates or oscillates, so that when they hit the ear drum we hear things or when they hit a pressure sensor like the microphone we can turn them into digital or analog signals.

Oscillations make up the whole field we reside in and carry the information of that field to the entities that are encompassed by the same field.

One makes the connection of inside and outside through oscillations in space. Oscillation, in a sense shapes the space that it originates in and gives inputs to our sensory interface or lets us capture these fluctuations and turn them into digital or analog signals.

Oscillations make up the whole sound spectrum and give way to different timbres, so that one can recognise the tone colour, tone quality and texture of any sound he or she experiences. Thus the data absorbed from these oscillations give information about the identity of the entity that generates them.

The standard dictionary explanation of oscillation is a frequent change from one state, position or amount to another and back to the original state, position or amount. It could be read as the journey of an entity from its idleness to movement and back to its idleness again. What happens in between can be translated into signals, can be calculated mathematically and hence can be graphed and measured. Through the data collected from an oscillation, one can understand the nature of its origin's true story.

The vibrating entity changes its environment, warps the space around it and its output becomes an input to other bodies that happens to be in the same space time continuum, which vibrate back and forth on their own frequencies.

Oscillation becomes an event that assures something is present, hence it can be considered as a signal, an attempt of an entity to connect to its environment, to give out data about its presence, an experience of being, a narrative information of some entity's

whereabouts, its identity, its material, its properties and its body. It gives out clues about the proximity of and the relationships of the entities in that very space or field.

If we were to make an analogy with the software culture of today about oscillation, we could say that oscillation as a metaphor is closely related to the concept of multimedia. Although oscillations send out data about the medium of the entity they belong to, they don't give way to a deep level of interaction between the entities as long as these entities vibrational frequencies don't resonate with each other.

> But, as I see it, multimedia does not threaten the autonomy of different media. They retain their own languages, i.e. ways of organizing media data and accessing this data. The typical use of multiple media on the Web or in PowerPoint presentations illustrates this well. Imagine a typical HTML page which consists from text and a video clip inserted somewhere on the page. Both text and video remain separate on every level. Their media languages do not spill into each other. Each media type continues to offer us its own interface. (Manovich, 2008: 76)

If we further this analogy, oscillations can be considered as layers containing information about their medium without clashing with other entities' properties and without transferring their techniques to each other. Oscillations are potentials and stand together without clashing as long as they don't resonate with each other. If there's no resonance, there's no spill from one entity to the other.

Oscillations without resonance do not create a new identity, they are just message carriers, they do not reconfigure the body that they happen to input. The conventional

structure of the entity that receives the vibrational frequency input of another entity does not change, it doesn't get transformed into another form of being.

What is resonance?

Resonance occurs when two sounds'/objects'/systems' frequency of vibration matches and produces a higher oscillation. It's the amplification of two signals originating from different entities that have matching frequencies and telling a new story, a story about something other than themselves.

If oscillation can be interpreted as the signal of the story of the inside of one entity then, one could assume that resonance is the story of the outside, the interaction of the entities in the field or space that the entities reside in, and how they unite in each others bodies. While oscillation is about the identity, the properties, the material, the story and the presence of the entity itself, resonance can be read as the identity, the properties, the material, the story and the presence of the unison of the oscillation of the entities and how they formed an amplified new signal vibrating in their bodies.

Resonance takes place in the field that the oscillations were first created and to some extent were departed from the sources of the oscillations, reconfiguring the bodies they reside in.

Hence the original entities' connections form a different entity or story, gain new properties and materials through a process of fusion in one of the bodies. The clash of the data from different entities unite to become a new form and distort their space in a

way that creates an amplified new story, exchanging their properties, creating new structures.

Since the data that clashed together from the two or more different oscillating entities have fused into a new form of oscillation and became resonant, with their own new identity, new properties, new material, new body and departed from their original frequency of vibration but kept properties of them, can one ask the question that resonance is actually a meta-medium? Can resonance be read as a temporal hybrid creature that has its own language?

> In hybrid media the languages of previously distinct media come together. They exchange properties, create new structures, and interact on the deepest level. For instance, in motion graphics text takes on many properties which were previously unique to cinema, animation, or graphic design. (Manovich, 2008: 76)

If one takes this assumption to be true, resonance as a metaphor can have deep connections with the software culture that we live in today. Resonance can be interpreted as a temporal platform that fuses entities into a new form. If oscillations are events, resonance is a happening, it is emergent. It is the process of becoming or coming into being, the signals of two entities coming together to form a new and updated DNA.

> In the case of media hybrids, interfaces, techniques, and ultimately the most fundamental assumptions of different media forms and traditions are brought together resulting in new species of media. To use a biological metaphor, we can say that media hybridity involves the coming together of

> the DNAs of different media to form new offsprings and species. (Manovich, 2008: 75)

That is the reason why while creating the *Resonant Field* project, I tried to implement technologies that enabled me to accomplish the construction of real time generated audio and graphics. To give a feeling of resonance as I understand it, the visuals and the audio had to be happenings.

The generations of the different forms when the user interacts with the *Resonant Field* had to be working in a way as if they were using an instrument of sorts. There had to be a live generative feedback loop, so that the users could act and feel instead of trying to figure out what they needed to do. This effect could make them feel as if the installation becomes a part of themselves that extends their abilities of interaction. Rather than forcing a functional interaction experience, I wanted to create an expressive one.

By connecting a video camera stream of the user and putting it on a mesh and making the vertices interact to the sound that he or she creates, I wanted the user to make a connection with the simulated world of *Resonant Field.* A connection where the oscillations of the user's body get measured both as a generative source of electricity and his or her physical properties put into resonance with the simulated reality of the field itself.

3.2. The Chance Factor

The chance factor in art has been widely used in many artworks through out the centuries but some of the most important examples of the usage of chance factor in artworks surfaced before the first world war. One of the most influential art movements back in those days was the Dada movement.

The dadaist manifesto was based on resetting the conception of the art world as it existed at the time. Dadaists were trying to eliminate the ideology of the art world which had been cumulated by the culture of art itself through the passing centuries, some of the parameters of the process that needed to be reset included quite basic things like planning, composing, giving a structure to the content being represented. The Dadaist movement was an attempt to recreate the art world and its parameters, which meant that this experimental art movement would need some expressive tools to represent itself. Randomisation of the creation process of art pieces was one of the most important tools of expression, and the chance factor was being introduced into the art world during this period which would be predominantly used throughout its lifecycle.

"The dadaists also wanted to create work that would be different from traditional fine art - which they considered a meaningless and elitist pursuit. They wanted to annihilate previous notions about Art in order to revitalise culture" (Staniszewski, 1995: 230).

At this conjuncture Marcel Duchamp created the work 3 Standard Stoppages in the year 1913. It was an experiment based on how human beings perceived and standardised the

measure of a length, one meter. He came up with the idea of an investigation on how to represent this unit of length in a different visual and structural format without causing it to loose its identity. He took three one meter long threads and tossed them over on a black canvas and fixed them on the surface. Even though the threads formed curvilinear structures over the canvas they were fixed upon, they still had the correct measurement of just one meter. So the identity of the entity being presented was preserved but was given a new form through a randomised mode of creation. It is a perfect application of the chance factor used as a form of expression (Figure 9).

Figure 9. *3 Standard Stoppages,* by Marcel Duchamp, 1913-14 | MoMA

As Marcel Duchamp had redefined the structure of one meter in a new visual and conceptual definition he thought about using these three new one meters on a piece of artwork, which was one of his earlier paintings. He applied these new structures as a

branched curvilinear composition which were connected through nodes over his painting and he called it the *Network of Stoppages* and released it in the year 1914 (Figure 10).

Figure 10. *Network of Stoppages*, by Marcel Duchamp, Paris 1914 | MoMA

What Marcel Duchamp did back in 1913 with his artwork *3 Standard Stoppages,* is actually also applied in algorithmic, generative and interactive art to conduct randomisation and apply the chance factor in digital medium.

> From the earliest days of algorithmic art, the probabilistic approach to art generation has been very popular. Its modus operandi can be summarized as follows: (1) a space of possibilities is defined in explicit, mathematical terms; (2) a probability distribution is defined over this space; (3) an algorithm is executed which draws random samples from the space, in accordance with the probability distribution (Scha, 2006: par. 1).

In algorithmic, generative or interactive art pieces the artist or the maker first defines a mathematical environment where possible outcomes of interaction or mediums to be presented can reside in. This definition is a mathematical expression of the realm that the representations take place. The mathematical definition of the environment can be a coordinate system, the shape and form of that universe, and its characteristics like the dimension count and the material of the universe along with its physical properties. Once this definition is accomplished the artist or the maker creates objects that reside in this environment which are assigned a set of probable distortions or controls to be imposed upon these structures connected with the physical rules of the created universe. This phase is called a probability distribution. The next step is to create a form of control to apply a random sample of distortions onto the object. The artist or the maker defines a number of distortion models and implements it into the physics engine of the artwork. The process is not actually random but it has a chance factor. The results are generated by the probability cloud that is defined by the artist or the maker. Actually it is an entirely curated experience. By defining the probable outcomes of the distortions that can take place in the generative or interactive art pieces the artist or the maker actually follows a stochastic sequencing procedure. Stochastic sequencing means that the random components of a distortion is applied through a selective process.

Another example of such an artwork where randomisation and chance factors were predominantly used is John Cage's *4′33″* composed in 1952. 4′33″ is a musical composition piece constructed from three movements where the partitions contain no musical keys, hence no sounds accept the sounds of the environment and the audience where the performance takes place. The ambient sounds created by the audience and the

environment is the random element which forms the composition of the sounds that make up the performance. Hence each time the performance was executed it was different from the one's that took place before it (Figure 11).

Figure 11. *4'33", by John Cage (1952)*, A performance by William Marx, 2010

Actually, John Cage's musical composition *4'33"* was inspired from another work created by Robert Rauschenberg, a painter from the United States of America. His *White Paintings* series was created in 1951, and they were flat white canvases where when the audience of the show walks around the gallery, they refract the light, cast shadows, caustic effects form from the reflections of the observers clothes' over the canvases and random compositions of stains occur over the canvas. Thus each visitor creates unique pieces of art in a series of movements, once again the chance factor is added and randomisation is achieved.

CHAPTER 4

THE PLAY ELEMENT

An interactive installation by its nature requires the participation of the user actively. The promise is fulfilled as the viewer transforms into a participant through his or her interaction with the installation and the space it is situated in. In order to encourage the viewer to participate in an experience, the installation must be engaging, hence, inviting. At this point, the element of "play" plays a crucial role, in determining and ensuring the interaction of the participant. This chapter focuses on the idea of how "play" is connected with the idea of interaction and how the element of play offers an immersive experience to the user/player/participant.

4.1 The Play Concept

During the implementation and experimentation of the project Resonant Field, I saw that although I did not foresee the connection of the project with the concept of play, it is deeply related with it. The aim of play as Hector Rodriguez stated "is the modulation

of human experience" (2006: par. 60) The prior intention of my project was to analyse the experience design through a designed interface. In order to clarify in what ways the project is bound with the concept of play one needs to look at key concepts offered by Johan Huizinga and Roger Caillois and investigate how the concept can be applied to an interactive installation.

In any interactive work the most important part is the user experience, since it is the act that forms , and brings the work to a completion. A successful interaction should transform the viewer into a user/participant/player in order to fulfil its promise. One possible and plausible way of engaging the users and encouraging them to participate is to add to the the art work the notion of play, where it helps the users to act voluntarily.

Play as a concept is embedded in the art scene for more than a century. We see the concept of play at work in the ideas and works of many Avant-Garde artists, especially the Surrealists. Surrealism challenged the traditional notions of art and integrated dream and the unconscious into their works. They incorporated various games and by modifying them, came up with creative techniques, which embrace the play element. The exquisite corpse, game of conditionals, surrealist story, dada poems, automatic drawing are some examples to such techniques.

An experience that is related with the concept of play holds the assertion that the activity is situated in a structured formation and the experience of play, is thus expected to be revealed in an organised, framed manner. "The player's experience essentially unfolds within a structured situation" (Rodriguez, 2006: para. 6).

In *Homo Ludens,* Huizinga states that play is older than culture, hence, it doesn't solely belong to humans. The action of playing is thus not restricted within the boundaries of culture. Hence, when we are talking about the concept of play, we mean an action or a series of actions, which precede the notions of society and culture.

He calls the human subject *Homo Ludens*; playing man, human who plays. He characterises play with the following sentences:

> Summing up the formal characteristics of play we might call it a free activity standing quite consciously outside "ordinary" life as being "not serious", but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner. It promotes the formation of social groupings which tend to surround themselves with secrecy and to stress their difference from the common world by disguise or other means (1949: 13).

Caillios in *Man, Play, and Games*, where he reflects on Huizinga's concept of play, defines play as an activity, which is free, separate, uncertain, unproductive, governed by the rules and make-believe (2001: 9). It is a free activity in the sense that the player voluntarily chooses to take part in the activity, he or she is not forced to do so. It is separate in the way, which also as Huizinga stressed, it has its own boundaries of space and time, it is fixed from the beginning. It is uncertain, not everything in the play activity is fixed and predetermined but some are left to the player's choices and actions. It is unproductive, because it does not create or produce goods, or wealth, however, it

can result with the exchange of properties of the players that they brought in at the initial state. It has its own rules that define the course of the play and form new regulations that govern the play. It is make-believe (fictive), so that the players can be immersed in the playing activity by confirming the formed reality of the play.

Both definitions by Huizinga and Caillois share aspects in common. Any activity that involves play has its own rules to be laid out and obeyed in order for the experience to be gratifying. The structure and rules of the play should be clarified at the beginning or during the flow of playing. The clarity of the rules are important in the sense that, it also designates the possible actions of the player and unfolding of the semantics. These rules also define a world for a particular play that has its own logic, space and time formation. The idea that a play as an activity should absorb the player is a necessity in the sense that it should create a new reality for the player along the duration of play. It is should be immersive and engaging in order to offer a satisfactory experience.

Caillois's one contribution to play concept was his categorisation of the forms of play as agon (competition), alea (chance), mimicry (simulation), and ilinx (vertigo) (2001: 12). This helps us to consider the play activity in further details, in addition to the point of view of Huizinga, who discusses the subject by relying on the idea of competition. Agon involves activities that has the competitive factor in them. As the idea of competition is inserted, the notion of wining and loosing gains significance. Chess playing or sports games can be considered as examples, hence, prior knowledge, preparation, experience become the keywords. Alea is based on the chance factor, with which the players actions are governed by the chance and destiny. Games of dice and

lottery can be given as examples. Mimicry is the type where the play activity unfolds via imitation, simulation or role-playing. It depends on the idea of a fictive, accepted temporal reality, which governs the play. Ilinx involves the loss of balance or introduction of sudden, temporary dizziness into the activity. A classical example can be the play of the toddlers, who are turning around themselves in the pursuit of vertigo.

Caillois stated that these four categories can be "placed on a continuum between two opposite poles" (2001: 13). He called these, paidia and ludus. Paidia designates unregulated, uncontrolled, free activities and ludus are the activities with fixes, definitive, certain rules and rigid structures. This characterisation and division is important in the sense that, by looking at these classes we can identify and, moreover, design the aspects and essence of interactive works with ease based on our intentions.

For instance, *Polyphonic Playground* is an interactive work, where the participants are transformed into players. It is a musical installation by Studio PSK that was shown in between January 29 - February 21, 2016 at the House of Vans, London. The installation by mimicking a playground, asks the adults "to re-discover this experience of play" (2016: para. 2, Retrieved March, 2016, from https://vimeo.com/133458309). *Polyphonic Playground* is an interactive, site specific installation, where the participants interact with a playground that generates sounds and music as they experience it. The idea behind the installation is to make the participant interact with the piece in a way that they are already familiar with from the years of their childhood. When an interface is intuitive and does not confuse the mind of the user through its logic, than it may be assumed as a successful one. The user should not struggle to interact with the system.

The installation is made up of a wooden structure that was covered with conductive paint, conductive tape and conductive thread. As the participants interact with the system, plays in the playground, swings, slides, climbs, he or she touches the conductive material that triggers sound samples. Hence, he or she does not only play in the playground for the classical experience, but also tries to reveal different sounds and samples that are embedded in the installation. The participant is immersed in the work by the sounds as the extra layer. This layer of the installation transforms the viewers into participants, and the playground into a musical instrument, with which the installation fulfils it's promise of being an interactive work (Figure 12).

Figure 12. *Polyphonic Playground,* by Studio PSK, 2016

4.2 *Flow, Flower, Journey*

In this section I would like to mention three video games, which were released by the same company, since I believe that the aspects and gaming experiences of these games are highly related to the discussions laid by Huizinga and Caillois and very much dependent on the different approach towards the design of the interface and user experience designs. These games are *Flow* (2007), *Flower* (2009), and *Journey* (2012), which are all Thatgamecompany's creations and were all published by Sony Computer Entertainment.

Flow is a video game, that was designed by Jenova Chen (and Nicholas Clark) for his graduate studies, which was related with Mihály Csíkszentmihályi's theory of "flow". Flow theory suggests a state in which someone is highly immersed in an activity he/she is conducting, which is highly based on the concept of motivation and concentration.

Csíkszentmihályi states that "every flow activity, whether it involved competition, chance, or any other dimension of experience … provided a sense of discovery, a creative feeling of transporting the person into a new reality" (1990: 74). *Flow* (2007) as a video game later was released by Thatgamecompany, which was co-founded by Jenova Chen and Kellee Santiago. In the game, the player controls a microorganism in water from a top down view and decides to eat and evolve other organisms around, or not, while at the same time trying to escape and avoid hostile organisms which are depicted in a different color than the others. The character of the player travels in between the planes which, resemble the depts of an ocean. The gaming experience is

based on Agon, although there are no winners or losers in the end. However, in order to progress in the game the player has to be ready and improve his or her skills of navigation. There are seven levels (planes) in the game and except for the first two planes there are hostile organisms on every plane that changes the course of the game from a relaxed one into an aggressive one. In order to stay immersed in the game, as the challenges increases, the player has to improve his or her skills as well.

The promise of the game is to create an experience that positions the player in the zone, where Csíkszentmihályi defines as the "flow channel", where the challenges and the skills meet in balance and puts the person in the flow state (1990: 74). If the player is to stay in the "flow channel", or in "the zone", as the challenge increases he or she must improve his or her skills, or the game should offer him or her new challenges in order to cope with his or her skills.

One of the important aspects of *Flow* is that there is no visible interface layer within the game such as a heads up display (hud). The game acquires its richness not only through its connection with the flow theory but also from its minimalistic and dynamic graphics. The invisibility of the interface and the simplistic, yet powerful visuals of the game offers an immersive gaming experience. The player's character cannot die. If he or she encounters a hostile organism and cannot escape or defeat it, he or she only loses its parts, which was gained during the evolution phase and continue in the pursuit of evolution again. Flow creates its own world and has its own rules in which the player embraces and becomes part of. The rules of the game are not told or dictated to the player, but he or she learns them intuitively (Figure 13).

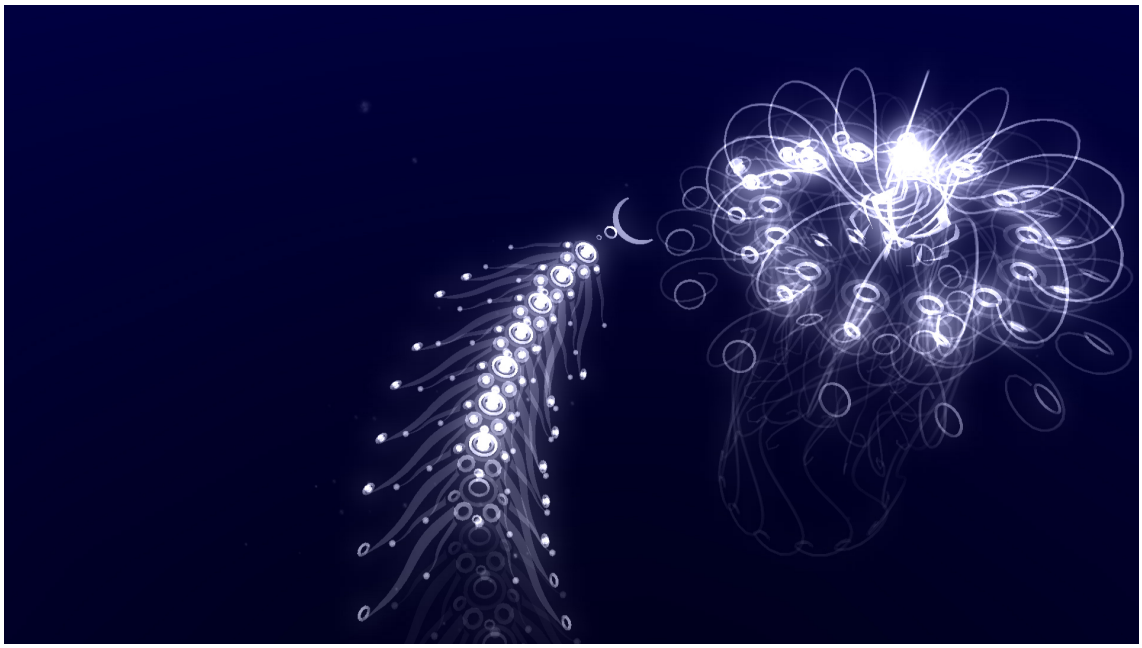


Figure 13. *Flow*, by thatgamecompany, 2007, Video Game Screenshot

Flower was designed by the team and released in 2009. The experience of the game is different from the others in the sense that there are no winnings or losings, no deaths, no enemies, and again no heads up displays. This time the player controls a wind through a sixaxis controller, that carries at first one flower petal, but then followed by many. The current of the wind changes within different scenes, creating lower or fast paced sequences. It consists of six levels. The ambience gathered and emotions evoked during the game is the promise of Flower. The user can change the color of the scenes by bringing flower petals to different fields or transforms the spaces by bringing those petals with the current. Agon this time is not as visible as it is in Flow. There is more of a free flow in the game. The challenge becomes to pick up every petal on the way and interact with the other elements in the course of the wind (Figure 14).

Figure 14. *Flower,* by thatgamecompany, 2009, Video Game Screenshot

Journey is the latest game that is offered by Thatgamecompany (TGC) in 2012. This time the player controls a humanoid character. The main aim of the game is to reach the mountain top by travelling along a desert, and during the journey learn about and reveal what happened. As the name suggests, the game is related with the journey that is taken on in order to unveil the story behind it. Unlike *Flow* and *Flower, Journey* actually has a narrative but once again there are no texts, no voiceovers, no time limits, no deaths, no head up displays. The interface is again invisible and in the first half of the game the player learns how to control the character and interact with the environment intuitively. One other different aspect of *Journey* is that, it is also a multiplayer game that is played online through the Playstation Network. The significant difference is that the user encounters another player in the course of the game but that other player stays anonymous, they cannot see each others identities, avatars, or any other information related with it. They meet in the desert as two strangers who share a similar experience. Jenova Chen stated that the emotions in the game are far more important than the game

mechanics or game simulation technologies (Journey Collector's Edition, 2012). We can clearly see that in all the three games the notion of the play element and the concept of flow is so important and dominant that they all try to offer an emotional experience, in a way a more spiritual experience through the design of the interaction, visuals and the sound designs. The executive producer Robin Hunicke at TGC stated in an interview that "the most important thing is that a game resonate with someone, that it be meaningful" (Journey Collector's Edition, 2012). This statement also underlines the importance of play element, when designed successfully puts the player is in flow state, hence, offers an immersive experience (Figure 15).

Figure 15. *Journey,* by thatgamecompany, 2012, Video Game Screenshot

CHAPTER 5

RESONANT FIELD

5.1. The Project

Resonant Field is an interactive installation project, where the participant is welcomed by real time generated abstract audiovisual sequences and a sensor based user interface with which his or her experience is defined through. The project is based on the theme resonance. Resonance occurs when two sounds'/objects'/systems' frequency of vibration matches and produces a higher oscillation. A user experience design should act in a similar way, it should amplify the experience of the participant/user. Although the graphical user interface tries to accomplish a seamless interaction, the hardware used for reaching the content always reminds the user of the media that the content resides. The mode of an interaction is based on the interface of any system. In order to reach, generate or alter any content the user has to interact with an interface, but this interface always reminds him or her of the medium that he or she is using. Thus, his or her interaction becomes a hyper-mediated one.

5.2. Elements, Technology, Implementation

As the flowchart of the project's thinking process suggests, the theme resonance is related to oscillation, vibration, manifestation, drawing on to light and becoming. The concept of resonance can be read as a collaboration or a fusion of two or more different identities which are vibrating in their own frequencies and becoming something other than themselves, hence, gain a new form. To visually represent such a transformation the project needed nodes that could both act on their own frequency and can gain form through signal manipulation so that when the interaction happens, those points defined through the algorithm could interact with the sound created by the user input from different controls to create distortions over the actual form.

In visual terms, a system created by a mesh, which can be interpreted as an interlaced shape made of a network of wires in 3D space can both behave like the untouched form and the shape of things that are projected onto it. As they already are to be manipulated by sound to alter the coordinates and distort the vertices of the mesh through audio signals. The main reason to create such a system is to be able to transform the experience into a journey from the static idle vibrational frequency of things alone themselves into a more dynamic one. Therefore, the aim is to create an interactive mesh field composed of multiple vertices like a grid system, so that the audience can change and enhance the visuals which are connected to the audio signals thus the interaction can be achieved.

The input system is made of the stencils painted on the input control area, so, when an input is triggered the user can watch the transformations and the fusion of two different shapes as they stood by. When the user approaches the input controls the sounds and geometric forms can take a new shape and form by the vibrations of the audio that was triggered by the user who interacted upon them.

To make this kind of system work, I have chosen to use the OpenGL platform so that one can generate realtime input based graphics on a 3D space while using the power of a GPU (graphics processing unit) rather than a CPU (central processing unit) for optimisation purposes.

OpenGL is a cross-platform application programming interface for rendering 2D or 3D vector graphics. As this application programming interface let's code to be executed on a hardware accelerated level it works fast enough for me to render with faster frame rates and gives way to control higher number of calculations, so that it can be run on the hardware which is than sent into the OpenGL context to be displayed on the surface where the viewer will see the processed images.

I have used a programming tool called Max MSP (Max Signal Processing) which was written by Miller Puckette back in the mid-1980s. The current version of Max MSP is a visual programming language developed and maintained for the needs of the artists, the makers, the designers, the educators and the researchers working with audio, visual tools by a San Fransisco company called Cycling '74. This company was formed by

David Zicarelli in the year 1997 (Cycling ’74, (n.d.), Retrieved April, 2016, from https://cycling74.com/company).

It’s mainly used by composers, musicians, interactive artists, designers, coders and researchers. The programming environment in Max MSP is modular. The programmer creates boxes of code/objects and connects them together. All of the elements created inside Max MSP are objects which can be used to make interactive sounds, graphics, custom effects and other rich experiences. This process of building code blocks and connecting them together in Max MSP is called “patching”. Patching is like programming but in a more organic and immediate way. It is an organic and immediate programming environment because the programmer can see the results of the changes that are made over the code in real time. This gives way to create code sketches and alter the code as needed while seeing the results instantly.

In the programming environment of Max MSP, there are pre-created objects with the ability to acquire new parameters. These objects are modular so that they can interact with each other, they can get and set the parameters between each other if one connects the inputs and outputs of the objects via an interface element called the patch cord. These interconnections are used to create the algorithms. The parameters of the objects inside the patch can then be manipulated by other input controls, so that the interaction between these objects can be achieved.

Software

The Resonant Field Max MSP patch is composed of four main parts. 1. synthesiser patch for creating the audio signal and the sound output, 2. serial port patch which is used to interface with the Arduino board from Bare Conductive, 3. webcam streaming patch which is used to capture real time video data of the user to be projected upon the 3D plane surface as a texture, 4. OpenGL patch which is used to create the context for the visuals and to display the final composite real time generated renderings as the output on the screen and the projection plane.

Resonant Filed Synthesiser Patch

The synthesiser patch is composed of a key slider object to capture the pitch and the velocity of the data gathered from the user input. This data is in MIDI format. Musical Instrument Digital Interface, in short MIDI is a protocol allowing instruments to communicate with each other. It carries information about note on, note off, pitch, velocity and other messages. So MIDI in itself does not generate an audio signal but collects and describes its properties. As a result in order for this generated MIDI signal to be interpreted by the oscillators of the synthesiser it is then converted to frequency.

The frequency output now has to be sent to one of the four different oscillators in the synthesiser patch in order for it to be modulated. All four oscillators create different wave shapes which are the saw, the triangle, the rectangle and the sine wave shapes. These wave shapes can be combined or used separately (Figure 16).

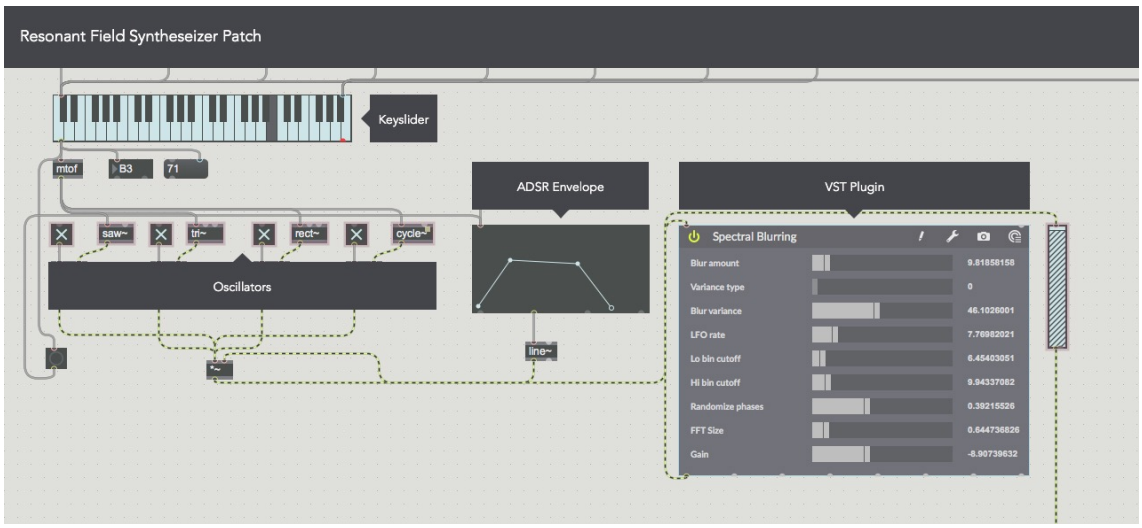


Figure 16. *Resonant Filed,* by Erhan Tunalı, 2016, Synthesiser Patch

Then this signal is sent to an attack, decay, sustain, release envelope and is filtered through a graph that can be edited by the programmer. What the ADSR envelope does is to control the timbre of the sound output. Attack defines how fast the sound reaches its maximum volume, decay defines how much time it takes for the generated sound to get to its sustain value from the initial peak value. Sustain on the other hand defines how long the pressed note keeps ringing and release defines how quickly the sound fades out.

The output is then fed into a VST plugin called “Spectral Blurring” which is embedded into the Max MSP patch. VST stands for Virtual Studio Technology. It is an interface for integrating audio plugins which utilises digital signal processing techniques that are required to simulate the traditional studio recording hardware equipments.

The signal that comes out of the VST plugin is then transferred to two other objects. One of the objects' catches the final audio signal to be stored into a matrix object so that later on it can be converted into an animated black and white image sequence to be used as a displacement map on both the captured camera video data and the circle shape made of vertices on a mesh, and the other object is used to output the signal through the speakers.

Resonant Field Arduino Serial Port Patch For Max MSP

The Arduino serial port patch is supplied by the Bare Conductive company for interfacing with Max MSP. In order for the board's inputs to be sent out as serial data streams I had to also use the open source Arduino Software Integrated Development Environment. The board does not output a data stream on its own, so I had to use and modify the data stream code supplied by the Arduino and upload the code to the board. After fiddling with the threshold settings of the data stream code, I was able to calibrate the touch board's sensors to work as proximity/distance sensors and made the connection with the Max MSP patch (Figure 17).

Figure 17. *Resonant Field*, by Erhan Tunalı, 2016, Arduino Serial Port Patch For Max MSP

Resonant Field Arduino Serial Port Code

Figure 18. *Resonant Field*, by Erhan Tunalı, 2016, Arduino Serial Port Code

Resonant Field Web Camera Streaming Patch

To create the webcam streaming patch, I first had to gain access to the webcam. After connecting the web camera to the Max MSP, I grabbed the webcam data stream which was in ARGB format and I ran a luminance filter so that I had a grayscale image. I then turned that data into a three plane matrix.

A matrix in Max MSP is an object, which may be used for data storage and retrieval, resampling and matrix type and plane count conversion operations. A visual representation of a matrix in Max MSP can be seen below (Figure 19).

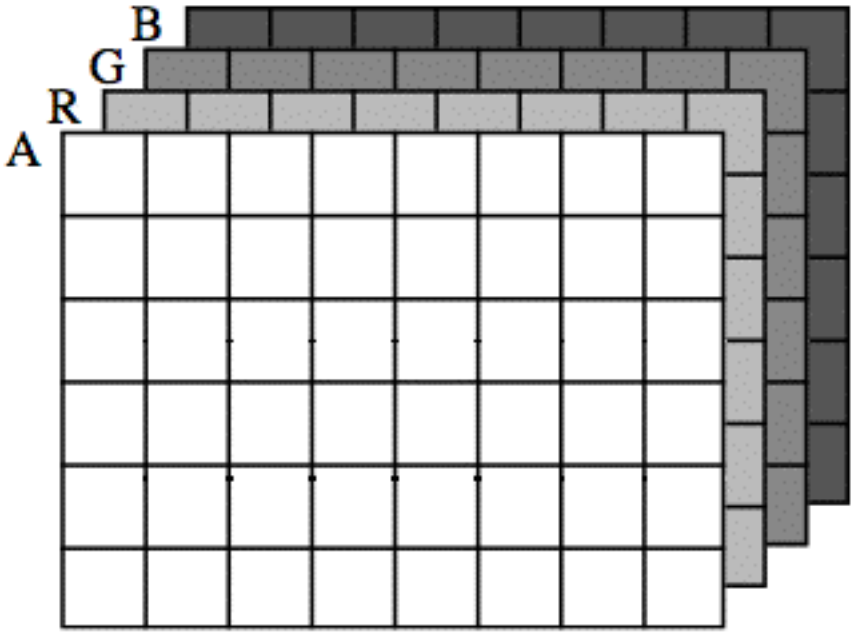
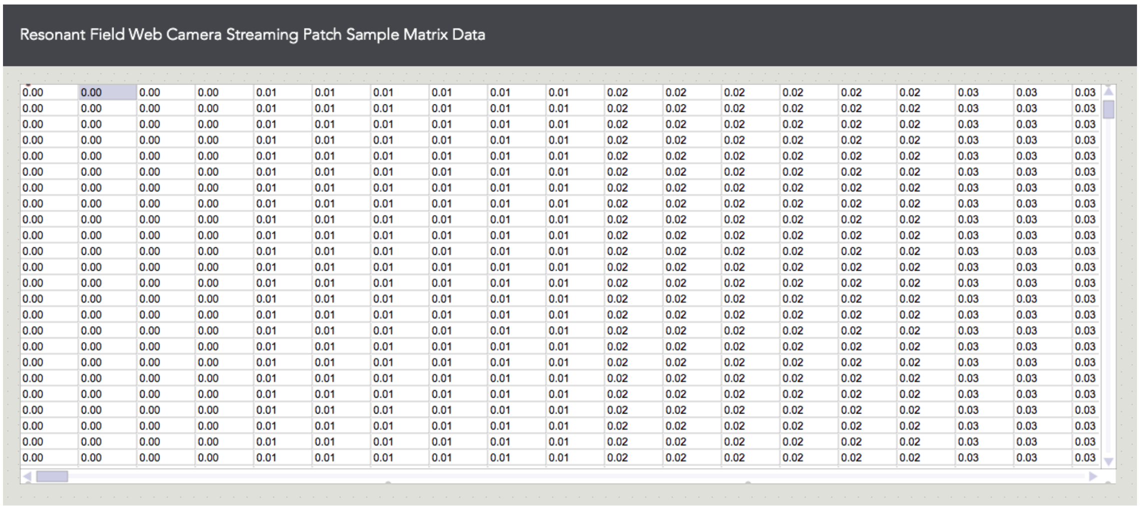


Figure 19. Max MSP Matrix Visual Example

This matrix would keep the x and y positions of the vertices of the mesh and the z position of the vertices would be controlled by the luminance data that was gathered from the webcam video stream.

Below you can see a sample of the captured webcam streaming data displayed as a spreadsheet by the help of Max MSP's spreadsheet object (Figure 20).



Resonant Field Web Camera Streaming Patch Sample Matrix Data

0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
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0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
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0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03

Figure 20. *Resonant Field*, by Erhan Tunalı, 2016, Web Camera Matrix Data Sample

This matrix data let me generate a texture for the mesh that the video stream would be displayed on. After creating this texture I added a parameter for controlling the z positions of the vertices, so that it could react to the audio signals that were generated. The darker pixels from the luminance map texture would go to a negative value on the z-axis and the lighter pixels would go to a positive one only if there was an audio signal that was coming in to set the parameter that was added. If there were no sounds there would be no distortions.

After achieving to map the data to a texture, I assigned it to the mesh object and turned its draw mode to points. Thus the distortions created by the audio signals would look

like they were made on a point by point basis. I also assigned a material to the mesh object and controlled its colour variations through it (Figure 21).

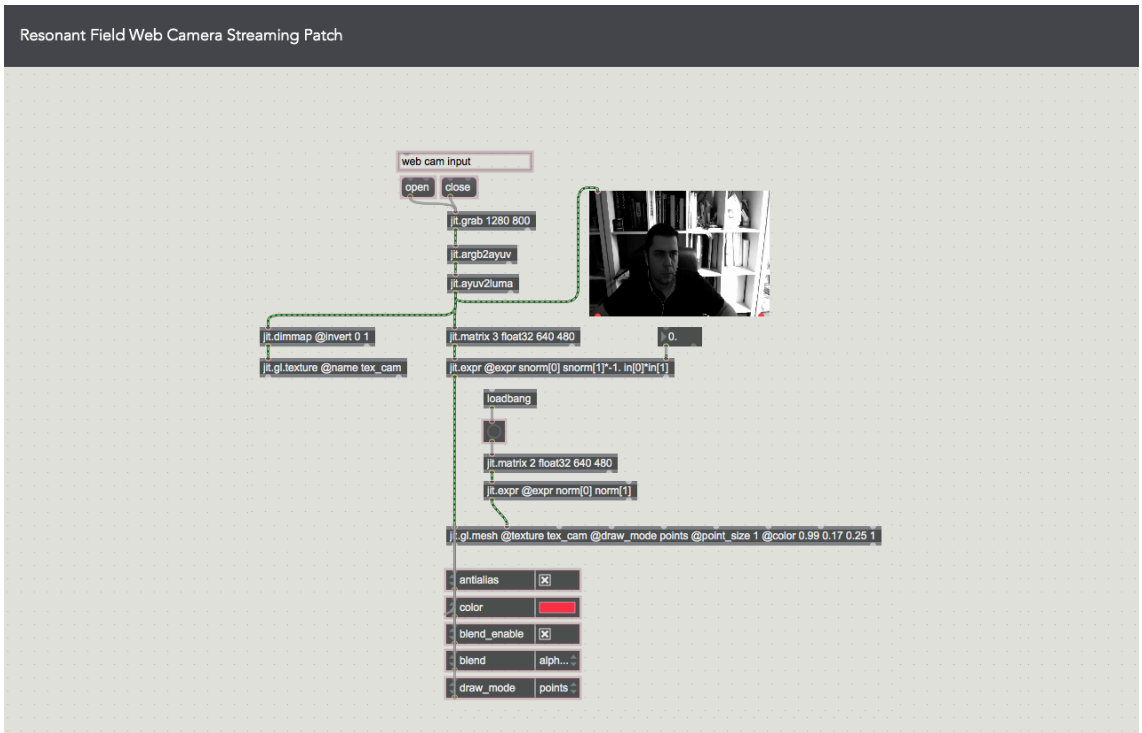

Figure 21. *Resonant Field*, by Erhan Tunalı, 2016, Web Camera Streaming Patch

Resonant Field OpenGL Patch

The OpenGL patch starts with capturing the audio signal created by the inputs of the user through sensor controls. Each sensor is assigned to a note and hence each input has a different frequency. This means that if we were to connect them to an oscilloscope we would have different amplitude and cycle counts in a given timeline because of the frequency change between each note. These frequencies are than captured, the numeric data gathered is split and stored into a 3 plane matrix. This matrix is than visualised for debugging information. The resulting data is fed through a texture into a mesh object which is based on a circular grid shape object with its draw mode set to line loop. The

line loop draw mode lets the software render lines between vertices of the mesh objects so that they are connected to each other when drawn procedurally. The vertices of the mesh object's z coordinate is manipulated through the incoming matrix data based on the frequency of the note being played. For aesthetic purposes the incoming matrix data created by the frequencies are applied with an easing effect onto the vertices of the mesh so the animation looks fluid and correct. This is done by an algorithm created through a sliding animation by the help of an object in Max MSP called jit.slide (Figure 22).

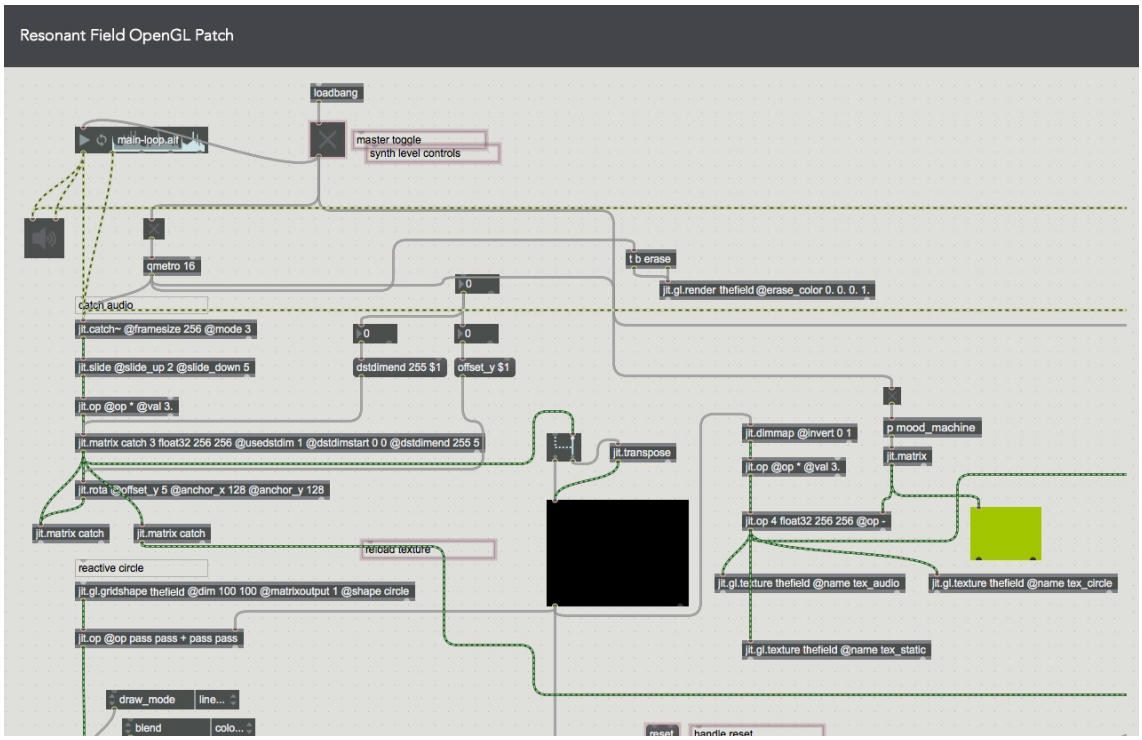

Figure 22. *Resonant Field*, by Erhan Tunalı, 2016, OpenGL Patch

The incoming texture data is fed through a transpose control so the directions of the distortions can be controlled. The same texture is fed into another mesh with the same vertex count through another circular grid shape which has its draw mode set to points.

These two circular shapes overlap to create the upper layer of the animations. While the web cam video data has been captured it is shaped by another special texture and mapped on to the video plane.

The OpenGL patch handles all the visuals that are brought together from different data sources, it composites the incoming video data and the circular grid shape objects data onto each other. The webcam capture data is actually the luminance information of the video frame being drawn and is given a material to create a colour channel over incoming texture data.

To create a controlled variety coupled with the chance factor over the distorted circular shapes I used a colour randomiser patch which is a sub patcher called the Mood *Machine.*

The algorithms of the OpenGL patch was inspired by a framework which is available from the Max MSP package manager named adsr221 by Masato Tsutsui (_adsr221, (n.d.), Retrieved May, 2016, from http://adsr.jp). I made use of the algorithms created by the author of this package extensively, which is freely available in the collections of Max MSP packages.

Hardware

To create a user input device which senses the proximity of the users, I have used a modified *Arduino Leonardo* board from Bare Conductive (Figure 23).

Figure 23. Touch Board

This board has the ability to capture data sent to its inputs via a special paint which is conductive. It can be used for both capacitive touch or distance sensing. I have decided to use the inputs as distance/proximity sensors for the context of this project. There are twelve inputs on the device, but I have chosen to use only 8 of them, for I needed to control the distance between the proximity sensing sensors and the touch board itself. Because after conducting a research based on trial and error, I found out that the conductivity levels of the paint was not perfect. The distance between the board and the sensors needed to be close enough so that the electric current could reach its destination

with enough voltage to create the changes needed for the inputs to function properly. Although the paint itself is conductive, it still has some resistance factor.

Then on a 115 cm to 20 cm white painted wooden plate, that I cutout, I drew the sensor designs with black conductive paint, I used sticker tapes around the edges of the drawings of the icons to create the stencils. Once the icons were drawn I waited for the paint to dry which is a very heavily saturated medium and removed the sticker tapes around the edges to finally create the icons (Figure 24).

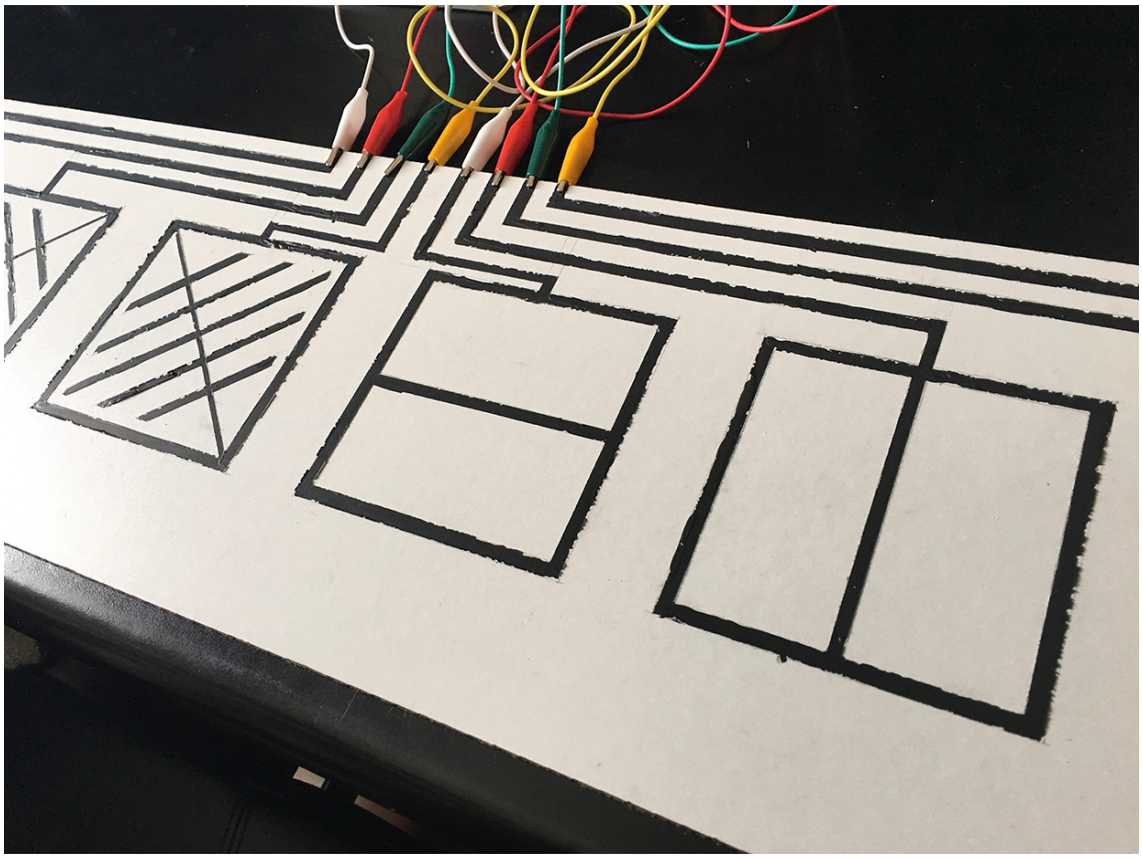

Figure 24. Sensor on Wooden Plate

The icons were drawn as suggested by the design guidelines on the *Bare Conductive* company's website. They needed to be thin and gapped structures in order for the proximity sensing features of the board to function properly.

Since the drawn stencils painted on the wooden board and the Arduino Leonardo board itself had to be in close proximity of each other because of the fact that the conductivity levels of the paint were not perfect, I figured that using alligator clips to close the gap between the Arduino Leonardo board and the stencils painted on the wooden plate was a better practice than trying to close the gap by drawing lines connected directly to the board. This also gave me a better chance to adjust the placement of the board in the installation space so I could rotate and place the board for a better interaction design solution.

The board was connected to an iMac 27 inch desktop computer, so that the inputs could be interfaced with the Max MSP programming environment. Once the proximity sensor serial programming patch was loaded onto the Arduino Leonardo board and the Max MSP patch that I created started running the only hardware piece left to be included was a projector. The projector was added to the installation after the beta testing at the exhibition hall. The usage of the projector enabled a more immersive environment, with which the user is also located in, through the maximised reflections of the visuals, that are created via the interaction of the user with the project (Figure 25).

Figure 25. *Resonant Field*, by Erhan Tunalı, 2016, Installation

4.5. Analysis

As I have stated above, the reason for the creation of the *Resonant Field* project was based on the metaphor of the resonance as a temporal hybrid media creation procedure situated in the digital world, which has close relationships with both the software culture of today, giving every chance for an interacting user to manipulate, remix, edit data models in terms of views and forms, through a plethora of curated mode of interaction techniques, mediated via rich interfaces offered in the physical computing world.

Resonance as a metaphor can be used as a body that encompasses the whole interaction process and the software culture of today, which turned the metamedium computer into a media creation and alteration machine allowing the data models presented inside the digital media to have the capability of transforming into different views and states, permitting the user to consume and experience different media as data and giving way for the spill of techniques of different media to exchange properties fusing into new structures and media of their own.

Resonant Field is also an investigation on the mode of interaction through sensors, an unconventional input method, on what the sensors can achieve in contrast to the conventional approach of granting the users access via the standard ways of manipulation and control like the keyboard and the pointing device. Removing this conventional layer of set of tools, which the users are accustomed to utilise, is both a challenge and an experiment to understand what the physical aspects of interaction can change through out the interaction experience and it can also be an advantage for the message maker, the artist to create an experience related with the concept of the installation piece, which other forms of interaction might not be able to achieve. All in all, it is not an act of reinventing the wheel, but rather an experimentation and a question of what can be accomplished with micro controllers, motion sensors, virtual reality devices or other physical computing devices that let one to customise the experience of the user's input phase in the interaction taking place from a different point of view. The physical relationship offered by the interactive work changes how the user perceives his or her overall experience in a radical way.

The reason for using sensor technology instead of the conventional ways of interaction input methods lies in the fact that sensor based mode of interaction has connections to the metaphor of resonance in terms of taking place in the aether in which two or more bodies interact without touching each other, but rather influencing the forms of creation by creating messages in the space that the entities take place. In resonance, the entities that interact through oscillation frequencies do not physically force each other through their bodies to gain new forms, there is no contact in the physical form but rather there lies an interaction and interchange of messages through oscillations and vibrations of the bodies themselves. The interaction is not forced, it is about the natural vibrational patterns that the bodies create only manifested because of their existence.

From the moment I created the interaction between the sensors and the synthesiser patch in Max MSP, I was so amazed and so immersed in the way the things worked in the experience. I did not recognise at first during the alpha testing stage, that there was a huge delay between the input phase and the creation of sound throughout the speakers. Because, I was actively engaging in the creation process, I was blinded to the delay factor as I was changing, modifying the algorithmic parameters of the audio visualisation processes with one hand while with the other hand I was playing the Resonant Field instrument. It was only after I installed and ran the software as a beta version in the gallery space, I understood something was wrong with the implementation of the VST plugin that was connected to the synthesizer patch which rendered the interactive process almost obsolete. The feedback delay was huge and someone without the knowledge of the inner workings of the software would probably not understand what he or she was forming in the field. I received this criticism from

my project and thesis supervisor Assist. Prof. Andreas Treske immediately after he made his first contact with the instrument. The feedback loop was not there, I was so accustomed to the use of the technology, which I implemented, that I was not aware of the fact that for a new user it would probably be next to impossible to grasp what he was changing in the system because of the huge input delay introduced by the VST Plugin connected to the synthesizer. After making the necessary alterations and modifications, in order to overcome the delay problem, the interaction was much more fluid and dynamic. The installation had become alive, once the real time feedback loop was established.

The problem encountered during the installation stage of Resonant Field was also encountered while David Rokeby was installing one of his works in 1983, he was invited to the "Digicon '83" in Vancouver with his interactive sound installation work The Very Nervous System. His experience there was very close to what I had encountered when I installed the project into the gallery space. In his first public show, he stated that he installed his project and calibrated its inputs for days vigorously without getting out of the gallery space. After all the work he had done, installing and calibrating the inputs of his work, he found out that the installation was only responsive to his actions. It did not respond properly to other people's interactions. He later found out what the problem was while watching his calibration phase before the exhibition from a videotape of himself interacting with his work. He states that he was acting in unnatural ways, he was doing twitchy and tense motions and gestures to actually make the technology he was implementing work. He understood that he had developed with

the technology in the ways he was interacting with it. (1998: para. 15, Retrieved from http://www.davidrokeby.com/experience.html)

The calibration process is also a stage of interaction for the developer or the artist. When any user starts to interact with such systems like my project Resonant Field or The Very Nervous System by David Rokeby implemented, there is an interchange of messages between the input system and the user himself or herself. The user learns the system and after a while when he or she becomes accustomed to the physical and mental actions necessary for controlling the system, these patterns of interactions become processes for successive usage.

This illustrates an interesting side effect of real-time interactive feedback loops. An action provokes a response which immediately provokes a shift in action which likewise immediately changes the system's response, ad infinitum. The issue of who is controlling whom becomes blurred (1998, Retrieved from http://www.davidrokeby.com/experience.html).

The reason behind using audio generation as a form of input to conduct algorithmic visual variations over the media gathered as data on the surface of the screen is that resonance as a concept is very closely related to sound which was stated before in the second chapter of this thesis. Its soul reason of existence is oscillations, oscillations which make up the whole sound spectrum. During the construction phase of the *Resonant Field* the decision was to create an experience of an audio visual instrument of sorts so that the visual model generated, captured and distorted in the field when the

user interacts with the input controls would be working in such a way that resembles the usage of a live instrument. One of the most important aspects of a live physical instrument is that when interacted upon it gives a real time generative feedback loop, so that the player acts and feels instead of trying to figure out how he or she needs to act to change the system. The experience that the players perceive with such instruments is based on intuition, so the interface of this installation had to be intuitive rather than informative. This effect could make the player or the user in this case feel as if the installation becomes a part of himself or herself that extends his or her abilities of interaction. Rather than forcing a functional and rigid interaction experience, the purpose was to create an expressive and intuitive one.

The model of interaction offered by the Resonant Field project to its users, inter actors is based on the model of reflection of the self. David Rokeby calls this model of interaction *transforming mirrors.* He describes this model of interaction as follows:

> While all interactive works reflect interactors back to themselves, in many works the idea of the mirror is explicitly invoked. The clearest examples are interactive video installations In which the spectator's image or silhouette becomes an active force In a computer generated context…The spectator sees some representation of himself or her- self on a video projection screen. This representation follows the movements of the interactor like a mirror image or shadow, transformed by the potentials with which the artist has endowed the space (1995: 145).

Reality of the self is constructed by inputs collected through the sensory system and their interpretation by the brain through electrical signals in human beings, while the digital reality is constructed through mathematical and logical foundations of the

computer and its interpretations of the electrical signals it receives through its own sensory inputs like the captured camera data and the proximity sensors.

In the case of the Resonant Field project, the input of the user is transferred into a machine, calculated, recombined, restructured and transmitted back to the user. This input becomes an output on the surface of the screen as a mathematical and logical projection of the user's residual self image and the space he or she resides in on to a plane composed of a mesh and its vertex points. Each point of the vertices captures the reflection of a part of the users image and his or her environment in the digital context by applying the data captured through the web camera as a texture on to the 3D surface. It is the representation and the interpretation of the user's residual self image, refracted by way of the algorithms through the software that is created by the programmer/artist. The gestures and body movements that the user does in front of the controls and the camera as well as the controls he or she chooses to interact upon adds to the chance factor of the compositions reflected on the screen.

This can be considered as a conversation between the user's perception of the real world and the projected world curated by the artist. The transformations applied on the self image combined by the gestural movement created by the user and the sounds he or she generates gives way to multiple distorted and unique residual self images and notes created in realtime. The changes in the system to conclude the feedback loop are these multiple residual self images created in motion. Thus interaction is achieved resulting in unique visuals and compositions each time the user of the system changes which adds to the chance factor included in the project.

I have given a close look at the users that interacted with my project in the gallery space and observed some patterns which I had foreseen would happen from my experiences as an interface designer. First of these impressions is that none of the users found out that next to the controls there lied a manual, and a statement written by the artist on, how to use the instrument and what the concept is all about, before they tried to interact with the controls. Most of them saw the text material but wanted to skip to the experience of using the device offered except if they were not waiting for the other users to interact with the project. I know this for a fact that people try not to read anything but to get immersed in the experience offered by the interaction designer. In product design, marketers call this happy talk and try to minimise the text incorporated in the interface design and trim it down to a point where only meaningful small chunks of text is allowed.

Next as the controls were painted on a 115 cm to 20cm board they immediately tried to touch the control inputs and waited for about three or four seconds pressing on them before they decided that the instrument was not working and that there was something technically wrong with the implementation, because all they saw was a tingling motion on the surface of the video plane, nothing else (Figure 26).

Figure 26. *Resonant Field*, by Erhan Tunalı, 2016, Tingling Motion

This happened because most of the users of today are accustomed to use tactile interfaces, keyboards, touch screens etc. for a variety of cultural reasons about the conventional user interfaces that happens to be on the scene. The users thought that the inputs would respond to touch rather than proximity. I could have applied a touch functionality easily, but that would have abandoned the whole experience design I was after. The trap was set, now the user would take his hands of the surface and something unexpected would happen, he or she would hear a note and see himself or herself distorted on the surface of the projection with variations depending on the frequency of the note that was triggered adding to the randomisation and chance factor (Figure 27).

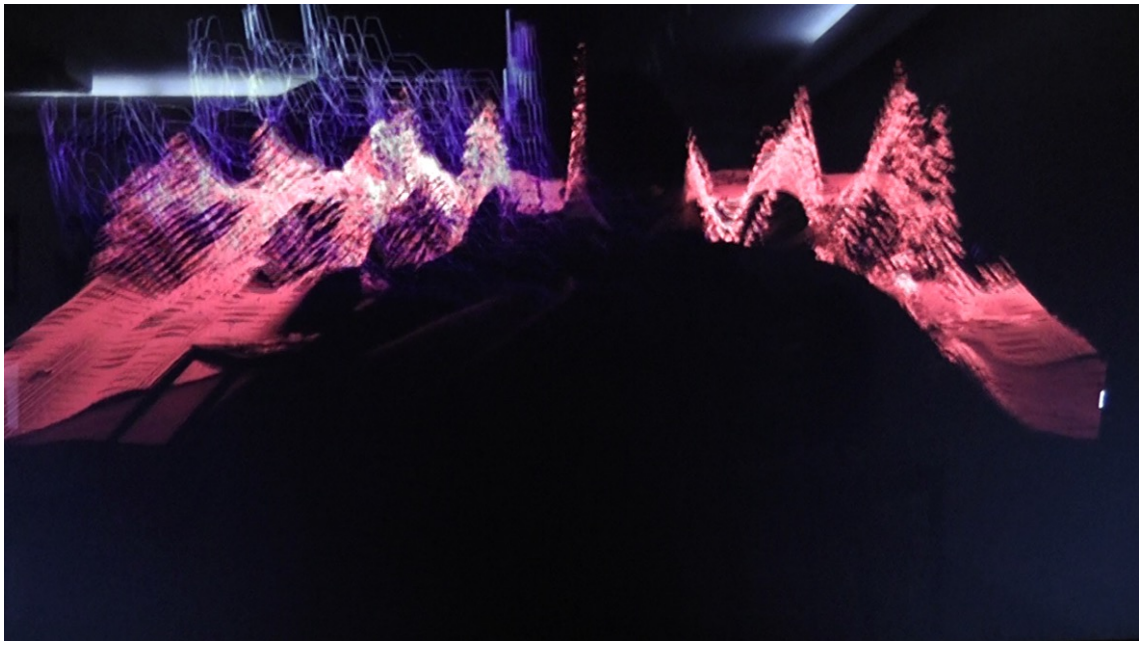

Figure 27. Resonant Field, by Erhan Tunalı, 2016, Audio Reaction

I saw this puzzled look on many of the inter actors that day. Then they would try to apply the same pattern, closing the distance between their hands and the controls and taking their hands of to see their residual self images as reflections. Once this pattern of interaction was applied a couple of times the connection was established and the inter actor understood what was going on, they started experimenting with the instrument to form either musical or visual compositions or both. This meant that the system had created a collaborative platform where the user now has an intuitive knowledge about what his or her actions might create in the Resonant Field.

As the composer of these strange body movements that I forced on the people who interacted with the instrument, I was amazed how easily they grasped to control the interface. To be honest, that was not what I was after, but the interaction phase forced the users arms and hands to dance in a strange rhythmic fashion. It was an after effect of

the usage of the instrument that I did not realise until there were a handful of users to interact upon the instrument.

One of the inter actors after fiddling with the instrument for a long time came and asked me why I did not implement a whole scale of musical notes. There was a harmonic relationship between the notes included in the instrument but it was not an octave. I think that she meant it would leverage people with musical skills to play the compositions they knew on the instrument. This was a totally legitimate question but I wanted people to interact, observe and learn the notes in this unique instrument by experiencing it and form their own combinations over the surface and start composing real time. Thus have an experience of their own, and hence compose their own unique songs in the interactive process.

A group of three people stood by the installation looking at their distorted images on the video plane and did not interact at all, instead one of them took her phone and took a selfie of herself and than took a second photograph of their group arranging them in front of the camera and placing their refracted images on the surface and shared it through some social media platform which I could not recognise because of the distance between us. The media creation machine was working.

Later at some point in time within which the gallery took place, there was a row of spectators waiting to interact and looking at the work, watching and listening to the performance of the inter actor. They did not seem to be competing with each other, although they were trying to create different experiences from the one's before them.

One could say that this was an act of play, forming a social structure, offering no benefits but just the experience of play through a structured reality with its own rules that are learned through the flow of the observation, exploration and modification phases of the interaction (Figure 28).

Figure 28. Group of People Interacting with *Resonant Field*

Resonant Field project, is my attempt to create an interactive instrument within which the users are given a unique audio visual experience of constructing and playing with a temporal residual self image, including processes of the chance factor and the act of playing.

CHAPTER 6

CONCLUSION

The shift in the software culture that started in 1970's created a digital media environment where the physical media is transferred into the mathematical and logical environments supplied by the computers. Hence media is converted into data. This shift came with its own necessities. The computer as a metamedium had to become a mature environment that needed to be served with proper tools to communicate its possible means of use. Thus paving the way to the human computer interaction paradigms that can be summarised with such terms including but not limited to, software, user interaction design, user experience design and graphical user interfaces.

These layers of interaction design had to be inspired by and had to transfer the properties and characteristics of the cultural environments in order to carry compressed messages. They needed to tell the concept and the meaning of the software's function as a story to the inter actors as an attempt to familiarise the user to the world of digital machines.

The digital interface is a combination of instruments for the user to engage in temporal experiences over a body of data represented in a metamedium. It models the experience of the user and modifies his or her perception of the content and is responsible from manifesting a navigable space. The interface layers that are created between the mathematical and logical platform of computers, their software and the human beings, have to be abstracted in such a way that they become understandable, symbolical and metaphorical in order to communicate and function with the least possible noise and in the most economical terms to the users introduced into the use of these interactive systems.

The whole problem of human computer interaction paradigm is about how to communicate the computer DNA, its function, its possible ways of use. Interaction design in digital media is an attempt to familiarise the user to the concept of the transformation of a cultural or physical object stemming from the daily lives of a society which in its essence is a persistent and tangible entity, to a transient and intangible object as computer data. As the properties, characteristics and the techniques of media is transferred into the digital medium, they loose their boundaries stemming from the physical reality, they become data and the software algorithms used to reconstruct this data lets the user to see their forms manifested in different view models. This structure also paves the way to the transfer of techniques of different media into each other forming hybrid media creations.

User interfaces have the responsibility of creating, guiding and familiarising the experience of users to alter, manipulate these view models in intuitive, productive and

immersive ways. Software in this context plays a crucial part, for all the user interfaces base their reason of existence on the algorithms and functions built into the software by the developers or the programmers influenced by the cultural environment they reside in. Once the physical structures of the media is transferred into an environment created with mathematical foundations and becomes data as a representation of the media transferred, the computer liberates the form and context of this media as a machine capable of creating permutational calculations over the essence of the media. These permutations of data as models of view are limited to the integrated algorithms developed into the software. Software comes with its own ideology coupled with the interaction parameters of its own. The abstraction layers put onto the software as interface design patterns further reduces the functionality of the metamedium in order to communicate its software to its user base. This phenomena stands as the coast of diminishing the chaos of the possible permutations of the data at hand. While the software coupled with an interface shapes, restructures, translates and familiarises the offerings of such a metamedium and becomes a window to another world constructed based on mathematical calculations from the ground up, it also becomes a curtain hiding the probability cloud of permutations that can be accomplished with the data fed into such systems.

Some parts of the digital data is hidden and is lost in translation in the human computer interaction paradigm. But as Lev Manovich puts it, transmission view of culture in Communication Studies constitutes of the authors and the audiences. The messages are created and transmitted by the authors and they are received by the audiences. He states that these messages may sometimes not be understood as a meaningful composition by

the audiences. Some parts of the messages may be lost in the transmission stage because they might either be misunderstood or there might be a technical problem in the transmission like noise. He states that communication theory in the classical sense identifies this as a problem while in cultural studies this fact is taken on a more positive level claiming that this lets the audience to create their own connotations of the message (Manovich, 2008: 17).

The statements above largely apply to the Resonant Field. The project uses a mixture of instruments to accomplish its user's experience such as the proximity sensors, the 3D video plane and the web camera video stream. This structure reflects the user his or her residual self image accompanied by the reflection of the environment that the interaction takes place. This is an attempt at randomising the generated images for each user's experience to create unique visualisations in the temporal engagements of the inter actors. The use of the self image and the user's environment adds to the familiarisation factor present in the installation. The integration of the spatial environment data created by the Resonant Field alters the results of the visualisation phase. This means that the placement of the instrument in the gallery space affects its representational characteristics. This factor offers different variations of the work itself through its coordinates in the architectural environment it is placed in. Thus adding to the uniqueness of the visual results.

To create a fluid user experience in the usage of the instrument, only two layers of graphical layers were used. This is done to accomplish the observation and the exploration phase of the interaction with the least possible noise and in the most

economical terms. One of the graphical layers that composes the representation on the surface is the field that contains the web camera data. The other one is the circular mesh layer over the video plane to create variations in the visual sense. There are no heads up displays or other layers of icons, images or typographical informative structures in the surface of the Resonant Field. This is because the aim of the installation is to speak for itself through its physical mode of interaction via its input devices. Temporal user experiences in the Resonant Field are delivered via the usage of an unconventional input method which is composed of the eight proximity sensors. The usage of physical icons outside the surface of the interaction helps the inter actor to better understand the nature of the instrument by being in the outside world. This input mode also lets the user to have a more engaging interaction and removes clutter over the visualisation taking place in the field.

Resonant Field takes the advantages of immersive navigation structures through using spatial, visual and sensory interactivity procedures. This also leads to the fact that it uses media hybridisation techniques. As the content of the captured web camera data is reflected upon a 3D plane in the form of texture, the techniques of video and 3D mediums spill on each other creating a different hybrid medium on its own. This hybrid medium lets the inter actor to create remixes of his or her self image and lets him or her alter the outcome by experimenting with the inputs. The input of the user triggers algorithmic changes on the view model, which paves the way to a deeper level of engagement and communicates the idea of resonance in an intuitive and immersive manner.

Resonant Field defines a 3D environment. This mathematical environment is then populated with the data of the user's image. This data is reconstructed in the field accompanied by its container objects. Thus, it turns the physical environment and the inter actor into data. This data is represented as a refracted and reduced image of the real physical objects. The inputs of the camera and the user are transferred into the computer medium so they become intangible and transient in nature. As this data has become intangible, its free of its physical restraints. This lets the algorithms of the software to apply distortions over the objects that contain the data creating different view models of the same data. User inputs through the proximity sensors form the control structure of the field.

The technologies that are applied in the Resonant Field accomplish the construction of real time generated audio and graphics. To give a feeling of resonance, the audiovisual constructions that take place in the field are emergent.

The generations of the different forms when the user interacts with the Resonant Field works in a way as if they are using an instrument of sorts. There is a live audio visual feedback loop, so that the users act and feel instead of trying to figure out how they need to engage in the experience. This effect makes them feel as if the installation becomes a part of themselves that extends their abilities of interaction. Rather than forcing a functional interaction experience, it creates an expressive one.

As the instrument of Resonant Field is engaged by the inter actors voluntarily, it is a free act. The interactivity is presented in a structured and organised formation. The

interaction is by its nature a temporal encounter which means that it happens in its own time and space. Hence one can state that the Resonant Field encompasses the characteristics of the concept of play.

What the experiment Resonant Field conducts on a personal level is a research on how one can get deeper into the essence of this metamedium. Through creating all the procedures from coding the software that processes the incoming signals to structuring algorithms. From learning about how to tame the input methods of a micro controller in the form of sensors to creating a software synthesiser. From understanding how digital audio signals are manifested and processed through midi messages and oscillators to how the frequencies of sound translates into visual data and how one can create an interaction mode on its own right. This is an attempt to understand how the abstraction layers of user interfaces effects the user's experience in positive and negative ways by creating a software program with all the necessary instruments to form a digital user experience from scratch.

Today we live in a software environment where media as data is easily manipulated, reshaped, remixed, recalculated and remodelled, in comfortable, understandable, functional, intuitive and sometimes immersive pattern structures that encompasses and utilises the abilities of computers. The digital media in such an environment is in continuous flux, ever changing as the dynamic medium that it resides in changes bit by bit. This change effects human computer interaction and all of its layers and will continue to effect our experiences as the new mediums rise from the metamedium machine. Hence Resonant Field as a framework will continue to evolve. It has all the

characteristics of a hybrid media entity. It can be enhanced by adding new algorithms, new modes of interaction and pave the way for conducting new user experience experiments.

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