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USAGE OF COMPUTER GENERATED IMAGERY IN VJ PERFORMANCE

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USAGE OF COMPUTER GENERATED IMAGERY  
IN VJ PERFORMANCE

A Master's Thesis

by

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Ankara  
May 2017

To Tülin & Lütü Özdem

USAGE OF COMPUTER GENERATED IMAGERY  
IN VJ PERFORMANCE

The Graduate School of Economics and Social Sciences  
of  
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by

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THE DEPARTMENT OF  
COMMUNICATION AND DESIGN  
İHSAN DOĞRAMACI BİLKENT UNIVERSITY  
ANKARA

May 2017

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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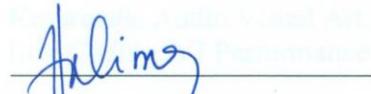
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## ABSTRACT

### USAGE OF COMPUTER GENERATED IMAGERY IN VJ PERFORMANCE

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This thesis aims to study the usage of computer generated imagery in VJ Performance. The main workflow of VJ Practices has been divided into content, process, and output. The project includes the creation of computer generated visual material via generative/creative coding defined as content, VJ performance with these materials defined as process, and presentation of visuals via Video Projection Mapping Technology defined as output.

**Keywords:** Audio Visual Art, Computer Generated Imagery, Generative Coding, Live Coding, VJ Performance

## ÖZET

### BİLGİSAYAR ÜRETİMLİ İMGELEMENİN VJ PERFORMANSTA KULLANIMI

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Bu tez, bilgisayar üretilmiş imgelemenin VJ performans sırasında kullanımını incelemeyi hedeflemiştir. VJ performans; içerik, işleme ve gösterim olmak üzere üç bölümde incelenmiştir. Bu projede, VJ performans sırasında kullanılan görsel kütüphane yaratıcı kodlama yöntemi ile oluşturulmakta olup, içerik olarak tanımlanmıştır. Üretilen görsellerin sanatçı tarafından gerçek zamanlı olarak manipüle ve senkronize edilmesi işleme olarak tanımlanmıştır. Bu görsel performansın video maskeleyme yöntemi ile sunulması ise gösterim olarak incelenmiştir.

**Anahtar Kelimeler:** Bilgisayar Üretilmiş İmgeleme, Canlı Kodlama, Görsel İşitsel Sanat, VJ Performans, Yaratıcı Kodlama

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## TABLE OF CONTENTS

ABSTRACT .....	iii
ÖZET .....	iv
ACKNOWLEDGMENTS .....	v
TABLE OF CONTENTS .....	vi
LIST OF FIGURES .....	viii
CHAPTER 1. INTRODUCTION .....	1
CHAPTER 2. COMPUTER GENERATED IMAGERY .....	4
2.1. Early Computer Generated Art in Bell Labs .....	5
2.2. CGI in Media .....	12
2.3. CGI in Other Disciplines .....	19
CHAPTER 3. ALTERNATIVE WAY OF VISUAL CREATION: GENERATIVE AND LIVE CODING .....	24
3.1. Aesthetics & Computation.....	25
3.2. Coding Culture .....	32
3.3. Creative Coding.....	38
3.3.1. Code Artists.....	40
3.4 Live Coding.....	43
CHAPTER 4. VJ PERFORMANCE.....	46
4.1 Introduction .....	46
4.2. Elements of VJing: Content, Process and Output.....	48
4.2.1 Content.....	49
4.2.2 Process.....	51
4.2.3 Output: Display Options in VJing.....	54

4.3 Generative Coding for Audio Visualization .....	56
4.3.1 Generative Coding VJs .....	56
4.4 Audience Engagement of Live Visualization in Musical Performance.....	59
 CHAPTER 5. DISCONNECT.....	62
5.1. The Project .....	62
5.2. Conceptual Design.....	63
5.3. Elements and Implementation .....	64
5.3.1 Content.....	65
5.3.1.1 Generative Coding Environment: Touch Designer.....	66
5.3.1.2 Generative Design Process.....	68
5.3.1.3 Projection Surface Design (CNC Cutting).....	75
5.3.2 Process.....	79
5.3.2.1 Software.....	79
5.3.2.2 Hardware.....	85
5.3.2.3 Audience Engagement .....	87
5.3.3 Output.....	88
5.3.3.1 Video Projection Mapping and Masking Process..	89
5.4. Related Works.....	90
5.5. Analyzes.....	95
 CHAPTER 6. CONCLUSION .....	99
 BIBLIOGRAPHY .....	104

## LIST OF FIGURES

1. <i>Gaussian-Quadratic</i> , by Michael Noll, 1962–1963.....	7
2. <i>Ninety Parallel Sinusoids</i> , by Leon Harmon and Kenneth Knowlton, 1967.....	8
3. <i>Gargoyle</i> , by Leon Harmon and Kenneth Knowlton, 1967.....	9
4. A stereographic pair of lines in a 3D space, by Michael Noll.....	10
5. Interactive Audio Visual Motion Graphics, by Laurie Spiegel, 1975.....	11
6. <i>Two-Gyro Gravity-Gradient Attitude Control System</i> , by Edward E. Zajac, 1963.....	12
7. <i>The Kineograph</i> , discovered by John Barnes Linnett, 1868.....	13
8. CGI scene from <i>Star Wars</i> , by Larry Cuba, 1977.....	15
9. CGI Data of dinosaur (T-rex) in <i>Jurassic Park</i> , by Steve Williams.....	16
10. Integration/Placement Process of the <i>Brachiosauruses</i> , by Steve Williams.....	16
11. Traditional Sculpting Tools in Different Sizes and Shapes.....	22
12. Ur game board, 2600 BC.....	27
13. Replica of Aztec Stone of the Sun.....	28
14. Ancient art of Kolam, Southern India, 1970s.....	28
15. A Temporary “Sand Mandala”, Kitzbühel City Hall, Austria.....	29
16. File Input Library in Python.....	36
17. <i>Oscillons</i> via Analog Computer, by Ben Laposky, 1953.....	41
18. <i>Analoggraphik</i> , by Herbert Franke, in between 1961, 1962.....	42
19. <i>Valence</i> Information Visualization, by Ben Fry, 2002.....	43

20. Modem Festival, visuals by TAS, Croatia, 2016.....	55
21. Ali Demirel and Arikan’s Visual Composition Set.....	58
22. <i>Crow</i> , by Tarik Barri.....	59
22. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 1.....	70
23. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 2.....	71
24. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 3.....	72
25. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 4.....	72
26. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 5.....	73
27. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 6.....	74
28. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Generative Design Process 7.....	75
29. Lotus, by Anıl Özdem, 2017, Video Projection Surface Modelling.....	76
30. Rino M-150 CNC Router.....	77
31. Lotus, by Anıl Özdem, 2017, Video Projection Surface Cutting Process.....	78
32. Lotus, by Anıl Özdem, 2017, Video Projection Surface Installation.....	79
33. <i>DISCONNECT</i> , by Anıl Özdem, 2017, “Spout Out” in Touch Designer.....	82
34. <i>DISCONNECT</i> , by Anıl Özdem, 2017, “Spout In” in Resolume Arena.....	82
35. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Raw Video Stream in Resolume Arena.....	83
36. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Mirror Effect in Resolume Arena.....	83
37. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Combination of Mirror and Cube Tiles Effect in Resolume Arena.....	84
38. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Sound Reactive Rotation in Resolume Arena’s Cube Tiles Effect.....	85
39. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Resolume Arena’s Midi Mapping Interface.....	86

40. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Hardware: Sound Card (left), Laptop (middle), Midi Controller (right).....	87
41. <i>DISCONNECT</i> by Anıl Özdem, 2017, Audience Interaction.....	88
42. <i>DISCONNECT</i> , by Anıl Özdem, 2017, Video Projection Mapping Masking Process.....	90
43. Ali Demirel’s Interface in “Hawtin Show”, by Ali M. Demirel.....	91
44. “An Interview with Tarik Barri on Tour with Monolake”, Cycling ’74, Tarik Barri’ Java Patch in Max MSP.....	93
45. “An Interview with Tarik Barri on Tour with Monolake”, Cycling ’74, Tarik Barri’s Input devices including 3D Space Navigator and Midi Controller.....	94

# CHAPTER 1

## INTRODUCTION

The thesis project *DISCONNECT* examines usage of computer generated imagery in VJ performance. Hence the media has converted into data and the term of digital media was born, the mathematical and logical environment supplied by the computers became an environment to generate visuals. Nowadays, it is possible to generate visuals by software technology and coding.

VJing which is a form of live video performance art, often undertaken with DJs and musicians to create a visual backdrop within music events is one of possible practices that computer generated imagery can be applied. The research question is “How VJs can have total control on visual material in VJ performance”. This thesis claims that generative coding can be applied to VJing practice and if VJs use real time rendered video source in the visual performance, it is possible to manipulate parameters in source code in real time. This circumstance provides environment where the parameters of visuals can be manipulated in real time.

The project is aimed to show that generative coding can be useful tool to generate digital media for VJ performance. Generative coding provides something expressional rather than functional. It is possible to generate imagery, sounds, architectural models and designs, and animations which are based on coding and algorithms. By virtue of generative coding environments, it is possible to generate real time rendered visual and it is also possible to manipulate its variable's value and parameters in real time. This circumstance makes that generative coding can be used in VJ performance which is fundamentally based on manipulation and synchronization in real time.

In this project, VJing had been divided into 3 layers including content, process and output. Content means that VJs need visual materials in order to use during visual performance. These materials can be media from computer's hard devices, DVDs, VHS tapes, live camera input or computer generated imagery. In *DISCONNECT*, computer generated imagery had been preferred to fill media library and generative coding environment have been used to generate visual. With the help of this method, it became possible to generate real time rendered video stream which can be manipulated in real time via input devices.

Second layer which is defined as process means manipulation and synchronization of visuals with considering live musical performance. VJing can be accepted under performance art, and visual artist is responsible to make real time manipulations on visual material, and synchronize visuals accompanying with musical performance. *DISCONNECT* offers that audience is also responsible to interact with visual performance and they can be part of the show.

Output means displaying of visual performance with output devices as screen and video projectors. In this project, the method of video projection mapping has been used for displaying visual performance on designed projection surface.

*DISCONNECT* have been formed as interactive video mapping installation where visual artist and audience can interact with visual performance. The audience and visual artist can send real time data which is taken via input devices as microphone and midi controller, and this data has been used to manipulate visuals in generative coding environment. In this project, visuals which are generated by generative coding environment *TouchDesigner*, had been used to fill media library in VJ performance.

The thesis is formed in 5 main parts. The second chapter includes information about “computer generated imagery”. Early ages of CGI, and role of CGI in media and other disciplines have been examined in this chapter. The third chapter focuses on method of generating computer generated imagery which is called as “generative coding” and coding is examined as a tool which can be used in generating digital media. The fourth chapter is about VJing which includes information about layers of VJing which is defined as content, process and output. Fourth chapter focuses on visual materials which are generated by coding, and generative coding has been examined as a way to contribute visual materials for VJ performance. The fifth chapter is the core of thesis, includes the project *DISCONNECT* containing its documentation, and analyzes. The last chapter is conclusion where the outcomes are evaluated.

## **CHAPTER 2**

### **COMPUTER GENERATED IMAGERY**

Computer Generated Imagery (CGI) is computer graphics which are generated by computer technology in order to create visual material for art, films and videos, printed media, video games and simulators. We have been using many different methods to generate visuals. In ancient times, people had used nails or bones as a tool in order to draw paintings into caves starting from 40.000 years ago. Then, they discovered new tools and materials in order to express their ideas and experiences visually. After the development in technology and computer systems, computer became a useful and accessible tool to generate visuals like the brush for a painter. Software, mathematical formulas, data, algorithms and coding are useful tools to create imagery just like a brush.

The main idea behind the computer generated imagery is that it is based on data. Computers are not as smart as we think. There is no computer or digital system which can be developed without human interaction. People design and develop these systems and then systems run. Operating systems in computer that we accept as the core layer of computing mechanism, are designed to create communication between

hardware and software systems. It has its own structures, communication styles and methods. The other software should be designed considering operation systems methods and its structure. There is no difference than languages. For instance, English has its own grammar, words and structure. In order to communicate in English, people need to follow the grammatical rules. These reasons are completely the same for the computer culture. It has to be designed starting from the core level of each application, and in order to operate these applications, we need to complete these steps. For CGI culture, if people can design required platforms and methods and give enough data, the software and systems can generate visuals.

CGI is accomplished through various methods. The use of algorithm to generate fractals, for example, can produce complex visual pattern. Image processing software can be used for creating special effects or motion graphics for movies. It is also very often used in architectural design, anatomical modelling and engineering with software which are developed to generate 3 dimensional models and object. There are many more methods to generate visual by computer, but the main idea behind all these methods is that all of these methods are designed by a human being.

Programming languages, image processing software, architectural design software, 3D modelling and all other platforms have their own methodologies, libraries, communication styles.

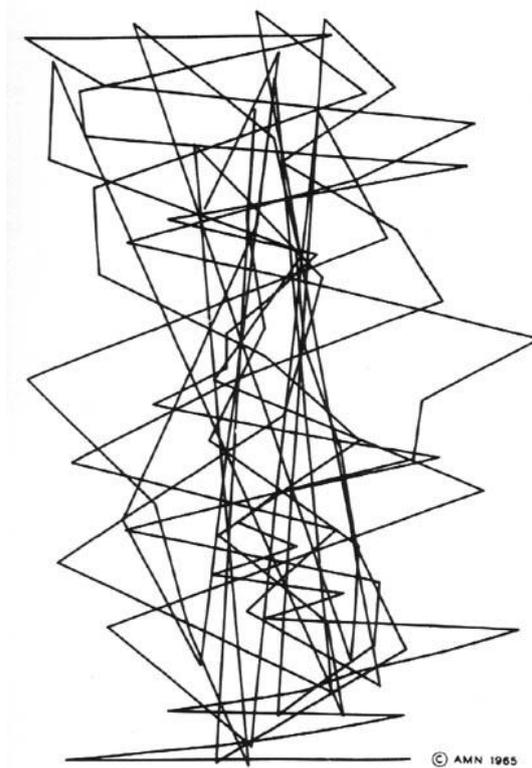
## **2.1 Early Ages of CGI**

According to Salmon (2016), “computer generated imagery was first used in the 1950’s which had been used for graphics in military, manufacturing, or applied

sciences applications” (Salmon, 2016). Michael Noll who was early pioneer in digital computing art and 3D animations in Bell Labs, has claimed that “Early pioneering research into digital computer art and artistic animation started to take place at Bell Telephone Laboratories, Incorporated (or simply Bell Labs), at its Murray Hill, NJ, facility during the 1960s” (Noll, 2016). Computer graphics provided a powerful means of displaying scientific and technological data calculated by a digital computer at Bell Labs in the early 1960s. The method explained by Noll (2016) as that the “data were plotted on 35-mm film by a Stromberg Carlson SC-4020 microfilm plotter, controlled by an IBM 7090 mainframe digital computer” (Noll, 2016).

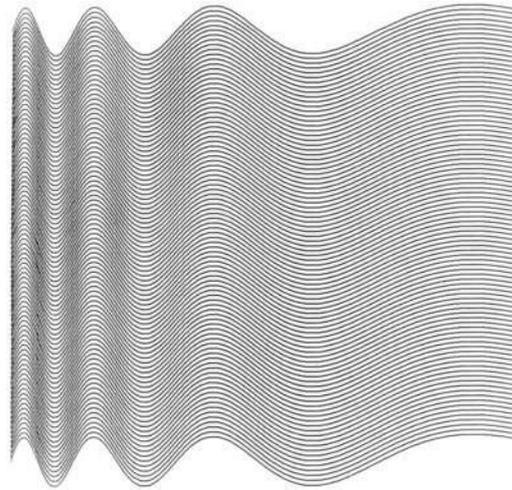
Noll (2016) indicated that *Gaussian-Quadratic* (Figure 1) has been accepted as one of leading computer generated visual art which is created by Michael Noll in between 1962-1963 as the culmination of a series of images in which the parameters of the algorithm were varied (Noll, 2016). Noll (2016) explained the logic behind the algorithm as;

“Coordinates along horizontal axis are chosen by a pseudo-random Gaussian subroutine, while coordinates along the vertical axis are chosen by a quadratic equation. When a coordinate reaches the top, it is reduced modulo 1024 to begin to climb vertically again. It is also an example of algorithm art” (Noll, 2016).



**Fig. 1.** *Gaussian-Quadratic*, by Michael Noll, 1962–1963.

One of the ideas behind the need of the creation of usage of computer generated imagery can be associated with need of data visualization and solving complex rules and algorithms. CGI, was accepted as a way to visualize scientific data in the beginning. Considering that there is no chance to make analytical mistake in calculations. The visualization of the data should give perfect results when there is correct algorithms and data used. The same logic is very helpful to see visual results of complex rules, mathematical formulas and algorithms are in a perfectly correct and easy way. Michael Noll's work which is named "Ninety Parallel Sinusoids" is one of the early example of visualization of algorithm and it is accepted as algorithm art (Figure 2). Noll said that "I believe that in the computer, the artist had a new artistic partner. I used FORTRAB and subroutine packages I had written using FORTRAN for all my art and animations" (Noll, 2016).



**Fig. 2.** *Ninety Parallel Sinusoids*, by Leon Harmon and Kenneth Knowlton, 1967.

Another example of early computer generated art was designed by Leon Harmon and Kenneth Knowlton in 1967, which is named as “*Gargoyle*” (Figure 3). The importance of this work is that they created an image with using small grayscale pieces. Different shades of gray were used to create a black and white image and software had a support for this process. This idea is similar to the usage of the pixel which means smallest controllable element of picture represented on the screen. The smallest pieces of colors which are named pixel come together and create bigger image. When the pieces become smaller, the image become more detailed. Harmon and Knowlton’s work looks like black and white image in low resolution like basic pixel image. Michael Noll explained this work as;

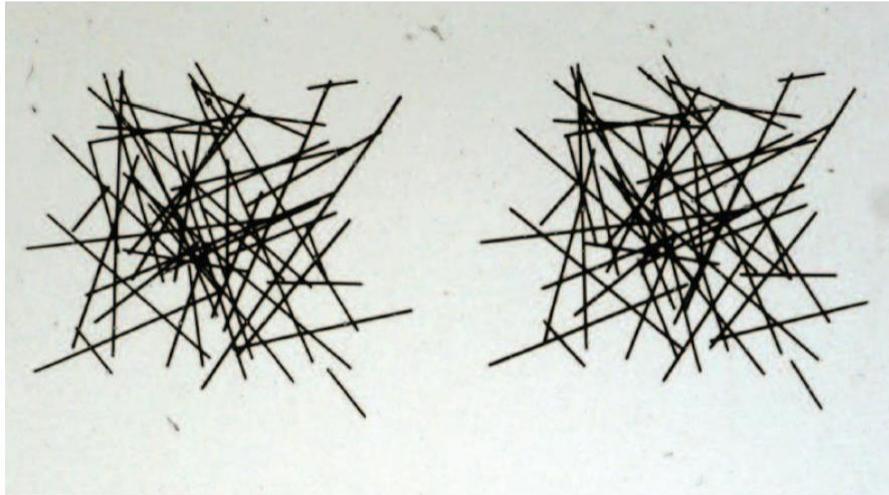
“Leon Harmon and Kenneth C. Knowlton, both researchers at Bell Labs, perfected a computer technique in the mid- 1960s in which a picture would be digitized and converted into a finite series of grayscale values, with a small pixilated image then assigned to each grayscale value. Harmon suggested the technique, and Knowlton programmed and perfected it. The final mosaic was drawn on the microfilm plotter. Usually small images (in an  $11 \times 11$  or a  $15 \times 15$  matrix) of transistors and other electronic circuit elements—or some other, richer variety of small images—were used to create the grayscale. Since the graphic output from the SC-4020 was not that large, a number of frames

would be pasted together to create a bigger picture on a large panel.” (Noll, 2016).



**Fig. 3.** *Gargoyle*, by Leon Harmon and Kenneth Knowlton, 1967.

Early examples of computer generated imagery had taken place in 2 dimensional space. Michael Noll’s stereographic pair could be accepted first 3D illusion in the field of computer generated imagery. Michael Noll said that “Expanding upon my childhood interest in 3D stereo viewers, I programmed the computer at Bell Labs to calculate and then draw on the microfilm plotter 35-mm images of various “sculptures” for the left and right eye, combining elements of mathematical order with computed randomness” (Noll, 2016).



**Fig. 4.** A stereographic pair of lines in a 3D space, by Michael Noll

The first audio visual computer generated visuals had been created also by Bell Labs in the same period. The idea behind this work was the same: usage of data in order to create visuals. However, it can also be accepted as a milestone for the interactivity and human computer interaction in CGI. Before this application, pre-designed algorithms and source code have been used to generate the visuals. In Laurie Spiegel's work, users allowed to interact with visuals via input devices in order to change some data as color, size and location of objects in the real time. The work is explained by Noll (2016) as;

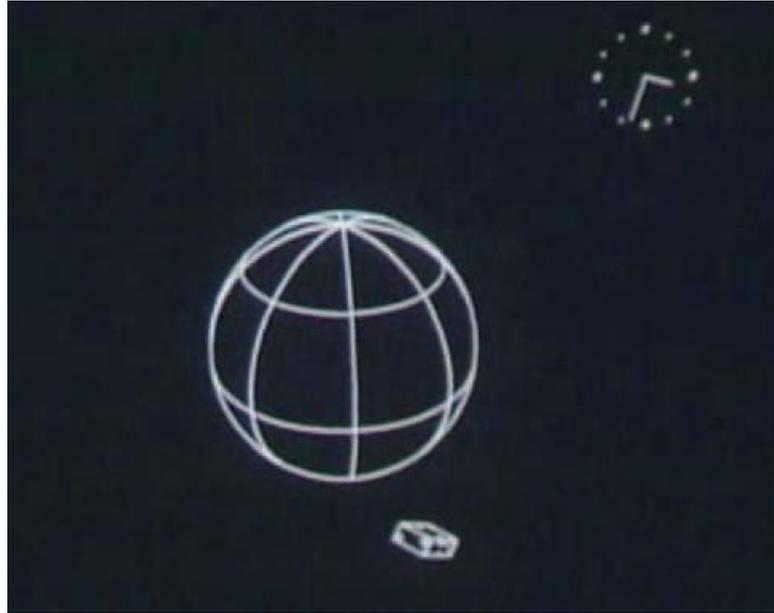
“Laurie Spiegel, still image (photographed from a scanned color video display), 1975, drawn using FORTRAN IV software Spiegel wrote for creating still images, real-time interactive video and algorithmic image generation using a DDP-224 computer at Bell Labs. Input devices (a Rand tablet, knobs, switches and push buttons) were used for drawing still images and also for real-time interactive improvisation of animated visual materials. These input devices controlled various visual parameters of the program, including color, location, path, texture, size, logical operations and contrapuntal relationships (such as inversion and imitation) derived from music. Time-based video output generated by this same software system (VAMPIRE) was recorded directly to analog videotape.” (Noll, 2016).



**Fig. 5.** Interactive Audio Visual Motion Graphics, by Laurie Spiegel, 1975.

In this period, we are also facing with early computer animated films. According to Noll (2016), early computer animated films were “a series of images could be programmed and drawn on the plotter to create a movie, thereby creating early computer animation” (Noll, 2016). Bell Labs’ early animations stimulated scientific data to illustrate and visualize. *Two-Gyro Gravity-Gradient Attitude Control System* which is computer animation film programmed by Edward E. Zajac in 1963 is one of early computer animated film of visualization of scientific data (Fig.6). This movie shows a communication satellite orbiting about the Earth as its gyros stabilized its motion. The clock on the upper top counts number of orbits. Noll (2016) explain this period’s computer animation’s aim and Zajac’s project as,

“It stimulated many others at Bell Labs to create computer-animated movies for scientific purposes. Zajac’s movie was a visual demonstration to the public of what he had learned from his mathematical simulation of the gyros in stabilizing a satellite.” (Noll, 2016)



**Fig. 6.** *Two-Gyro Gravity-Gradient Attitude Control System*, Edward E. Zajac, 1963

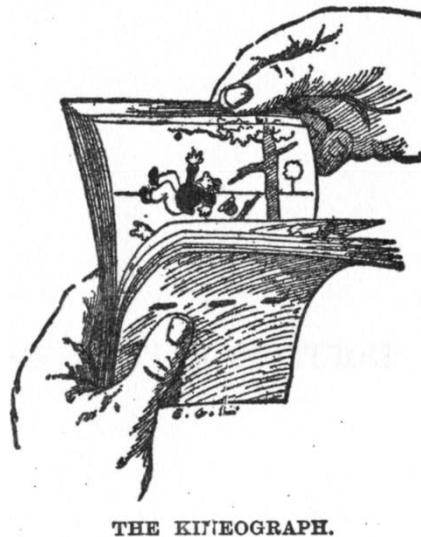
## 2.2 Computer Generated Imagery in Media

There is no doubt that, the most effected fields by CGI are movies, television and animations. The simplest way to explain computer generated motion graphics and images in media is to think of typical hand-drawn animation or stop motion, which consist of a series of drawings or photographs to create the illusion of movement.

When we consider human beings, regarding their eyes and brain capacity to understand the motion is actually based on frame and time relation. The logic is the same with kineograph which is called as flipbook (Fig. 7). Erik (2011) explained it as

“It has been discovered in 1868 by an English lithograph printer, named John Barnes Linnett, and registered a patent for his invention under the name kineography “moving picture”. In German, the flip book is known by the name “Daumenkino” which translates to “thumb cinema”. The many pictures, flipped quickly, relies on the persistence of vision, to create the illusion of an ongoing scene” (Erik, 2011).

Our brain is willing to unify the scenes together in time and create motion illusion and it explains the fundamental logic behind the animation and motion graphic. This method is also used in media industry as in creation of computer animations, special effects, and motion graphics.



**Fig. 7.** *The Kineograph*, discovered by John Barnes Linnett, 1868

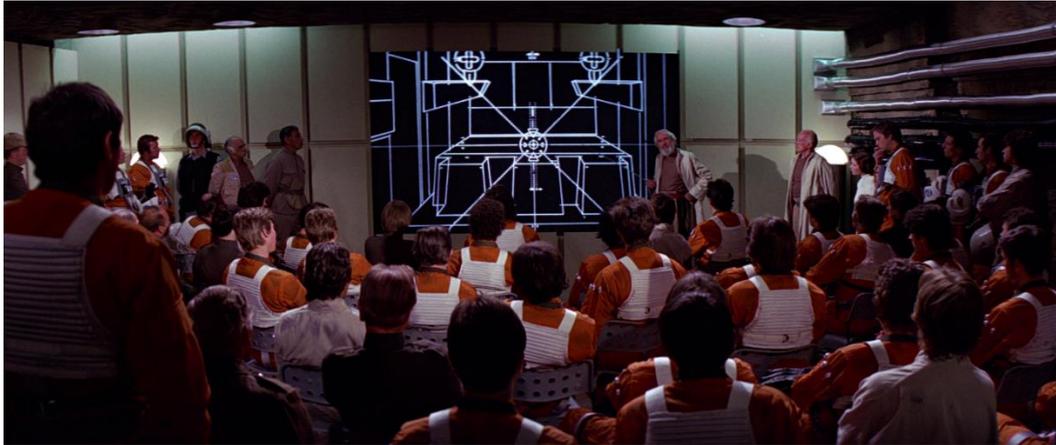
Starting from 1970s, this method has also digitally used to generate motion graphics via digital computers. Development on computer graphics and software technology allowed people create imagery and motion graphics for the media and movie industry. Salmon (2016) indicated this circumstance as;

“CGI became an area of artistic and commercial appeal because of enhanced technology, more people trained on computer animation and imaging, and a larger market. CGI forever changed the ability of television and film to portray images and stories, while bringing attention to the special-effects industry” (Salmon, 2016).

The first movie which had computer-generated imagery was Michael Crichton's "Westworld" in 1973. “A film notable too for being the first major motion picture to

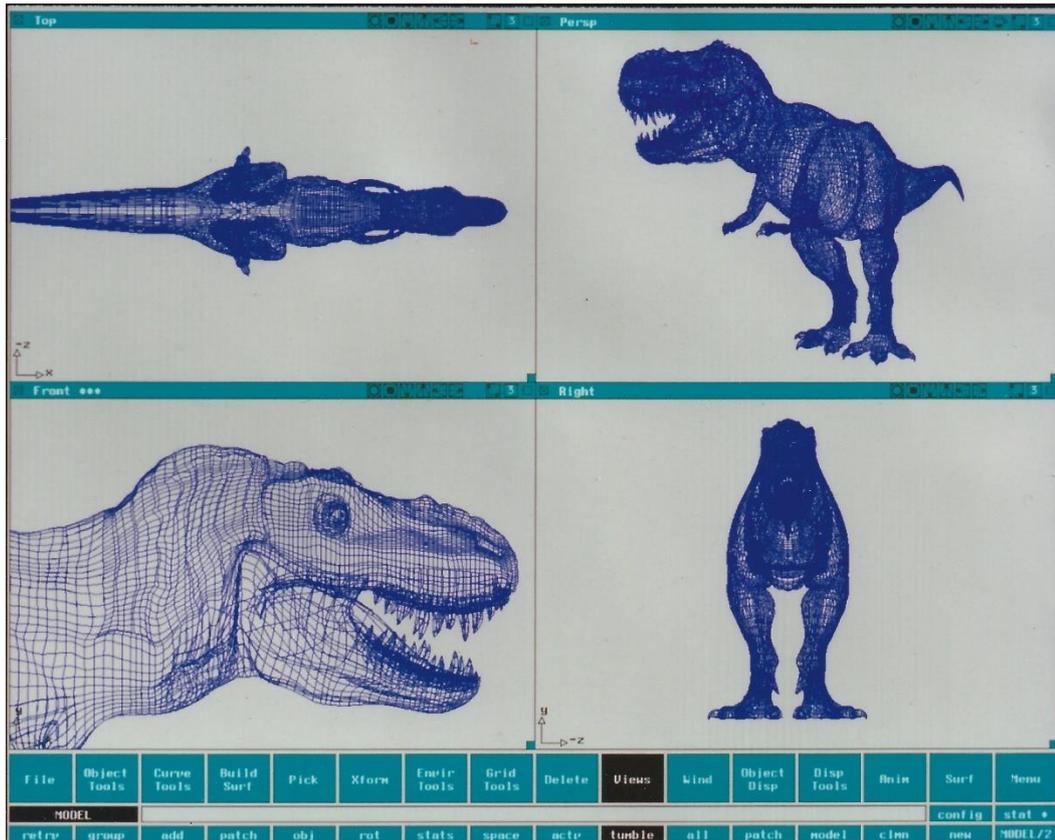
use CGI. Brynner's robo-vision, a pixelated POV digitally processed by computer graphics whizzes John Whitney Jr. and Gary Demos of Information International, Inc. (better known as 'Triple-I' or 'III'), was truly revolutionary" (Salmon, 2016). According to findings, Salmon (2016) said that "Each frame of footage was color-separated and scanned so it could be converted into rectangular blocks, then color was added to make a coarse pixel matrix that could be output back to film" (Salmon, 2016).

A few years later, George Lucas used CGI in 1977's "*Star Wars*" which is a legendary science fiction movie series. The events take places in an unnamed fictional galaxy at an undetermined point in the distant past. Some of the exciting scene which include *Empire's moon-shaped HQ and Rebel Alliance's IT Department* were designed via CGI which carry a well-designed and detailed computer generated design (Figure 8). According to Ntikoudis, Larry Cuba who was born in 1950, Atlanta, Georgia, is computer animation artist and he received a Bachelor of Arts from Washington University in St. Louis and Master's Degree from the California Institute of the Arts. Cuba's personal works were examples of abstract animation which were created from algorithms written in computer language. In the late 1970s, Cuba was hired to provide computer graphics for an upcoming feature film *Star Wars*. His work is mainly seen where an animation of the Death Star is displayed to the pilots of *Rabel Alliance* (Ntikoudis, n.a.).

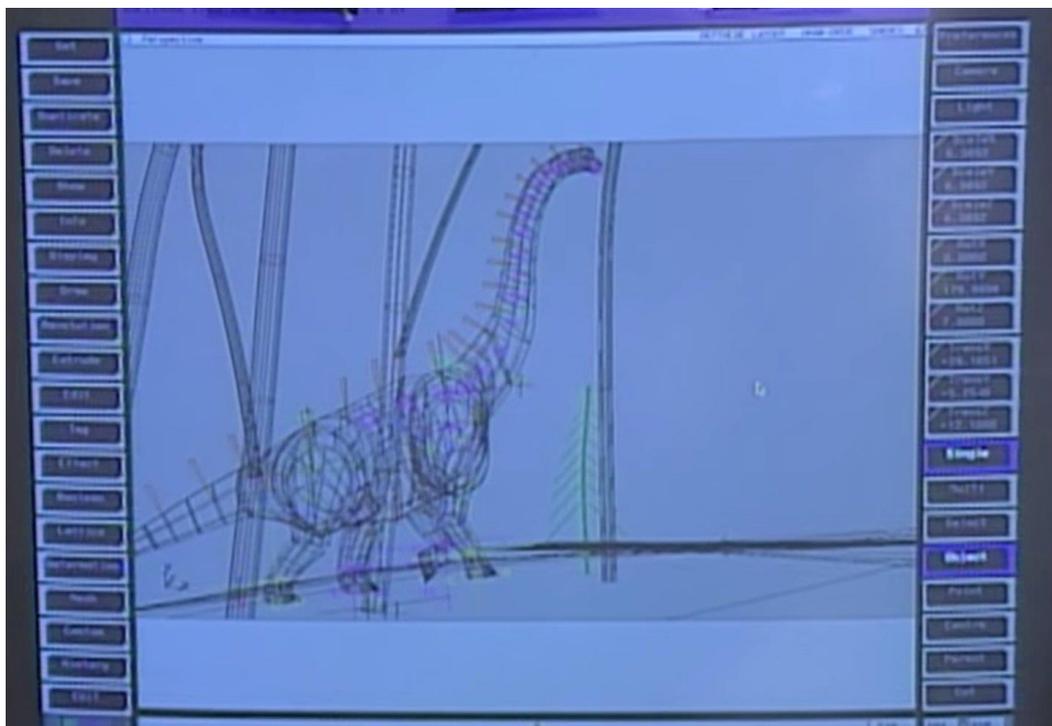


**Fig. 8.** CGI scene from *Star Wars*, by Larry Cuba, 1977

However, according to Acuna (2014), Michael Crichton who raised CGI to the next level and brought popularity to it in his 1993 film, "Jurassic Park". Acuna (2014) explained usage of CGI in Jurassic Park as "the movie used a mix of real actors and CGI to bring dinosaurs to life alongside the actors. There are 14 minutes of dinosaur visual effects in the movie" (Acuna, 2014). In this project, various number of software had been used for different purposes mainly including modelling, animating and texturing. According to Acuna (2014), the dinosaurs' characters designed by the modelling software which is called Alias (Figure 9) and they had also used another software which is called SoftImage 3D in order to give motion to character and integrate it into movie's scenes (Figure 10). They had also used a software to integrate texture into character which make more realistic. Steve Williams who worked in CGI designing process said that "we used a program called Viewpaint, which allowed us to actually paint the texture of the skin in the computer so now we have this textured map" (Acuna, 2014).



**Fig. 9.** CGI Data of dinosaur (T-rex) in Jurassic Park, by Steve Williams



**Fig. 10.** Integration/Placement Process of the Brachiosauruses, by Steve Williams

In 1990s, CGI was highly developed and started to become popular in media industry. The first ever full-length computer generated movie was published by Pixar which is named Toy Story (Salmon, 2016). It can be accepted as milestone in movie industry with the aid of its success in terms of production quality and effort relation. According to Fine (2013) there were a team of animators in number of 27 and writer Peter Docter said about that “If we’d known how small our budget and our crew was” (Fine, 2013). Fine (2013) explained the creation process with numbers as;

“Once the computer models were made, the animators coded each motion control. Woody alone had 723 motion models, with 212 in his face and 58 just for his mouth. Each computer generated shot went through eight teams, and every 8 seconds of footage took around a week to create. The animators created new storyboards with the computer animated characters, then added shading, light and visual effects. The shots were then sent to a "render farm," which used 117 Sun Microsystem computers running 24 hours a day and 300 computer processors. Each frame took anywhere between 45 minutes and 3 hours to render, and the final film took 800,000 machine hours, had 114,240 frames, and 77 minutes of computer animation over 1,561 shots, rendered at 1536x922 pixels.” (Fine, 2013)

According to Semlyen (2010), Bill Reeves, Toy Story’s supervising technical director, looks back on the experience with pride: “To this day, it’s the hardest, most exhausting, and still most fun I’ve ever done at Pixar. We were essentially kick-starting an industry in terms of CG films.” (Semlyen, 2010). There is no doubt that after the success of Toy Story, the computer generated imagery became more accepted by movie industry in terms of technology usage in media.

In the end of 90s and 2000s, CGI continued to get along with its developments and improvements on CGI systems, graphic quality, resolution and photorealistic imaging allowed directors to use computer technology in their production. The main idea started to become the creation and simulation of reality in more controllable

way. Photorealistic characters, scenes, backgrounds and special effects via computer technology became one of main material in media industry. This circumstance gave the power to directors to have total control over what viewers would see. They allowed to create any character, place, motion and more in a realistic or fictional way. Especially, in genre of science fiction and fantasy, many number of movie started to use computer generated imagery in order to create controllable photorealistic scenes and characters.

“In 2001, *Final Fantasy: The Spirits Within* became the first theatrically released feature film to feature photorealistic CGI actors; each of its 141,964 frames took ninety minutes to render, and the final product took 15 terabytes of memory. However, the film, which cost \$150 million to make, was not successful critically or commercially. Peter Jackson's *Lord of the Rings* trilogy was considered noteworthy for its extensive use of CGI for its various fantasy creatures; in 2002, Andy Serkis, who played Gollum in the films, became the first actor nominated for the new Critics' Choice Movie Award for best digital acting performance. It also used artificial intelligence to guide CGI characters in its large-scale battle scenes.” (Solmon, 2016)

Another important movement in computer generated imagery is the usage of motion capture and artificial intelligence. According to Manache's (2011) definition, “motion capture is the process of recording a live motion event and translating it into usable mathematical terms by tracking a number of key points in space over time and combining them to obtain a single three-dimensional (3D) representation of the performance. In brief, it is the technology that enables the process of translating a live performance into a digital performance.” (Manache, 2011, p. 2). Engadget's article which is named as “What You Need to Know about 3D Motion Capture” (2016) indicated the reason behind it as;

“The producers of a game or film want to transmit the complex motion of the performer's body and face to an animated character. Creating digital animation by hand is known as “keyframing” or filling in the movement of character between different keyframe poses over time. To automate that

process, animators looked to motion capture” (“What You Need to Know about 3D Motion Capture”, 2016).

The first movie based on motion capture technology was *Sinbad: Beyond the Veil of Mists* in 2000, however, the most important motion capture product can be accepted as *Avatar* in terms of level of usage technology, and technical and commercial success (Salmon, 2016).

There is no doubt that computer technology has great impact on media industry with the help of computer generated imagery. From my point of view, the computer generated imagery gives chance to directors, designers, animators and creative to create a world beyond imagination. It makes all fictional or realistic scene, character, object, and more available for designing and it blurs the limits between imagination and production.

### **2.3 Computer Generated Imagery in Other Disciplines**

Computer generated imagery has also great contribution to other disciplines like engineering, architecture, industrial design and fine arts including digital sculpturing and digital painting as well as media and movie industry.

Hence media is converted into data, computer generated imagery become useful tool to generate technical drawing. Technical drawing is an act or discipline to communicate visually which is mostly used in engineering, architecture and industry. It can be made manually or by instrument like computer aided design. Computer

aided design which known as CAD provides environment to generate technical drawing largely automated and accelerated by virtue of designed software.

According to definition of technical drawing,

“Technical drawing is essential for communicating ideas in industry and engineering. To make the drawings easier to understand, people use familiar symbols, perspectives, units of measurement, notation systems, visual styles, and page layout. Together, such conventions constitute a visual language and help to ensure that the drawing is unambiguous and relatively easy to understand. Many of the symbols and principles of technical drawing are codified in an international standard called ISO 128.” (“Technical Drawing”, n.d., para.2)

It is clearly to see that technical drawing is universal and designed to make the drawings easier to understand. Nowadays, many number of architects, engineers and industrial designers are using computer software in order to generate technical drawings. For instance, in case of architecture, Autodesk which produces software for architecture, engineering, media and construction have been published a software which is named AutoCAD. According to Softonic’s website, AutoCAD is the industry standard software in computer aided design and it has been defined as “AutoCAD is a complete program for designing buildings, objects and just about anything else that requires precision in 2D or 3D” (Developer Autodesk, I. M., & Team, S. E, n.d.). The software is used across wide range of industries including architects, engineers and designers in order to produce computer based technical drawing.

This circumstance makes the design process easier, accelerated and automated by virtue of standardization, supporting tools in software and versatile working environment. It is also possible to work in across platforms. By virtue of standardization in design process, the project can be used and edited by other

software and even the machines. Nowadays, it is very common that computer generated models can be applied to production via cutting machines like CNC or 3D printers.

Another point is that computer generated imagery has indirect contribution to engineering and industry but it has also direct contribution to some other mediums. There are a certain number of mediums as digital sculpturing and digital painting which were born with discovery of computer generated imagery. The environments that allows to designer to generate 2 and 3 dimensional objects, have been started to be used for artistic production. Although the disciplines like sculpturing and painting are based on physical interaction, computer technology offer digital environment to create sculpture and painting.

Digital sculpturing is based on usage of software to generate 3 dimensional sculptures. With the help of development of technology, computer software can generate photorealistic and hyper realistic models. Generally, digital sculpturing is based on polygons and detailed meshes. The digital sculpturing software like Mudbox offers an environment to produce highly realistic digital sculptures including real like sculpturing tools, lighting tools, and texture tools. Mudbox offers these traditional sculpture tools' and environment's digitalized version (Figure 11).

“The tools available in the traditional sculpture studio are numerous. Wooden modeling tools, metal clean-up tools, rasps, trimming tools, loops, spatulas, and dental tools are used. Each tool comes in various sizes and strengths depending on the density of the clay and the size of the project.” (De la Flor & Mongeon, 2010)



**Fig. 11.** Traditional Sculpting Tools in Different Sizes and Shapes

By virtue of software technology, traditional method of sculpturing has been applied to digital media and the way of creation is digitalized. However, the method has not been changed. The same tools and methods are still using in digital way. According to De la Flor and Mongeon (2010) Mudbox’s sculpturing tools explained as;

“Mudbox has many of the same tools found in the traditional sculpture studio. These tools can be customized by adjusting their properties such as size, strength, and falloff to create a myriad of tools that do different tasks.” (De la Flor & Mongeon, 2010)

Another issue is explained by De la Flor & Mongeon (2010) that “A sculpture studio is equipped with movable lights that allow the sculptor to light the sculpture and subject in different ways to study forms, shadows, and details. Often, the look and feel of a sculpture changes with different lighting” (De la Flor & Mongeon, 2010). This circumstance is also provided in digital sculpture environments as Mudbox. It is possible to add lighting with the help of lighting tools. According to De la Flor and Mongeon (2010) “In Mudbox, the lighting is also very important. Using the default

light or lighting presets in Mudbox accomplishes the same goals as the real studio lights. In fact, in Mudbox, you can add as many digital lights as you want and move them around as needed.” (De la Flor & Mongeon, 2010). Digital sculpturing is an expressive example of usage of computer generated imagery in artistic production which offers cyber environment to simulate art work production process with digital tools and the software.

There is no doubt that computer generated imagery is nested with many disciplines including engineering, architecture, fine arts and media. This list can be extended with more disciplines including industrial design, anatomical modelling, and game design. The main idea behind computer generated imagery is based on shifting media into data. Data can be used in order to produce static imageries, motion graphics, 3D models, technical drawings, and also interactive media. Nowadays, computer generated imagery greatly contributes to images visual production.

## **CHAPTER 3**

### **ALTERNATIVE WAY OF VISUAL CREATION: GENERATIVE AND LIVE CODING**

There is no doubt that computer generated imagery is a great development in terms of technology since Bell Labs' first discovery. The way and method of generating computer graphics always developed and changed. The story started with analog computers. According to Greenberg, analog signals, and algorithms had been used to generate visuals for the first time (Greenberg, 2007, 14). After a while, digital computer had been developed and pioneer computer generated images are created by coding and plotted on 35-mm film by microfilm plotter (Noll, 2016). After development of computer technology and computer graphics, the graphical user interface has been started to use in personal computers, and it can be accepted as today's modern computers. Software which were designed for image processing, modelling, texturing and matte painting have started to be developed in order to create environment for designer, artist and creatives to work. After a while, 3D computer animation and imaging technology has been developed and the way and method of creation of computer generated imagery was developed and extended (Salmon, 2016).

However, it should be clear that the main workflow has never changed. Computers work with signals to communicate between hardware and software which are based on “on and off” in binary “1 and 0”. This system is called as binary code or machine code. The most developed image processing software also needs to translate any action into binary code, and combination of these codes make computer operate. Therefore, when designer, artist, or other creatives create computer generated imagery via any software or application, actually, they create a binary code. Graphical user interfaces of software do not give any information about the things happening in the background, but technically, there are just a number of 1 and 0.

Clearly, coding can be a way to visual expression and artist, designer and other creatives can use scientific data, mathematical formulas, algorithms and functions in order to create visual art. The method of generative and live coding which is developed for mainly audio and visual artistic purposes has been used as an alternative way of visual creation.

### **3.1 Aesthetics & Computation**

It has always been a controversial issue that art and science could be integrated. At the early ages of computer programming, coding had been accepted as too technical to use in art works and ignored by artists and designers to use it (Salmon, 2016). However, from the ancient ages, it is easy to see that mathematics, geometry, and analytical systems had a great importance to create aesthetic beauty.

Greenberg (2007) explained the term computation, according to [www.dictionary.com](http://www.dictionary.com), it is “the procedure of calculating; determining something by mathematical or logical methods.” (Greenberg, 2007). Obviously, a lot of artists, designers, architects are using mathematical and logical methods in their works. Many number of concepts exists in both art and science including line, form, scale, proportion and more which makes them naturally overlap. Bernstein and Lee (2011) defines the similar concepts and terms in art and science.

“We know that line, shape, form, pattern, symmetry, scale, and proportion are the building blocks of both art and math. Geometry offers the most obvious connection between the two disciplines. Both art and math involve drawing and the use of shapes and forms, as well as an understanding of spatial concepts, two and three dimensions, measurement, estimation, and pattern. Many of these concepts are evident in an artwork’s composition, how the artist uses the elements of art and applies the principles of design. Problem-solving skills such as visualization and spatial reasoning are also important for artists and professionals in math, science, and technology.” (Bernstein and Lee, 2011)

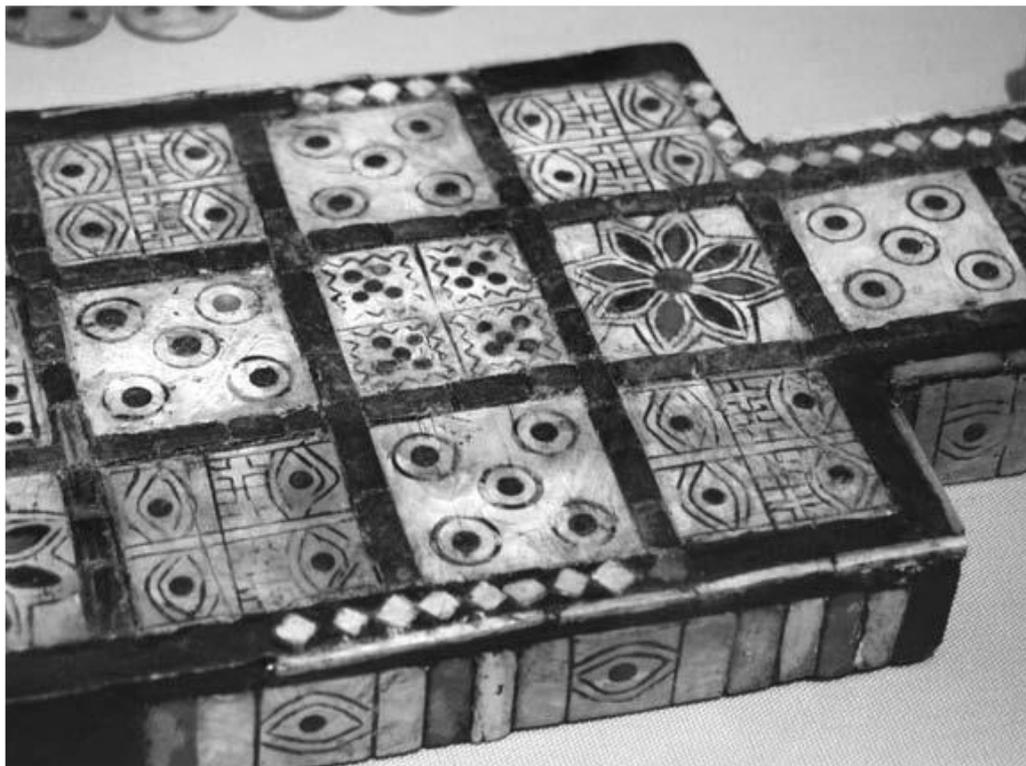
In addition to this relation, according to lecture by Robert Eskridge, science and art had defined as naturally overlapped. He defined the relation between art and science as;

“Science and art naturally overlap. Both are a means of investigation. Both involve ideas, theories, and hypotheses that are tested in places where mind and hand come together—the laboratory and studio. Artists, like scientists, study—materials, people, culture, history, religion, mythology— and learn to transform information into something else. In ancient Greece, the word for art was *techne*, from which *technique* and *technology* are derived—terms that are aptly applied to both scientific and artistic practices” (Eskridge, n.d.).

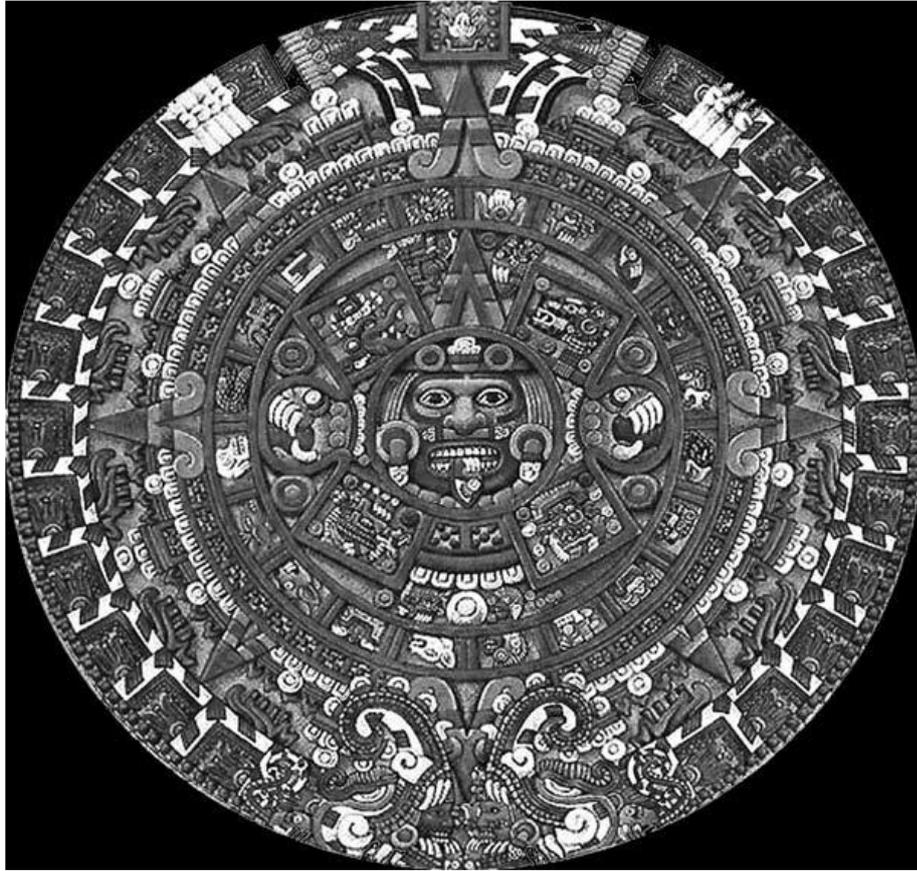
This relation had been discovered in the ancient ages (Figure 12-15). According to Greenberg (2007), in Ancient Egypt, they have built the Great Pyramids with using mathematical calculations. Phidias was Greek sculptor and mathematician applied phi to the design of sculptures for the Parthenon. In ancient Greek, there was a period

between 900 and 700 BC which is named Geometric Period including that art form contained representation and repetitions of shapes rather than the more realistic work of the earlier periods (Greenberg, 2007). Greenberg (2007) explained the usage of computation in ancient times as;

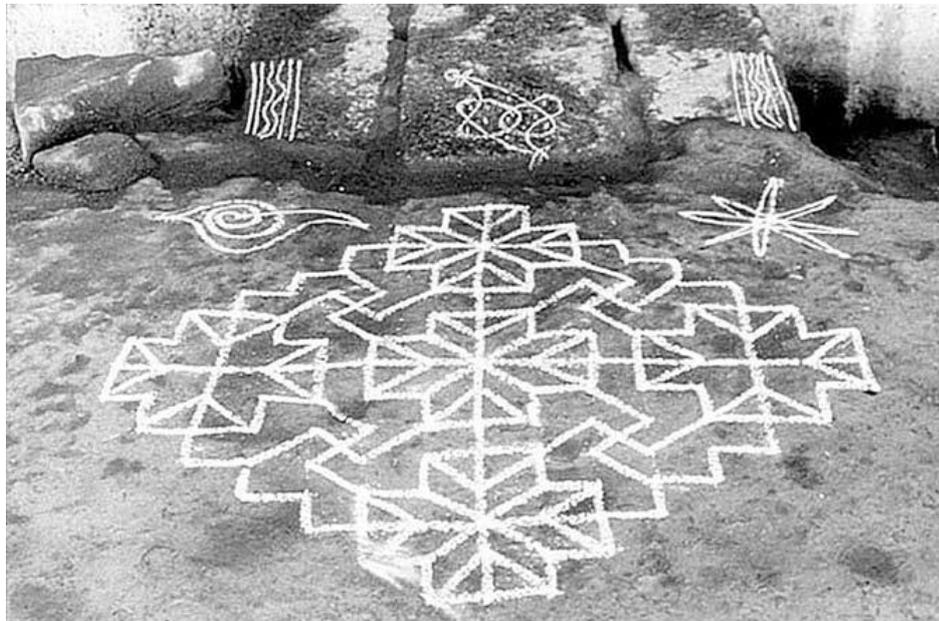
“Early astrological and calendar systems, across many cultures, combined observed empirical data with richly expressive, mythological narratives as a way of interpreting and ultimately preserving and disseminating the data. Weavings, textiles, engravings, mandalas, and graphs from cultures around the world employ complex algorithmic patterns based upon mathematical principles, yet most often are not developed by mathematicians. Rather, these developments seem to reflect a universal human impulse to integrate right-brain and left-brain activities, combining qualitative notions of aesthetic beauty with analytical systems for structuring visual data.” (Greenberg, 2007).



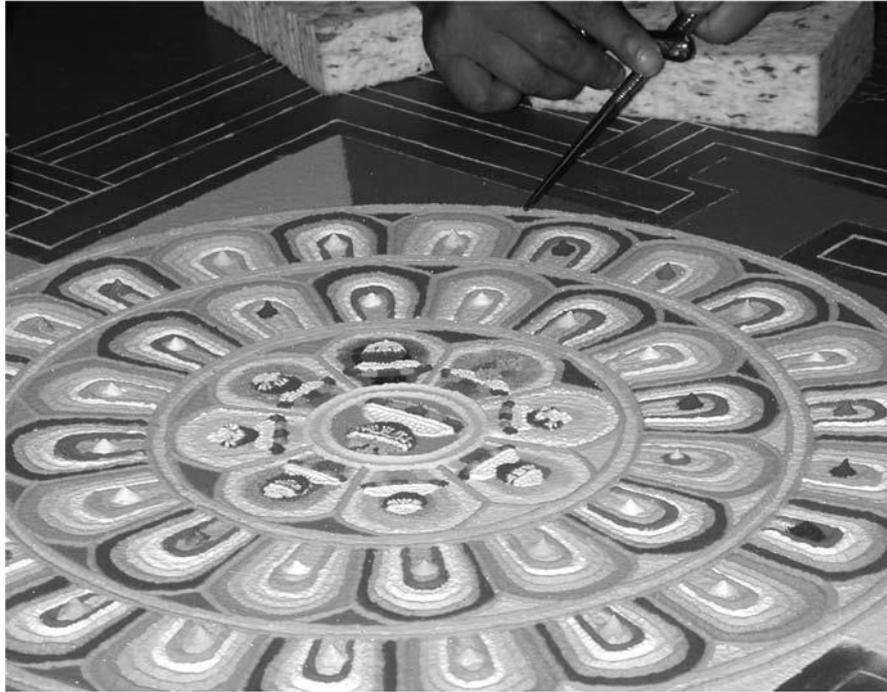
**Fig. 12.** Ur game board, 2600 BC.



**Fig. 13.** Replica of Aztec Stone of the Sun



**Fig. 14.** Ancient art of Kolam, Southern India, 1970s



**Fig. 15.** A Temporary “Sand Mandala”, Kitzbühel City Hall, Austria

Golden ratio is one of expressive example of aesthetics and computation working together. It is a mathematical divine proportion which can be used for create aesthetic and balance in design. Hom (2013) defined golden ratio as;

“Golden ratio is a divine proportion which is a special number by dividing a line into two part that the longer part divided by the longer part divided by the smaller part is also equal to the whole length divided by the longer part. Its equitation form is defined as  $a/b = (a+b)/a = 1.6180339887498948420$ ” (Hom, 2013).

It has been used in multiple disciplines containing painting, sculpture and architecture since the ancient times. Hom (2013) explained the usage of golden ratio in the ancient architecture as;

“Historically, the number can be seen in the architecture of many ancient creations, like the Great Pyramids and the Parthenon. In the Great Pyramid of Giza, the length of each side of the base is 756 feet with a height of 481 feet. The ratio of the base to the height is roughly 1.5717, which is close to the Golden ratio.” (Hom, 2013)

Luca Pacioli published a book that refers to the number as the *Divine Proportion* in 1509. Da Vinci later called this *sectio aurea* or the Golden section (Hom, 2013).

Hom (2013) claims that “the Golden ratio was used to achieve balance and beauty in many Renaissance paintings and sculptures.” (Hom, 2013). According to Hom (2013), some known example about golden ratio are Leonardo da Vinci’s Vitruvian Man and Mona Lisa. Michelangelo, Raphael, and Rembrandt had also used golden ration in their works (Hom, 2013). These examples show the importance of science on visual creations and art with blurring the border between them, especially, after Renaissance Period. Greenberg (2007) had been explained the Renaissance movement in terms of art and science relations as;

“Renaissance biographer Giorgio Vasari tells us that the Florentine architect Filippo Brunelleschi (1337–1446) took up painting to apply his newly developed theory of perspective, based upon Greek geometry. Additionally, other major Renaissance painters including Piero della Francesca, Albrecht Dürer, and Leonardo da Vinci not only experimented and applied principles of geometry in their work, but published treatises on mathematics. Dürer even developed several drawing machines that could be used to teach perspective. Especially during the European Renaissance, the division separating art and science blurred to the point that many of its greatest practitioners made nearly equal contributions to each.” (Greenberg, 2007).

However, the biggest movement on science and technology integration happened after development on computer technology. As Salmon said that “Technological development and computer technology had great impact on usage of computation in art works. During the 1970’s and 1980’s, computer technology became more practical and useful. The 1970’s saw a transformation of the technology and a lowering of the cost, so 3-D computer animation and imaging technology greatly progressed” (Salmon, 2016). After this process, designers and artists accept computer technology as useful and accessible tool. Many number of image processing,

modelling and visual generative software developed, and artists, designers, architects and more have started to use computer technology as fundamental tool in art works.

The name of chapter which is named as “Aesthetics + Computation” is the name of the now famous research group at MIT’s Media Lab, where Casey Reas and Ben Fry, the creators of the Processing programming language, worked as grad students under John Maeda (Greenberg, 2007). They aimed to create a cyber-canvas in order to allow designer and artist to create artwork with using science and technology.

Mathematical formulas, logical operations, algorithms and data can create complex and well-designed art works which also allow artist to create their own featured software with the help of software development environment.

Recently, a huge number of software are developed in order to contribute to visual arts with the same reason with MIT’s Media Lab. For instance, Adobe is one of the leading software company which produce media and graphic software (Adobe, n.d.). Adobe Photoshop is one of image processing software which can be used to create concept art, texturing and matte painting. Adobe After Effects is designed for the motion graphic and compositing where people use to create videos. In addition to this point, Maya, 3D Studio Max and Houdini are mainstream modelling and animation software which allow user to work in 3 dimensional space (Top 15 Applications for 3D Artists, n.d.). The list of media and graphic software, methods and reasons could be varied but the common point for all media and graphic software is that this software can create computer generated imagery which is called as CGI.

## 3.2 Coding Culture

In order to understand how software works and allows users to create art work, it is important to see through the code work and concepts in it. Coding is the computer language used to develop apps, website and software (Retrieved April, 2017, from <http://www.computersciencedegreehub.com/faq/what-is-coding/>). Basically, computer needs to communicate with hardware and software and it works based on signal. Therefore, they designed computer language structure based on “on and off” which means as in digits 1 and 0. It is known as binary code or machine code. The combination of these codes make computer work. However, it is impossible to write statements based on binary code because of the complexity. For example, letter of “a” is equal to “01100001” in binary code system (Retrieved April, 2017, from <http://www.computersciencedegreehub.com/faq/what-is-coding/>). When we compare how hard to write single character, it looks impossible to give command which include complex statements and calculations. In order to solve this problem, programming languages are formed to translate designed commands into binary code.

“To put it very simply, the code is what tells your computer what to do. To go a bit deeper, computers don’t understand words. They only understand the concepts of on and off. The capabilities of a computer are guided by on and off switches or transistors. Binary code represents these on and off transistors as the digits 1 and 0. An infinite number of combinations of these codes make your computer work. In order to make binary code manageable, computer programming languages were formed. These languages each serve different purposes, but they all allow programmers to translate important commands into binary code.” (Retrieved April, 2017, from <http://www.computersciencedegreehub.com/faq/what-is-coding/>)

Operating systems can be accepted as the core level of software in computers which can communicate with hardware, and other software need to communicate with operating system. When user give a single command in a software, software transfer this to the operating system, operating system gets in touch with hardware like CPU (Processor), then the command is applied, operating system makes contact back with software again, and software gives response. The important point is that this chain of reaction happens in excessively short time by virtue of the development on computer technology, many number of computer users cannot realize how big actions are taking place in the backstage.

There are a huge number of programming language which are used for different purposes. More than 8,500 programming languages have been created and used since Grace Hopper's A-0 compiler (Bergin, 2007). According to Code Conquest website, the oldest language, which can be accepted as father of programming language is C. C has been developed in 1972, and still one of the most frequently used language in programming. C is compiled language and the lowest level of programming languages. It is also using for different area and platforms, Including Microsoft Windows (Code Conquest, n.d.). Java is another popular programming language which is developed by Oracle Corporation in 1995. Its importance that it had been designed for cross-platforms compatibility (Code Conquest, n.d.). Therefore, it is fair to say that many number of software and application web to desktop are designed in Java. SQL which means Structured Query Language is used to communicate with database since 1974 (Retrieved April, 2017, from <http://www.codeconquest.com/what-is-coding/common-programming-languages/>). With the help of this method, software, websites and applications can communicate

with database including creating, reading, updating and deleting the data in database. PHP, HTML and JavaScript are designed for web based applications and websites. There are some other programming languages that have been developed for different purposes as it seen above. The list can be increased with Visual Basic, C++, Ruby and Python.

In order to understand programming, a certain number of concepts should be clear to show how it works as algorithm, variable and library. Algorithm is a common term in coding which means flow and order of actions (Greenberg, 2007, 40). There is no difference then real live action. For instance, if you want to make a coffee, you need to pursue a certain number of actions and you need to make it with correct order. It can be imagined that your statements in code can be accepted as actions which you need to take in order to make coffee, and the algorithm can be accepted as order of this actions. If you put water before it boils, probably, it won't be a good coffee.

The logic behind algorithm is so simple: computers are not smart as that people think. There is no computer can understand anything without human interaction. Developers need to program each step and action with correct order in order to get meaningful feedback from computer. Greenberg have explained the circumstance with following explanation:

“Computers are inherently dumb machines. They are super-quick at processing data and have awesome memories, but they have no innate intelligence. For example, if I asked a computer to hold a 1,000-pound weight over its head (just assume computers have arms), it would eventually destroy itself by dropping the weight on its head when its arms gave out. Why? Because computers are perfect literalists; they do only and exactly as they are told, without any assumption, reflection, or self-awareness.” (Greenberg, 2007).

Therefore, when software developer develops a software, they have to consider the order of action which is called as algorithm. It is also accepted at first step of programming and generally, algorithms are designed before starting coding.

There is another very common programming structure called a variable. According to Greenberg (2007), “a variable is simply a location in memory that will hold a piece of data” (Greenberg, 2007, 65). For instance, `myColor = “Red”` is a simple usage of variable. `myColor` is a name of variable and a value can be assigned to it. In this example, Red is assigned to variable which is named `myColor`, and when developer calls `myColor` it turns as Red. This assignment can be made directly as in the sample, or it can come from another functions or calculations. On the other hand, it can be assigned by user’s input like asking user to enter a value to it. This usage in assigning variable makes the program dynamic with human interaction. There are also some input devices like midi controller or keyboard can be assigned into the variable’s value and user can change the values with the help of these devices. This method allows to user interact with computer in real time and make software responsively dynamic.

Library in computing work similar with its meaning. Library is a collection of pre-defined resources which is used by computer programs, often to develop software. This may include configuration data, documentation, help data, message templates, pre-written code and subroutines, classes, values or type specifications. The idea behind the need of libraries in coding, is making coding easier and fast with sharing most needed actions, structures and functions. For instance, if we are expecting computer do not know anything without instructions, it is impossible to

read data from the file. Because it requires, a certain number of steps. First of all, file need to be opened, then first line need to be read and keep it in memory, if the line ends, the same action needs to be made until all lines finish. The program carries it out with using a structure and a flow to get manageable data, for example, keeping each line in different variable. There is no doubt that a certain number of steps need to be designed in order to make basic action and it is so unnecessary to write code for these steps. Therefore, libraries have been designed to solve this problem, developer can import a library according to their needs, and they can use information in this libraries. The example shows that how getting input from the file is easy in Python (10.2. fileinput — Iterate over lines from multiple input streams., n.d.). Developer can write “import” and the name of library, and then they can access the library’s source code in their program. After that, they can call functions, variables, classes, and more from libraries which make coding easy, fast and manageable.

```
import fileinput
for line in fileinput.input():
    process(line)
```

**Fig. 16.** File Input Library in Python

There are a huge number of libraries developed for different programming languages, and for different purposes including object and class libraries, remote libraries, and code generation libraries. However, many number of libraries are used commonly and there is no need to import libraries for each program. Therefore, shared libraries have started to use in order to save space from memory. For instance, operating systems as Windows, load the major frameworks and its libraries when the

computer turn on, and software get data from these applications when they need. For example, when you buy a brand new computer and try to watch a video from Youtube, there would be error message and browser would ask you to firstly install *Java Runtime Environment*. The reason behind this circumstance can be explained by usage of shared library. Java is one of fundamental framework and it needs to be installed in order to run Java based application, website and software because it should give required information and libraries. I also would like to mention that when the source code of program is bigger, it may take more time to give response which make computer slow while working. This method also offers better performance in memory allocation and make computer faster.

Libraries are important because libraries can be designed, shared and used by anyone and there are certain number of developer groups who develop libraries for specific aims including animation, data usage, GUI (graphical user interface), geometry, hardware management, sound, video and more. People can import these external libraries in order to develop their program with new functionalities. It is also called as third party libraries. Especially, for coder, designer and artist who has limited coding background, they can easily produce well designed, complex works with the aid of usage of these supporting libraries.

The software which allows to user write and develop their works called as frameworks. Frameworks which bring different components to develop project can include support programs, compilers, code library, tool sets and more. There are a certain number of frameworks have been developed for different purposes. For example, Visual Basic by Microsoft is one of the mainstream framework which

allow user to create project with graphical user interface. Processing is another framework which is designed for creatives including designer, artist and musicians. We can count more examples but the reason behind why there are many number frameworks can be explained by usage purpose and competence. Therefore, it is important to use logical framework in terms of usage purpose. In case of artistic coding, it would be really hard to develop project without necessary libraries and functions which are normally provided by programming framework.

### **3.3 Creative Coding**

Creative coding is an intersection between art and programming which allow creatives to express themselves via coding. The common important point in creative coding frameworks is that these coding platforms are created for artist and musicians with little or no programming background. It is really quick to be up, running and creating. The platforms' features and libraries are designed in order to create something expressive instead of something functional. This method is used to create live visuals by VJs, as well as creating visual art and design, art installation, video projection mapping, sound art, advertising, and product prototypes. *Processing*, *OpenFrameworks* and *Cinder* are the well-known creative coding frameworks. There are also frameworks which has visual interface in order to build source code visually, called as *Max MSP* and *TouchDesigner*. Visual coding platforms allow the designer create their work without writing code with the help of the creating relation with drag and drop method which is more understandable and easy way to develop source

code. The common point is, the aim of these frameworks is making coding more easy and efficient.

The programming language which is used in generative coding could be different. For instance, *Processing* is a framework that build in object oriented Java programming language, but *OpenFrameworks* and *Cinder* have been built on C++ programming language. Designers who use *Processing* in order to create art work, need to write their code Java language. The fundamental logic is in this circumstance is usage of common programming languages. These frameworks could create their own programming languages; syntax and structure but it is meaningless to learn specific language for each platform. Therefore, when software developer creates the frameworks like *Processing* and *OpenFrameworks*, they prefer one of the common programming language like Java, C, and C++ considering its benefits and capacity and build the framework into top on it.

The third party libraries which can be manually appended able libraries for different purposes, allow user to expend the frameworks' talent. For example, in *Processing*, Microsoft's motion sensor which is named *Kinect* can be used as input devices in order to get some real time data. However, in default library in *Processing*, user cannot connect the devices like *Kinect* because the framework has no information about how to manage *Kinect's* data. Therefore, user need to import a *Processing Kinect Library* into their source code, and then the program has information about *Kinect's* variable and structure. People who develop these kind of software could add all libraries and packages at the beginning, but it makes the code more ungainly and over complicated. Therefore, they allow users to add or create third party libraries

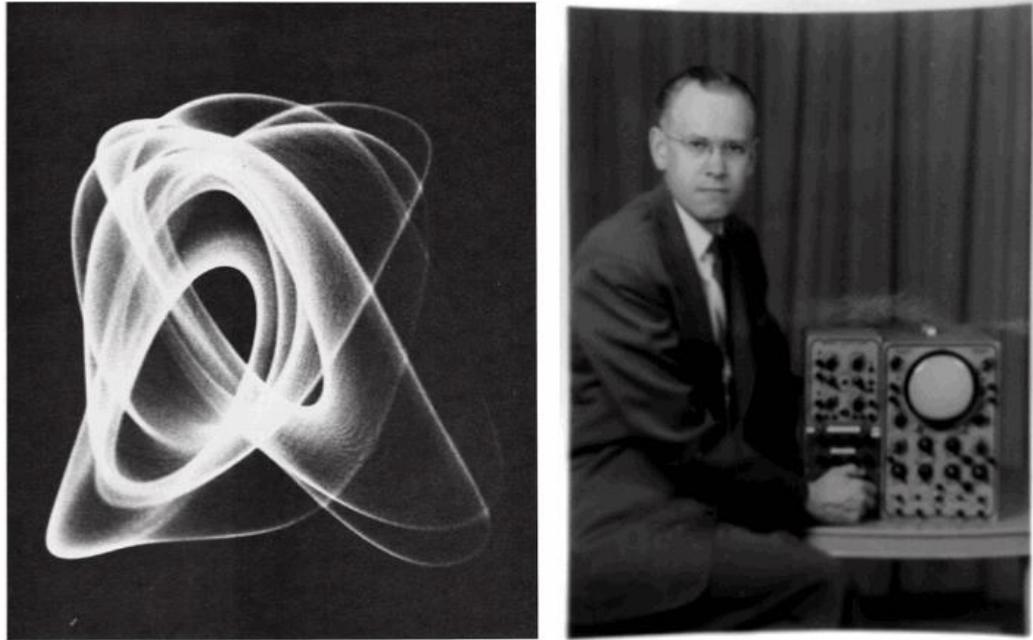
when they need. There are many third party libraries designed for different purposes including visual style, motion tracking, sound analyzing, gesture recognizing and etc.

### **3.3.1 Code Artists**

According to Greenberg (2007), after development of computer technology and computer graphics, many number of artist and designer have used coding in order to create artwork and the term code artist was born and these people apply computation and technology to their creative practice in a formally rigorous way, utilizing code and algorithmic approaches (Greenberg, 2007). It has been started from discovery of analog computer and signal processing and in today's world, a certain number of artist use code and algorithm to generate art.

#### **Ben Laposky, 1914–2000**

Benjamin Francis Laposky was mathematician and artist who was born in Iowa, USA, in 1914. According to Greenberg (2007), his famous work which is named as “oscillons” was a pioneer computer generated art work via using analog computer. Greenberg (2007) indicated that he created an image of mathematical curves which based on the basic waveforms utilized in analog computer as the creation medium for abstract art. (Greenberg, 2007, 15).

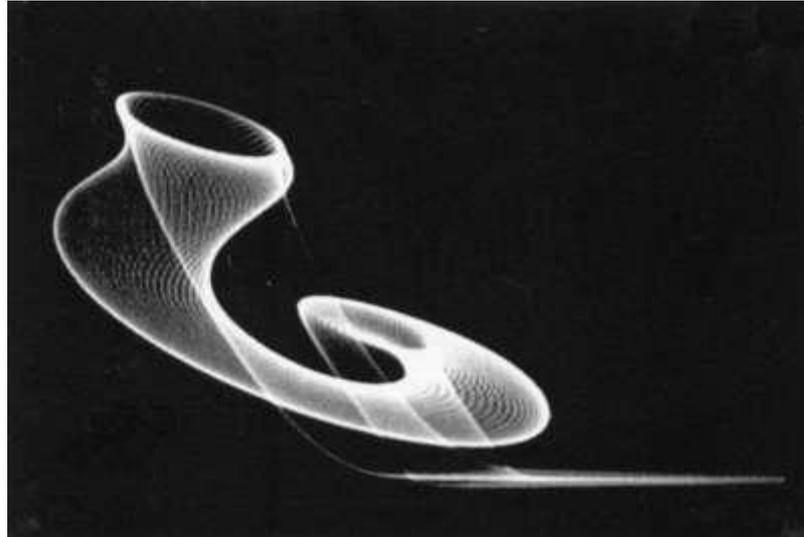


**Fig. 17.** *Oscillons* via Analog Computer, by Ben Laposky, 1953.

### **Herbert W. Franke, b.1927**

Herbert Franke was born in Vienna, Austria in 1927. He is scientist and writer, but, he is also very active in fields of future research, speleology, as well as computer graphics and digital art. He worked about experimental aesthetics and usage of mathematical rules on visual creation. According to Greenberg (2007), his works can be accepted as algorithmic animation. He is also a co-founder of one the biggest electronic art festival which is named as *Ars Electronica Festival*. He released a book which is named as *Animation with Mathematica* in 2002. (Greenberg, 2007)

*Analoggraphik* is one of the well know work by Herbert Franke. He used oscilloscope and camera in order to generate visual patterns in 1960s. These group of lines had been created via electrical signals by oscilloscope.



**Fig. 18.** *Analoggraphik*, by Herbert Franke, in between 1961, 1962.

### **Ben Fry, b. 1975**

Benjamin Fry is American data visualization expert and also co-developer of Processing and his works deal with visualizing large data sets, mainly the human genome (Greenberg, 2007, 22). He also worked about developing tools for the visualization of scientific data including human genome. He aimed to developed a visual way understand large set of data which can be called as data visualization.

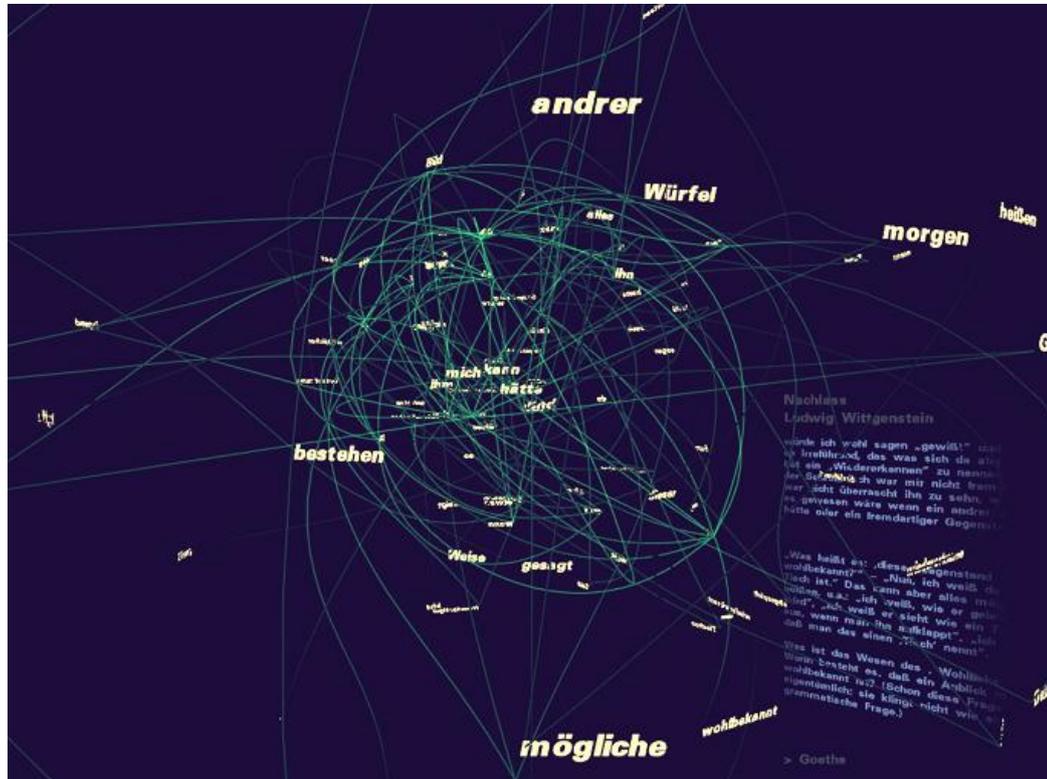
According to Greenberg (2007),

“His personal work also deals with visualization. For example, his well-known and visually engaging piece *Valence* (Figure 19) is custom software he wrote about building representations that explore the structures and relationships inside very large sets of information.” (Greenberg, 2007, 22).

His works are important because data visualization could be a way to understand some deeper content, to see big image, or make specific analyzes via visual perspective. In his PhD, he called this method as Computational Information Design.

Greenberg (2007) indicated that;

“On the online title page of his PhD dissertation, he proposes, “To gain better understanding of data, fields such as information visualization, data mining and graphic design be brought together as part of a singular process titled Computational Information Design.”” (Greenberg, 2007, 22).



**Fig. 19.** *Valence Information Visualization*, by Ben Fry, 2002.

### 3.4 Live Coding

Live coding is a simply running code and changing parameters in prewritten code in real time. It is accepted as a performing art form and a creativity technique.

According to Thor Magnusson: “As an arts practice, it has its roots in musical performance, but live coding has become common in visual arts, light systems, robotics, dance, poetry, and other art forms that operate with algorithmic instructions.

Live coding can exist with only manipulating parameters in real time, or modification algorithms during the execution of the program.” (Magnusson, n.d.).

Live coding can be accepted as very useful methods in audio visual work and interactive audio visual art installations generally use live coding method in order to get data by human interaction and give immediate audio or visual response. Input devices like motion sensor, camera, and microphone can provide data and live coding platforms can use these data in real time. In example of VJ practice, in some cases, VJs have to use the audio in order to synchronize the music and the visuals. Some of visual artists use motion sensors in order to understand visitor's placement and motion, and generate their visual or audio work considering this information.

This method would be called as experimental because audio or visual work with live coding gives different responses in each experience. In otherwise, it can be designed totally controllable. Magnusson said that "This is arguably a prerequisite of live coding, as simply running code and changing parameters in prewritten code is more comparable to operating buttons, sliders, and knobs on a screen interface or a MIDI controller" (Magnusson, n.d.). This circumstance allows that creatives would create their own experience in coding via limiting or enhancing interaction level and method.

In live coding history, pioneers of live coding can be listed as Ron Kuivila, and Alex McLean. According to information from Key (2001), Ron Kuivila is an American sound artist who is mainly known for his sound installations which are used live coding systems in his works. He is a contributor to *SuperCollider* audio programming language which is for real time audio synthesis, algorithmic composition (Key, 2001). Alex McLean who is British composer and researcher has

great contribution in developing live coding as a musical practice including for creating *TidalCycles* which is a live coding environment to express music with generating patterns (Retrieved April, 2017, from <https://tidalcycles.org/>). Thor Magnusson, Andrew Sorensen, Matthew Yee-King, Nick Collins are also notable live coder.

There are also many number of live coding environment including Max MSP, *TouchDesigner*, *LiveCode*, and *Fluxus*. In today's technological background in coding, all computer programs could be dynamic by getting data input and allows user to manipulate source code in real time which is completely similar with logic behind live coding. The important point is that the platforms must know how to manage with these data. These environments which are listed above have been designed to cover audio and visual artists' needs including device and data management. For example, *TouchDesigner* gives native support to provide data via input devices including *Kinect 2*, *Leap Motion*, *Realsense* and *TUIO* and other touch screen protocols (Retrieved April, 2017, from <https://www.derivative.ca/088/FeaturesToLove/default.asp>).

Considering these reasons, live coding environments can create meaningful data to use the necessary parameters and variable in order to change and play, and offer an alternative method to create audio and visual art. There is no doubt that this circumstance extends visual creation methods and interaction level of the media. Although, this circumstance looks related with production process, this method is also useful for audience engagement. It is very possible to apply live coding method to contribute interactive art installations where audiences have a participatory role.

## CHAPTER 4

### VJ PERFORMANCE

#### 4.1. Introduction

According to Taylor et al. (2009), “VJing is a form of live video performance art, often undertaken with DJs and musicians to create a visual backdrop within nightclubs and other music events” (Taylor, Izadi, Kirk et al., 2009). Xarene Eskandar has defined that “characteristics of VJing are the creation or manipulation of imagery in real time through technological mediation and for an audience, in synchronization to music” (Eskandar, 2006). The term of VJing which means Video Jockeying, is the manipulation and selection of visuals, quite similar to DJing which is selection and manipulation of music. People who make real time visual performance during musical performance is called as VJ.

Usage of music and visuals together is nothing new. For many years, the idea of creating music for eyes and dancing images made people fascinated. Early example of creating music for eyes can be accepted as *Ocular Harpsichord* by Louis Bertrant Castel. According to ImageryInstruments.org, Castel designed a color organ which

was a mechanical device to represent sound visually. Organ's each note assigned to a color from rainbow which number in 7, and when organ player pressed the keys, it mechanically turned to visual representation of live music (Retrieved May, 2017, from <http://imaginaryinstruments.org/ocular-harpsichord/>).

There is no doubt that music and visual relation always exists but the big improvement on representation sound visually happened during 1960s and 1970s thanks that computer and media technology has been developed, the devices which was designed for editing, manipulating and recording a video started to used. However, development on video synthesis and processing technology has biggest impact on VJing history because VJ practice is based on two basic techniques which are sampling and synthesis. In these ages, video equipment had been developed that moving images could be sampled, manipulated and played back live in early '60s. Hardware such as Sony's 1965 VideoPortapak became more accessible and allowed user to make real time controllable experiments on motion graphics. This circumstance allowed people to have real time control on visual material, and in case of music, now it is possible for us to watch the movements of music while it's playing.

Before the term of Vjing, nightclubs and other music events also used visual materials as lights during musical performance. According to Crevits (2006), "the history of VJs had started in clubs in New York and San Francisco in 1970's to refer to a person using video, film projections and lights to accompany a DJ' music sets" (Crevits, 2006). Clubs are place to where people listen music, dance and drink. First aim of clubs is entertainment where participant can escape from their ordinary life,

release bottled-up feelings and enjoy a sense of freedom. People enjoy the feeling of isolation from daily life and sense of togetherness in a trance. There is no doubt that a club which is well developed in terms of visual entertainment system as lighting can fulfil requirements of clubbers and give opportunity for them to feel more isolated from daily life. By aid of development on media devices technology, video projectors, screens, and controllable lights have been started to be used during musical performance, many number of musicians and DJ's started to work with VJs in order to support their musical performance with visual performance. Especially, clubs started to give attention to visual entertainment, and in European cities like Berlin and Amsterdam, VJ culture was born.

There is an interesting point that in 1980s, VJs introduced video clips on MTV, and the term of VJ and VJing started to become popular with the help of MTV. However, after a while, the term of VJ had associated with "presenters" in television channel and lost its meaning a little bit. Unfortunately, many number of people know that VJ means a presenter who present a music video.

#### **4.2. Elements of VJing: Content, Process, and Output**

VJing need to be analyzed and divided into 3 layers including content, process and output which forms the pipeline and main work flow of VJ performance. Each step carries fundamental elements of VJing and it is not possible to ignore any of these steps in VJ performance.

#### **4.2.1. Content**

VJing is a process which includes fundamental steps. First of all, VJs need visual material in order to use in live visual performance. In terms of concept of visual material, Marina Turco indicated that “a VJ set always works at different levels: it can be challenging for our structure of perception, trigger deep emotional reactions, or functions as superficial vortex of eye prickles and visual candies. Some sets transmit ideological or political messages; others just pimp the club with a cool look.” (Turco, 2014, 8). These visual material forms could be short movies, video loops, computer generated imageries, pictures, live streams from input devices and more. There is no limit in the usage of visual material, if the VJ software or analog device support the file format. However, a certain types of visuals are preferred to be used by VJs including video loops, real time computer generated imageries and conceptual videos.

The most frequently used visual material type for VJing can be accepted as VJ loops. Loops means that the video generally starts and ends with the same frame which gives an effect of eternity without any interruption. When the loop video ends and starts from the beginning, viewer can not realize repetition by virtue of logic of looping. It makes never ending feeling. VJ Loops could be more useful than other videos because these loops are more controllable in live performance. Videos like short movies or animations without looping could be used but it is really hard to synchronize and harmonize the musical performance. Looping can blur the transition between beginning and ending and VJ can use looped videos without any timing

limitation or sequence problems. Therefore, many number of designer, animators, film makers and creatives who generate visual materials for VJ Performance, prefer to design their visuals in looping structure. There is also a huge online market that people can buy or sell VJ Loops.

Another type of visual material in VJing is real time generated visuals. When we consider that VJs who regularly perform in clubs, need to work with different musicians and DJs. This circumstance paves the way for content problems in terms of limitation in visual material and it can be accepted as impossible that VJs cannot create specific content to catch all musicians and DJs including different styles and genres. In order to solve this circumstance, real time visual creation could be beneficial to response musical performance in real time.

Music can be analyzed in terms of many different attributes like sound level, frequency, bpm, and spectrum with the help of software technology. For instance, *Madmapper* which is video mapping and VJ software can automatically generate visual patterns, movement and visual reactions by virtue of analyzing live sound input which is called audio reactive computer generated imagery (Retrieved April, 2017, from <http://www.madmapper.com/madmapper/features/>).

This audio reactive visual generators can be included in the VJ Software, or it can be externally added. This circumstance allows VJs to extend their visual libraries with sound reactive visuals.

Another method in creation of visuals is creative or generative coding. This method is usable for VJs who want to generate their visuals via coding. The platforms like

*TouchDesigner* and *Max MSP* which are called as generative coding platforms allows that people can generate visuals via coding and algorithm. It can be rendered in real time or designers can record and use it for multiple time. In case of VJing, it is very useful because it provides a total control over visual creation. Designers can intervene to all parameters, variables and algorithms in coding. They can create unlimited relations between these items. This circumstance creates an endless opportunity to make visual experiments. In case of musical performance and VJing, getting live musical data can be used in order to change color, shape, location, position and everything. Therefore, a certain number of mainstream VJs use generative and live coding including Ali Demirel, and Tarik Barri.

#### **4.2.2. Process**

VJing can be accepted under performance arts and the artist is responsible for real time interaction with visuals. Process means manipulation and synchronization of visuals considering live audio performance. In 60's, the interaction over video had started with analogue video synthesizers as *CEL Chromascope* (Retrieved May, 2017, from [http://www.eyetrapp.net/Chromascope\\_Video\\_Synthesizer.html](http://www.eyetrapp.net/Chromascope_Video_Synthesizer.html)). After 1980's, development on computers and digital electronics provided digital ways to video manipulation and the devices and software started to use create interaction with videos. *Fair Light Computer Video Instrument* can be example of early video processor (Retrieved May, 2017, from [http://www.audiovisualizers.com/toolshak/vidsynth/fair\\_cvi/fair\\_cvi.htm](http://www.audiovisualizers.com/toolshak/vidsynth/fair_cvi/fair_cvi.htm)). However, at the end of the 1990s the first VJ software appliances appeared and computers

became fast enough to store and play back large video files (Turco, 2014, 127) and when we consider today's VJ processing tools that it can be generalized according to Taylor et al. as "Current Video Jockey (VJ) practice typically utilizes laptop computers running dedicated VJ software, with additional peripheral input and output devices, such as MIDI surfaces, scratch pads, mixers and so forth" (Taylor, Izadi, Kirk et al., 2009).

In order to mix and manipulate videos video mixers was so useable. The video mixers allow VJs to mix multiple video source, add dynamic visual effects, control parameters like speed, size, color and more. For example, according to Webber (2008);

"The Edirol V-4 mixer is an affordable four input/three output video mixer with more than 90 types of effects such as Still, Strobe, Multi Screen, Picture in Picture, and composition effects such as Chroma Key (blue screen) and Luma Key (black screen) capability for superimposing images." (Webber, 2008, 188).

DVD Decks is another tool which can be used in VJing practice. It is like a turntable which is used by DJs and it is designed for manipulating videos, not a music. The first DVD turntable is the *DVJ-XI* was developed by *Pioneer* and offered features as looping, digital pitch, tempo control and more (Webber, 2008, 188). However, with the help of today's software technology, users can use all these devices features via VJ software including compact and flexible features.

VJ software generally includes many number of visual effects which can be used for manipulation and image processing in real time. There are also a huge number of parameters about visuals, effects which can be changed by users in order to

manipulate or synthesis the visuals. *Resolume* is one of well-known VJ software that offers 70+ video effects which can be applied to clips, layers and the compositions, 40+ transitions and blend modes can be used in order to combine layers and make transition between them. It also offers video output control containing device management which allows user to use multiple screen or output devices, mask and wrap the video in real time. (Retrieved May, 2017, from <https://resolume.com/software/specs>)

Another advantages of VJs software is that many number of software companies offer a trail version of the software and user can try before buying it. This circumstance gives chance to examine software features, and convenience in terms of users' needs. Another point is that hardware interfaces like midi controller and mixers can be recognized by the software and knobs, faders and buttons can be assigned to software's parameters like opacity, size and color. VJs can liberate themselves from mouse and get physical connection via hardware devices. There is no doubt that these kind of advantages has great impact that VJs software are growing and many number of VJs prefer to use of software and additional hardware interfaces instead of usage of hardware like video mixer or DVD deck.

It can be clearly seen that performative side of VJing has significantly important and the difference between VJing with all other multimedia art fields is the role of visual artist which is based on real time manipulation. By virtue of the development of computer technology, VJs have a great partner which is computer software. Role of software in VJing practice is increasing and a certain number of VJs use VJ software in their visual performance.

### 4.2.3 Output

Output section means that VJs need to display their performance via single or multiple output devices including led panels, screens and video projectors. The usage of multiple screen can be seen since the term of expanded cinema is heard. Expanded cinema rejects the traditional one-way relation between audience and screen and gives more participatory role and immersion. According to Westgeest's book which is named "Video Art Theory:", Birgit Hein explained as "expanded cinema extends film into the art scene: expanded cinema never really functions in a movie theater because you need more space, more than one flat screen, and more often the audience must be able to move in the space." This point of view is also the same with the definition of video installation consisting of multiple projection screens (Westgeest, 2016: 103). The term is also defined in Tate.org's website as;

"The term was coined in the mid-1960s by the US filmmaker Stan Van Der Beek, when artists and filmmakers started to challenge the conventions of spectatorship, creating more participatory roles for the viewer. They chose to show their works, not in cinemas, but in art galleries, warehouses and in the open air, and invented different ways of experiencing film through multi-screen projections." (Expanded cinema, (n.d.), Retrieved April, 2017, from <http://www.tate.org.uk/learn/online-resources/glossary/e/expanded-cinema>)

The idea of usage of multiple display is also exists in VJing practice. Dancing images could be displayed via multiple displays via splitter devices and artist can digitally manage the devices and visuals. This feature allows VJs to create immersive relation with audience and create unique environment for visual compositions. Attribute of

the screens like shape, and size can have significant role on designing visual materials.

Video projection mapping is another display method which is regularly using in VJ practice. It has been defined in Projection Mapping Central's website as "Projection Mapping uses everyday video projectors, but instead of projecting on a flat screen (e.g. to display a PowerPoint), light is mapped onto any surface, turning common objects of any 3D shape into interactive displays. More formally, projection mapping is "the display of an image on a non-flat or non-white surface" (Jones, B., & Jones, A. B., (n.d.), Retrieved April, 2017, from <http://projection-mapping.org/whatis/>). It is very useful in VJing because it allows designer to physically create conceptual displays rather than traditional flat screens. For instance, Modem Festival 2016 had unique mapping surface which conceptually match with festival's manifest (Figure 20).



**Fig. 20** Modem Festival, visuals by TAS, Croatia, 2016

There is no doubt that development on software and displays technology including video projectors, screens and software which can manage these devices give chance to VJs create unique composition with designing display areas.

### **4.3 Generative Coding for Audio Visualization**

Generative and live coding could be used in order to generate visual material and sound reactive visuals that are one of the most popular visual material in VJing. Pre designed variables, algorithms, and parameters in code generate real time visuals and if there is a real time input like sound data, and be assigned to one of these parameters, the input data can manipulate the visual in real time. VJing is based on musical performance and the data which is taken from musical performance could be used in order to synchronize the music and visual. There are a certain number of VJs who are using the method of live coding in their visual performance.

#### **4.3.1. Generative Coding VJs**

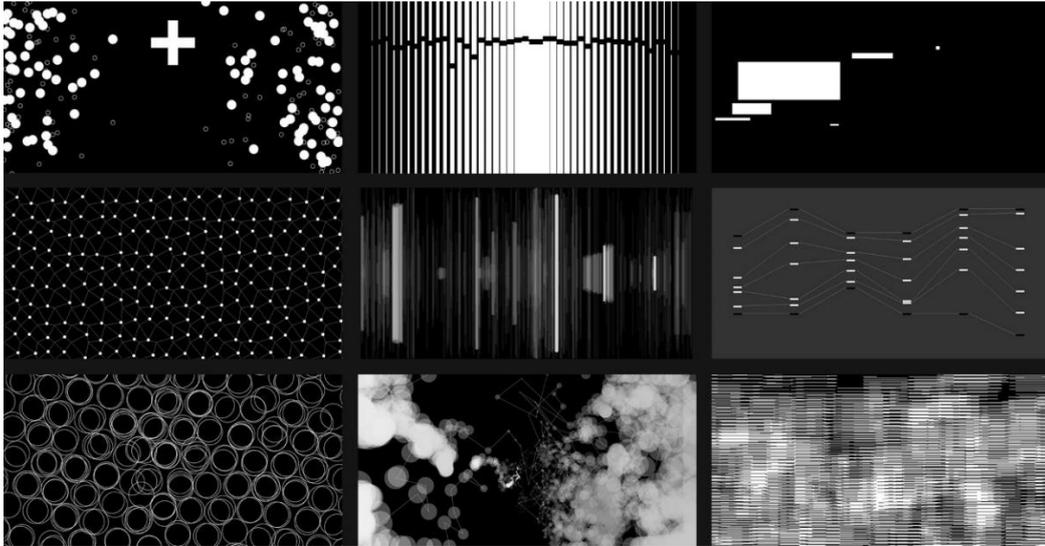
##### **Ali Demirel**

Ali Demirel was born in 1972, Turkey. He studied architecture at Middle East Technical University and then he worked and lectured at GİSAM (Audio Visual Research Center) of METU. According to the resume in his personal website; he collaborates with musician Richie Hawtin (aka Plastikman) and he produces music videos and performs live visual shows with him. Reflecting his background in

physics and architecture, he has established a unique visual style with minimal electronic music (Ali M. Demirel).

He also designed a VJ software which is named 2V-P which is available for Mac on iTunes. It is defined in Apple App Store as “2V-P is a simple but effective two-channel video mixer. It is designed by Ali M. Demirel for his live performances and engineered by Pascal Lesport.” (Lesport, P. H. , 2016). 2V-P allows the user full play back and real time control over movie, image and Quartz Composer compositions. Quartz Composer is visual programming language which allow user to create computer generated imageries via coding (Quartz Composer User Guide, (n.d.), Retrieved April, 2017, from [https://developer.apple.com/library/content/documentation/GraphicsImaging/Conceptual/QuartzComposerUserGuide/qc\\_intro/qc\\_intro.html](https://developer.apple.com/library/content/documentation/GraphicsImaging/Conceptual/QuartzComposerUserGuide/qc_intro/qc_intro.html)). 2V-P can control parameters in Quartz Composer compositions and manipulate visuals in real time.

According to his personal website, he is also using generative coding frameworks like Processing in order to create visuals content. His project which is named as “META-CONTROL” is interactive visual composition. He developed this project in Processing generative coding environment with the help of collaboration with Burak Arıkan for Richie Hawtin’s electronic music performance (Figure 21). (Meta-Control, (n.d.), Retrieved April, 2017, from <http://www.ali-m.de/works/meta-control/>).

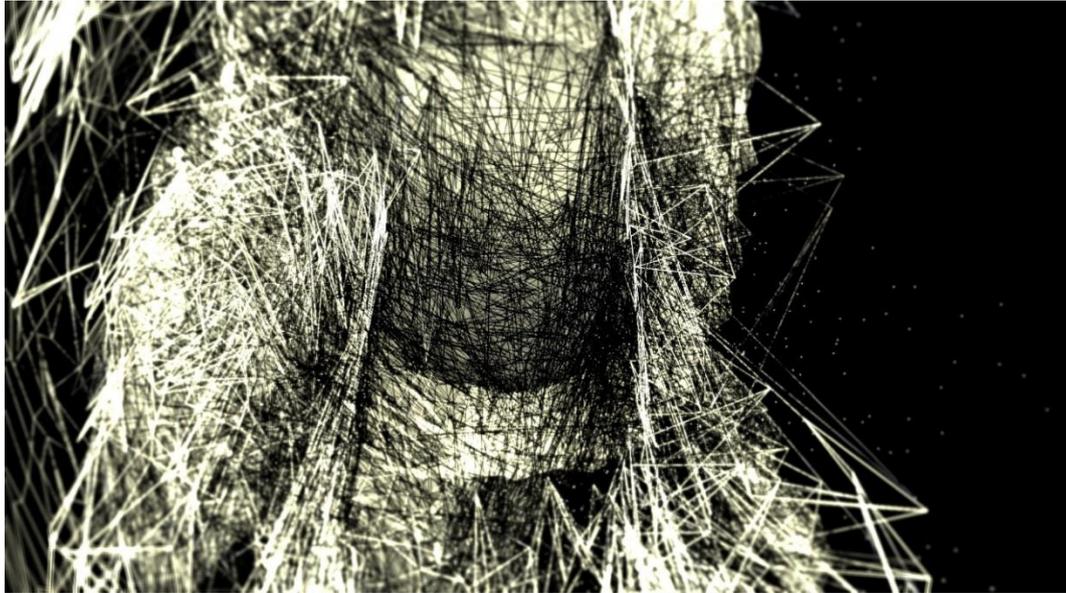


**Fig. 21** Ali Demirel and Arikan’s Visual Composition Set

### **Tarik Barri**

Tarik Barri is a Dutch audio visual artist who studied Music and Technology at the Utrecht School of the Arts. According to his personal website, he is working about audio visual performance, installation and videos but he is also creating live visuals for artist like Thom York, Monolake, and Nicolas Jaar. (Tarik Barri, (n.d.), Retrieved April, 2017, from <http://tarikbarri.nl/cv/>). The important point is that he uses generative coding in order to generate his audio visual work and VJ performance. According to his personal website;

“There I saw that the methods I used to create music could also be applied to create moving images. With tools like Max/MSP, Java and Supercollider I now develop software for audiovisual performance and composition. Using these tools, I search for new synergies and aesthetics in the combination of image and sound.” (Tarik Barri, (n.d.), Retrieved April, 2017, from <http://tarikbarri.nl/cv/>).



**Fig. 21** *Crow*, by Tarik Barri

He is aimed to generate aesthetics compositions where people can hear the images and see the sounds. Hence the media is converted to data, it is possible to create relation between audio and visual data. In this way, sound can be seen, and image can be heard. Barri's work includes data transformation between different medium in order to create aesthetic harmony with music and visual. He applied this method into audio visual performance and VJ performance. In his works, the data which is taken by live audio is fundamental source for visual generation.

#### **4.4. Audience Engagement of Live Visualization in Musical Performance**

In traditional VJing, VJ as a visual artist has all responsibility to control over visuals. They have role on all visual appearance including content, visual effects and real time manipulations. However, according to Sheirzadian, audience engagement adds value to the experience: the concert is enhanced with an additional visual layer, which causes a higher level of immersion and feeling of togetherness among the

audience. We have the idea of audience engagement in theaters. Interactive theaters or immersive theater is a term that audience has active role during performance and blurs the wall between audience and the performer.

The same integration could be assigned to VJ performance. According to Sheirzadian (2016), “new technology developments in the field of human computer interaction open new pathways which can enrich the experience of musical events. User generated content plays an important role in this development” (Sheirzadian, 2016). The real time data which are taken by audience via input devices like motion sensor, microphone, camera or mobile application could be used in order to engage audience into visual performance which create feeling of togetherness. Sheirzadian who examine VJ performance with audience engagement explains meaning of togetherness in a music show as “the aspect of 'togetherness' is equated in this research as the degree of 'feeling part of a group'. In a music show, the audience member can feel as part of the audience, but also - when included with GSR data (the data by motion sensor) in the visualization -part of the concert/show.” (Sheirzadian, 2016).

The method of human computer interaction could be in various types. According to research of Sheirzadian (2016), “one example that incorporates user generated content in visual art at music events, is shown by Engström et al. (2008), where users can directly upload videos to the VJ through an app” (Sheirzadian, 2016). Another type is usage of input devices. Microphone, camera, a various type of sensors containing depth, motion, and even temperature can provide real time data which are taken by audience and give role to audience in visual performance. Barney McCann

has developed an interactive form of live VJ visuals with using LEAP Motion which is motion tracker and VJ software Modul8 and he wrote in his blog about his work that “He can control the visuals projected on a band or artist with just my hand; cutting between, layering, colorizing, saturating and distorting footage with various hand movements”. There is no doubt that his method can be applied to audience engagement and participant’s motions could provide data for visual manipulation.

## **CHAPTER 5**

### **DISCONNECT**

#### **5.1 The Project**

DISCONNECT is an interactive audio visual installation which audiences are welcomed to participate for real time visual manipulation in VJ performance. The project is based on usage of computer generated imagery in VJ performance. I claim that if VJs can control and manipulate visual's parameters in real time, it is possible to have total control over visual performance. Therefore, I have decided to create computer generated imagery by generative coding which offers to create visuals via coding and algorithms. This method offers that all visual parameters in source code can be controlled and manipulated in real time via getting live input from visual artist and audiences. Although, VJing is based on visual manipulation and synchronization of visuals with musical performance which is processed by visual artist, in this project, participants are also part of the show.

## 5.2 Conceptual Design

When I first discovered VJ performance, it was my first psychedelic festival experience. One of the biggest psychedelic festival in Turkey had taken a place in a unique nature, in Karagöl, İzmir. Tree of Life Festival had welcomed to great visual artist on the stage who had accompanied live musical performance with their visual performance. I was completely impressed about dancing images and harmony between music and visuals. DISCONNECT which is an interactive VJ performance has been developed for psychedelic rave events as Tree of Life Festival.

In the project, lotus flower shaped projection surface had been used for displaying psychedelic visual patterns which have kaleidoscopic effects and movement. When we consider definition of kaleidoscopic effect it has been explained in wonderopolis.org like;

“Inside the kaleidoscope, there are mirrors arranged in a circle, as well as a variety of colorful objects, like beads, pebbles or small pieces of glass, that are free to move around. As you look through the viewer and rotate the outside of the kaleidoscope, the mirrors reflect the movement of the small objects to create fascinating visual images that change with each movement.”  
(What is a kaleidoscope, n.d.)

The reason behind usage of kaleidoscopic effect is that psychedelics and hallucinogens which are commonly used in psychedelic rave culture causes a view like colorful kaleidoscope. According to Buskist and Davis, very small dose of LSD cause vivid visual hallucinations like colorful kaleidoscope lights and distorted images (Buskist and Davis, 2008: 159). Although the idea is based on hallucinogens’

effects, kaleidoscope is associated with psychedelic culture without considering any drugs usage.

In this project, I have decided to create video projection mapping surface in lotus flower form. Lotus is associated with spiritual awaking in psychedelic and eastern culture. According to Ravenscroft, the lotus is known to be associated with purity, spiritual awakening and faithfulness in Buddhism. Furthermore, in Hinduism the Lotus flower is representative of how a person can become awakened to the spiritual reality (Ravenscroft, n.d.). In addition to this point, Alex Grey who is one of famous visionary artist also use lotus flower in his paintings in order to symbolize inner awareness and spiritual awakening. In Alex Grey's book which is named as Transfigurations, he also wrote as "The lotus is a symbol of transformation because it begins life in the mucky underwater mud and grows up toward the light, opening as a beautiful pure white blossom" (Grey, 2001).

### **5.3 Elements and Implementation**

DISCONNECT has been divided into 3 fundamental parts which are defined as content, process and output. VJs performances is required to have media library in order to use in visual performance. This content can consist of pre-made videos and images, live camera streams, or computer generated imageries. In this project, the visual materials in library are generated by generative coding with real time rendering. Second fundamental step is process which means manipulation and synchronization of visuals with considering live musical performance.

DISCONNECT offers that audience is also responsible to interact with visual performance and they can be part of the show. Output means displaying of visual performance with output devices as screen and video projectors. The method of video projection mapping has been used for displaying visual performance on designed projection surface.

### **5.3.1 Content**

One of fundamental point about VJing is mixing of content from library of media. This library can be on storage like VHS tapes or DVDs, or video and image files from computer's hard drive. In this project, I have tried to fill my media library with computer generated imagery which is real time rendered and generated by coding.

When I started to VJing, I asked for feedbacks about my visual performance. One of the common idea about my performance in some cases was that I could not totally control my visuals in terms of synchronization with the music. Even pre-made videos or video loops are designed to VJ performance, in some cases, it was not possible to interact with necessary parameters of the visuals. Therefore, I had started to discover new ways to generate my visual library, and I had discovered to generative coding.

Generative coding is a tool to generate visuals via coding and algorithms and when I started to examine works which are developed generative coding, I was totally impressed in terms of quality of works. I could not believe how code, algorithms, and data generate these kind of aesthetic beauty. After that I started to be experienced in

Processing programming language and I have created my first interactive audio visual work with using motion sensor.

When I continue to work about generative coding, I learnt graphical user interfaced programming environments as Max MSP and Touch Designer. These platforms allow designers, artists and creatives to write code in a visual way including logical operations, drag and drop method, and relational operations. When I examined these platforms I have decided to use Touch Designer in terms of applicability on audio visual works and VJ performance.

#### **5.3.1.1 Generative Coding Environment: Touch Designer**

TouchDesigner is a node based visual programming language for real time interactive multimedia content which is published by Derivative. It has been often used by artist, designer, and creative coders in order to create performances, installations, and fixed media works. There are a certain number of reasons to select *TouchDesigner* environment in order to generate visuals including interoperation with other applications, visual coding environment, and enabling human computer interaction.

The first reason to use *TouchDesigner* is interoperation with other applications. *TouchDesigner* has been designed to work with other application like *Ableton Live*, *openFrameworks* and *Resolume*. It can be collaborated and integrated as an elements of larger creative pipelines (TouchDesigner 088 - 30 Features to Love, n.d.). Spout is a video memory sharing application that real time rendered video can be used by

other applications and software. Therefore, it is decided to generate my visuals for VJing media library via *TouchDesigner*. The logic can be explained with usage of live video stream from camera. VJ software can play real time video streams and there is only difference that my stream is generating by coding rather than video camera.

Another reason is that *TouchDesigner* is designed for artist, creatives and designers who have little programming background. The usage of the software is very easy with visual interface. User can visually add any channel and data operations, interact with any components' parameters, create logical relations with objects. There are also ready to use tools for mesh warping, projection mapping, image effects and generative design.

Human computer interaction is also another reason to use *TouchDesigner*. According to *TouchDesigner's* website, it provides native support for the latest hardware like *Kinect 2*, *Leap Motion*, *Realsense* and device *TUIO* and other touch screen protocols. It also provides a huge range of analysis methods for motion and sound. It supports for low-latency ASIO drivers and hardware, and tools for real time audio processing including filters, compressor, limiter, and spectrum analyzer (TouchDesigner 088 - 30 Features to Love, n.d.). This circumstance makes that the software is easy to use in audio visual works like VJ performance.

It is also possible to add third party libraries into *TouchDesigner*. User can import full 3D scenes using *FBX 2015.1* which support for geometry, animations, textures, cameras, lights, skeletons, deformations, and blend shapes (TouchDesigner 088 - 30

Features to Love, n.d.). There are more third party libraries which are developed for specific aims and this circumstance makes the coding environment extendable in terms of designer's needs.

Considering all of these reasons, I tried to find the best environment according to my project needs. *TouchDesigner's* features including interoperation with other applications, user interfaced development environment, and audio visual analyzing and production quality direct me to use *TouchDesigner* in order to generate real time controllable visuals for my media library in VJ performance.

### **5.3.1.2 Generative Design Process**

First of all, the project is aimed to create kaleidoscopic effect in order to match with conceptual ideas. The video had been created in generative coding platform but the main manipulation had been made on VJ software.

According to Wonderopolis website, David Brewster who is Scottish inventor created the kaleidoscope in 1815 while doing experiments on light polarization. The word of kaleidoscope is combination of several Greek words which means "observer of beautiful forms" (What is a kaleidoscope, n.d.). The fundamental logic behind kaleidoscope is based on reflection of light from mirrors and movement on it. It has been explained like;

"Inside the kaleidoscope, there are mirrors arranged in a circle, as well as a variety of colorful objects, like beads, pebbles or small pieces of glass, that are free to move around. As you look through the viewer and rotate the

outside of the kaleidoscope, the mirrors reflect the movement of the small objects to create fascinating visual images that change with each movement.” (What is a kaleidoscope, n.d.)

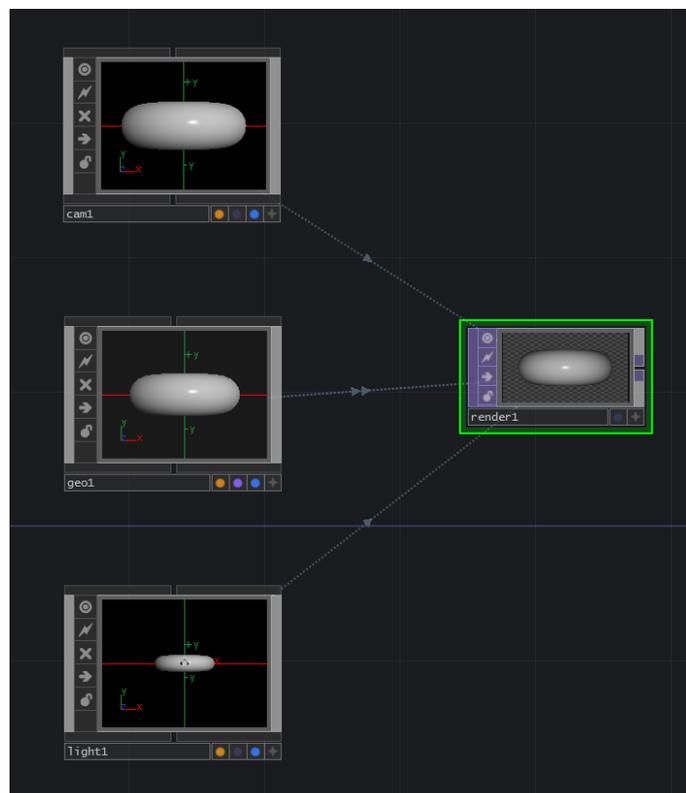
According to Stephen Davis’s book which is named “21st Century Psychology” commonality among hallucinogens and psychedelic drugs is their ability to cause users to disconnect from reality and hallucinate. After Albert Hoffman accidentally experienced a “psychedelic trip” in 1943, and since then *LSD* become one of the most well-known hallucinogen and it is one of the popular substance in rave culture (Buskist and Davis, 2008: 159). According to Buskist and Davis, very small dose of *LSD* cause vivid visual hallucinations like colorful kaleidoscope lights and distorted images and this circumstance makes that kaleidoscope is associated with psychedelic experience, therefore, kaleidoscope effect is important symbol in psychedelic rave culture and psychedelic visuals (Buskist and Davis, 2008: 159).

Considering these information, I have decided to generate visual pattern based on reflection and controllable movements as a kaleidoscope. First of all, visuals patterns have been generated by virtue of generative coding and usage of mathematical calculations have been used creation of symmetry. After that a video stream is generated with the help of application that share video source which is named as *Spout* and this application transfers my real time rendered visuals as a video source into VJ software.

The process of visual creation need to be divided into 2 steps. First one is a creation of interactive visual patterns in generative coding environment, second point is processing video source in VJ software. Therefore, I started to design process with creating audio reactive visuals in Touch Designer.

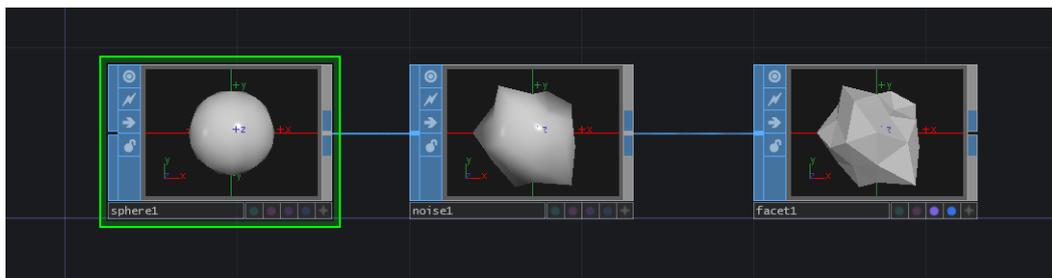
In generative coding platform *TouchDesigner*, when user double click it shows the operators which are building blogs of source code. These operators can be connected with each other in order to create procedural effects. There six different type of operators including, components, texture operators, channel operators, surface operators, materials, and data operators. Considering the listing order above, these operators listed as COMP, TOP, CHOP, SOP, MAT and DAT in the Touch Designer's interface.

The project had started with adding Camera, Geometry and Light from COM section and, Render from TOP section was added and these 3 components have been automatically connected to Render (Fig. 22). Camera's Translate parameter increased to 20 from 5 in order to get smaller sized object in render area.



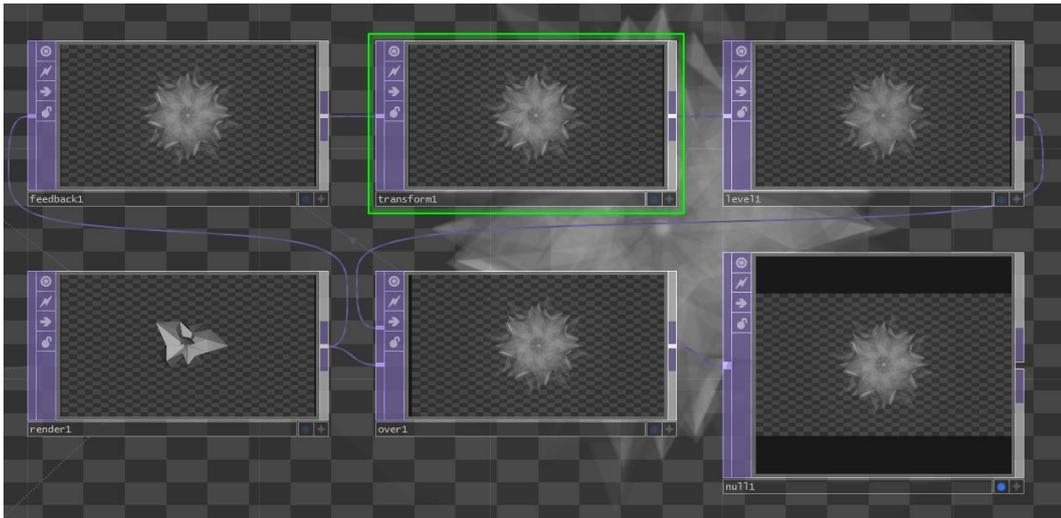
**Fig. 22** *DISCONNECT*, by Anil Özdem, 2017, Generative Design Process 1

After that I have double clicked to Geometry and this action allows users to enter inside of the object. It can be accepted as folders including objects. Torus object was defined as default inside of Geometry and Torus was deleted and, added Sphere, Noise and Facet and connected to each other (Fig. 23). In this process, parameters of objects were changed in order to shape object. Unique Points and Compute Normals of Facet turned on and Sphere's Primitive Type was changed to Polygon. Noise's Amplitude increased in order to give more variations. In this process, 3 dimensional object created and animated with distortion effect.



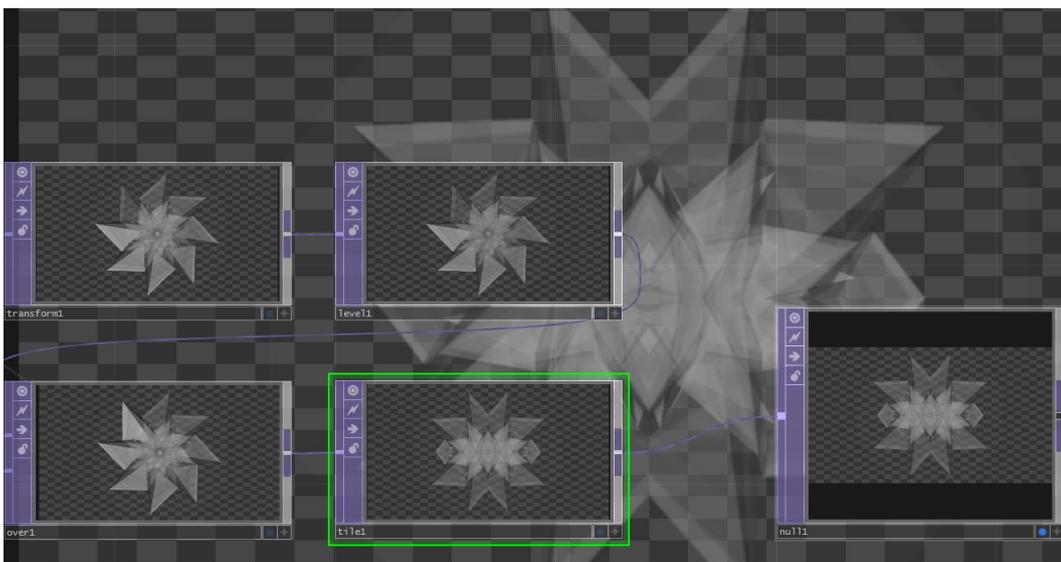
**Fig. 23** *DISCONNECT*, by Anıl Özdem, 2017, Generative Design Process 2

In next step, I turned back to main project folder and Over from TOP section was added. Over has two input points which allows user to combine two compositions. Feedback was added into relation between Render and Over, and Over was dragged to Feedback's Target TOP parameters in order to define a source for feed backing. After that an object which is named as Null had been added, and clicked to blue button on bottom in order to view render in the background. For next step, Transform was added and Rotate parameters defined as 45 which turned my visual to circular form. After these steps, my visual started to be seen like randomly animated mandala (Fig. 24).



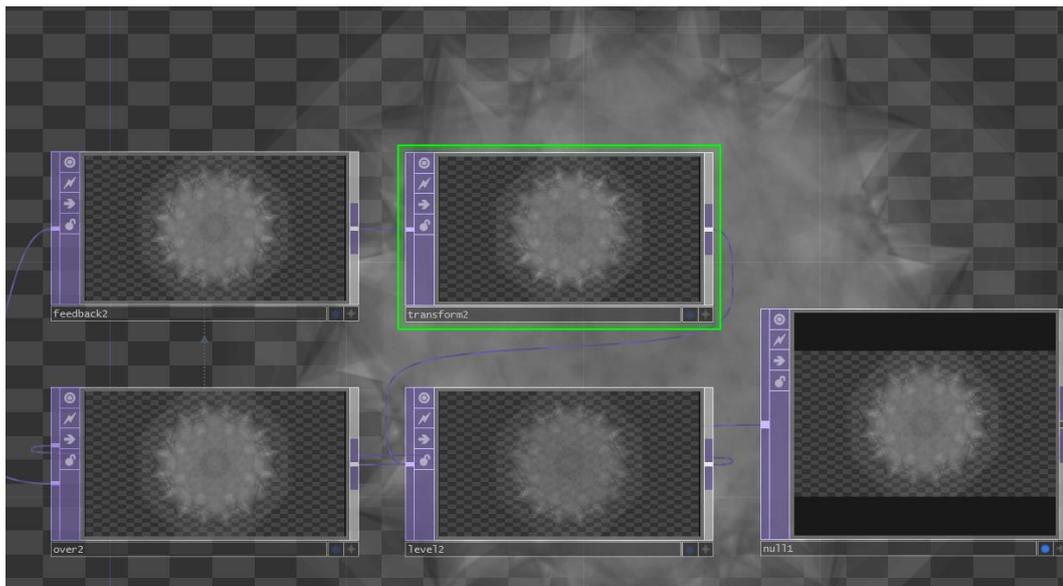
**Fig. 24** *DISCONNECT*, by Anil Özdem, 2017, Generative Design Process 3

As a next step, I decided to create reflection and one more feedback process in order to generate mirror effect in my visual. Firstly, Tile between Over and Null had been added which created 4 reflections of the composition on the corners. Therefore, Crop Left and Crop Bottom set to 0.5 which placed reflections in the center. After that the parameters including Flip X, Flip Y, Reflect X and Reflect Y have been turned on. With the help of this process, my visual started to look symmetric (Fig. 25).



**Fig. 25.** *DISCONNECT*, by Anil Özdem, 2017, Generative Design Process 4

In second step of this process feedback loop was created in order to create circular and symmetrical design form. Over and Feedback added between Tile and Null. As it is explained above, Over function has two inputs in order to combine in one frame, and in this process, one of these input came from original video source, other input came from feedback process. Feedback's Target TOP had been assigned as Over and the feedback loop was started. Level added between Feedback and Over and assigned Opacity as 0.8. Transform added and Value of Rotation assigned as 45. After this process, my visual looks like a psychedelic pattern which contains symmetry and geometrical relations inside (Figure 26).

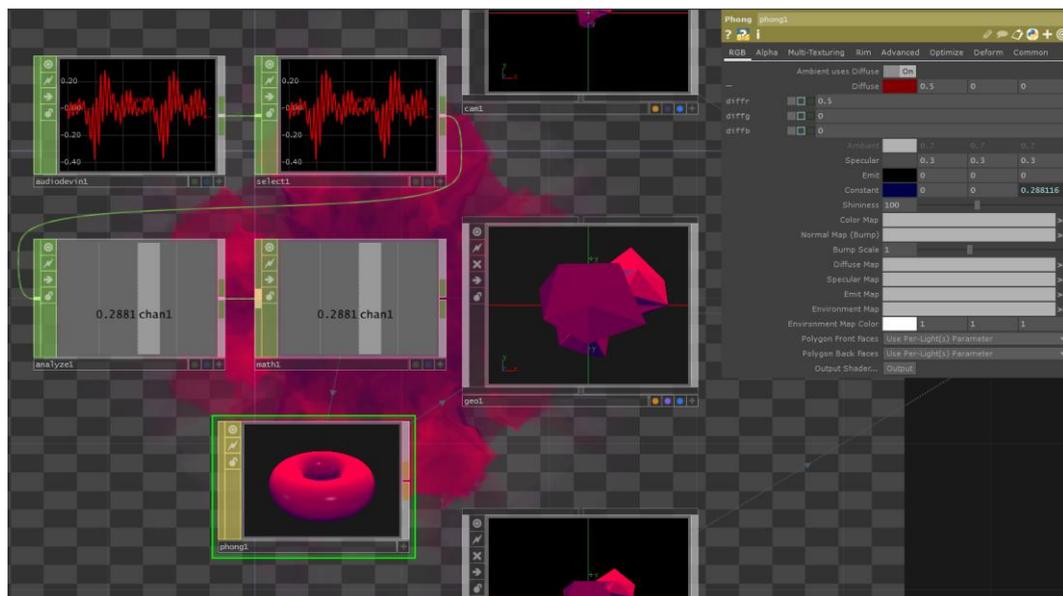


**Fig. 26.** *DISCONNECT*, by Anıl Özdem, 2017, Generative Design Process 5

Considering the needs of VJ performance, I decided to make this visual audio reactive and synchronized with the music. Therefore, a sound analyzes part have been added into my source code and it is decided to change color according to sound. The process has been started with the defining input source and Audio Device In

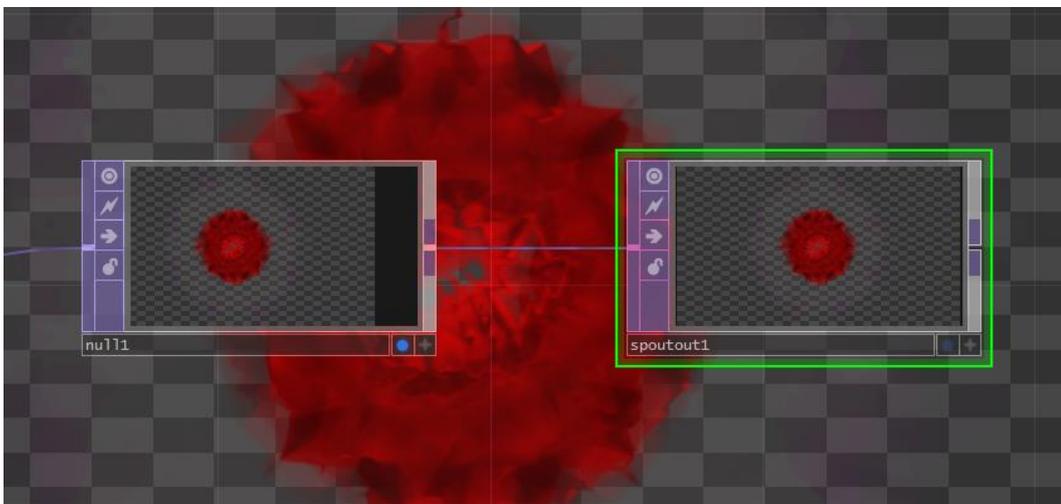
added and Device defined as Microphone. After that, Select Object was added in order to select data source. Then, Analyze Object was added and Function was defined as Maximum in order to get incensement on the sound in real time. In next step, this real time data had been converted to numerical data with Math object.

In order to add color to my composition, Phong was added from MAT section and it was dragged this item to Geometry and selected “Parm: Material”. With the help of this method, it become able to assigned color from Phong’s Diffuse parameter. Diffuse set as 0.5 which turns as dark red. In this process, the data from audio analyzes was assigned into color selection field in order to make my visual sound reactive. Math Object was dragged into Phong’s Constant parameter which made this parameter’s value was equal to Math’s real time changing value. By virtue of this method, I made audio reactive visual which can be possibly use in VJ performance (Figure 27).



**Fig. 27.** DISCONNECT, by Anil Özdem, 2017, Generative Design Process 6

As a last step of generative design process, I added function to share my real time rendered visual with VJ software *Resolume Arena*. This method can be accepted as window sharing, and the small application which is named *Spout* allows user to share media between applications. Both *TouchDesigner* and *Resolume Arena* supports *Spout*'s media sharing method and after installing application, *TouchDesigner* allows users to add Spout Out function. Therefore, my Null object was connected to Spout Out item at the end (Figure 28).



**Fig. 28.** *DISCONNECT*, by Anil Özdem, 2017, Generative Design Process 7

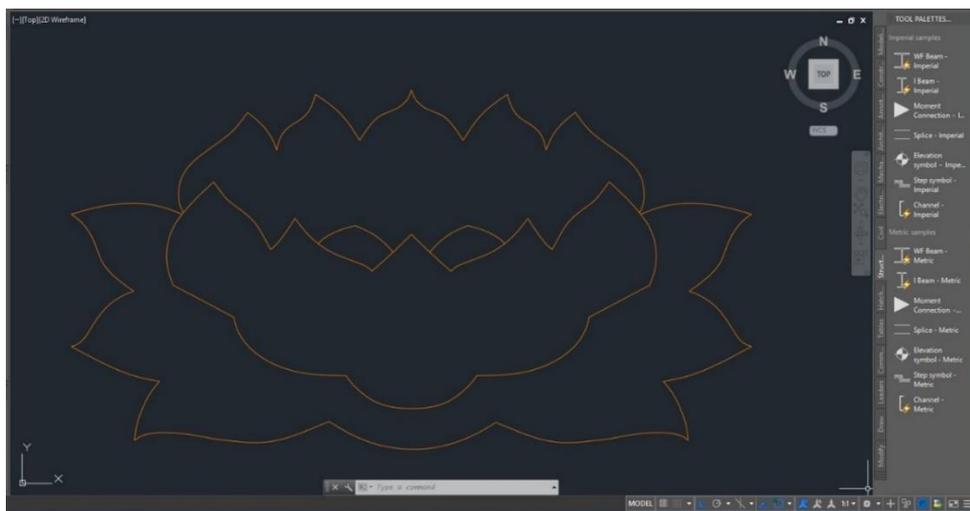
### 5.2.1.2 Projection Surface Design (CNC Cutting)

Video projection mapping technique turns the object, often irregular shapes, into the surface for video projection. Visuals can be digitally masked into the surface which allows to designer and creators to create conceptual displays. Therefore, I decided to create a custom mapping surface which is in lotus flower form in order to use as a

display of visual performance. In Buddhism the lotus is known to be associated with purity, spiritual awakening and faithfulness (Ravenscroft, n.d.).

The design of surface has been developed in *AutoCAD* environment which is architectural design software. However, fundamental reason behind usage of *AutoCAD* is that two-dimension projects which are designed in *AutoCAD* and can be process able with computer controlled cutting machines. CNC which means computer numeric control is a way to cut materials with designed models.

The design had been made based on symmetry (Figure 29). Left and right pieces can be accepted as mirror view of each other. The reason behind usage of symmetry is that kaleidoscopic effect is also based on reflection and symmetry. Therefore, if my mapping surface could design considering symmetrical rules, it would be matched with my visual language.



**Fig. 29** *Lotus*, by Anıl Özdem, 2017, Video Projection Surface Modelling

The cutting process has been done in carpenter Bilkent University. *Rino M-150 CNC Router* had been used for cutting process (Figure 30). Project has been modeled with software technology and converted to a file which is readable by CNC Router. DWG file has been developed in *AutoCAD 2016* (Figure 29). After that this file had been converted to a cutting plan via software which named as *Artcam Pro*. This software had created a file which includes information about model, and real objects. In this step, properties like material size, blade type and size had been defined. The software also created a route for cutting and it is possible to watch simulation of cutting process. Lastly, the software which is named as *Mach3 CNC* applied this information for cutting process. It converts digital data to real action with computer oriented cutting machine CNC. With the help of this technology, it was possible to generated perfectly impeccable material according to my design (Figure 31).



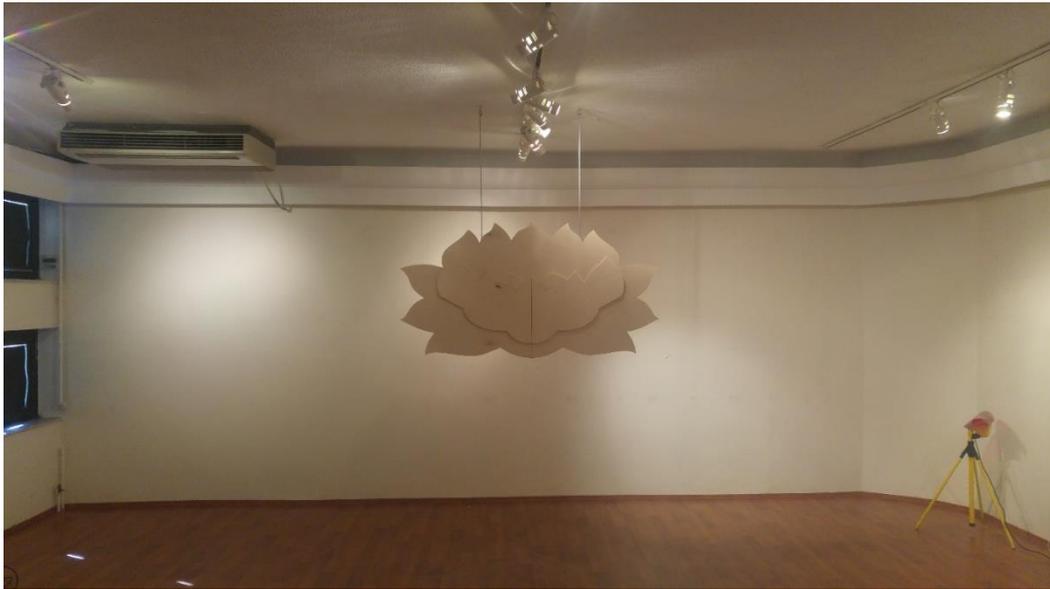
**Fig. 30** Rino M-150 CNC Router



**Fig. 31.** *Lotus*, by Anil Özdem, 2017, Video Projection Surface Cutting Process

There is no doubt that it is also important to see how computer generated imagery can be used in industry. The model has been generated with architectural design software in digital environment and, by aid of development on technology, it was applicable to shape material without any human interaction. It makes that creation of irregular shapes and complex designs during cutting material is possible without any mistakes.

After projection surface had been ready, the video projection mapping surface has been installed to gallery with two metal sticks which are placed with 70 cm distance from the wall behind. The reason behind this decision is aim of creation immersive space where people can walk through and interact with objects. According to Bonnie Mitchell (2010), use of immersion, interaction and manipulation of both virtual and physical space enables audiences to experience alternative realities. Immersive installations satisfy the viewer's inherent desire to escape physical reality and become part of the art experience itself (Mitchell, 2010)



**Fig. 32.** *Lotus*, by Anil Özdem, 2017, Video Projection Surface Installation

## **5.2.2 Process**

### **5.2.2.1 VJ Software**

The history of VJing had been started with equipment like video synthesizers, VHS tapes and DVDs. However, with the help of computer and software technology, these traditional devices have been replaced with software and external input and output devices. According to Taylor and Izadi, “current Video Jockey (VJ) practice typically utilizes laptop computers running dedicated VJ software, with additional peripheral input and output devices, such as MIDI surfaces, scratch pads, mixers and so forth” (Taylor, Izadi, Kirk et al., 2009).

In this project, I have used a laptop which is running *Windows 8* and VJ software which is called as *Resolume Arena*. *Resolume Arena* is a software which is designed

for VJs and visual artists. It allows users to play video source, mix multiple channel videos, add composition and layer effects with user friendly interface. It also allows to video projection mapping with advanced output settings.

*Resolume Arena* can also run external video source including camera, and computer generated imagery. It is possible to get live streams from hardware or software by virtue of usage of additional software. With small applications which are called *Spout* on *Windows* and *Syphon* on *Mac*, user can stream visuals in real time between *Resolume* and other application. This feature is completely necessary for me because my visuals are generating by other application, and I need to get this live visual as a video source.

One of important features of *Resolume Arena* is video projection mapping tool. *Resolume Arena* has advanced output settings which allows user to create custom display areas with creating mask and slices. With the help of this feature, it is possible to project video for any surface including complex geometrical shapes. It is also possible to use multiple screen with edge blending and users can generate their custom display design even wrapping for 360-degree experience.

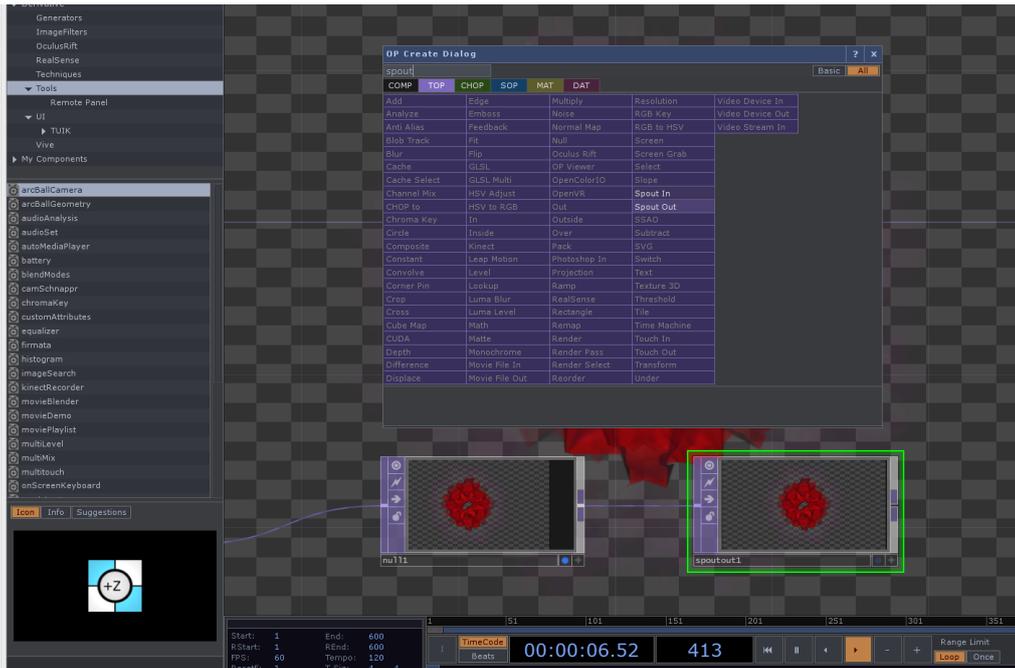
Midi mapping is also important feature to use *Resolume Arena*. Midi mapping means that user can assign the parameters which can be changed with software's user interface to any midi controller. Midi controller can be accepted as digital mixer including knobs, faders and buttons which turns data from 0 to 100 for designed software. This circumstance lead to liberate visual artist and VJ from mouse and keyboard and they can control parameters as using physical video mixer. It is also

important that *Resolume Arena* allows to manually map midi controllers which provides custom usage design. Users can manually assign most used effects, video source, and other parameters according to their own needs.

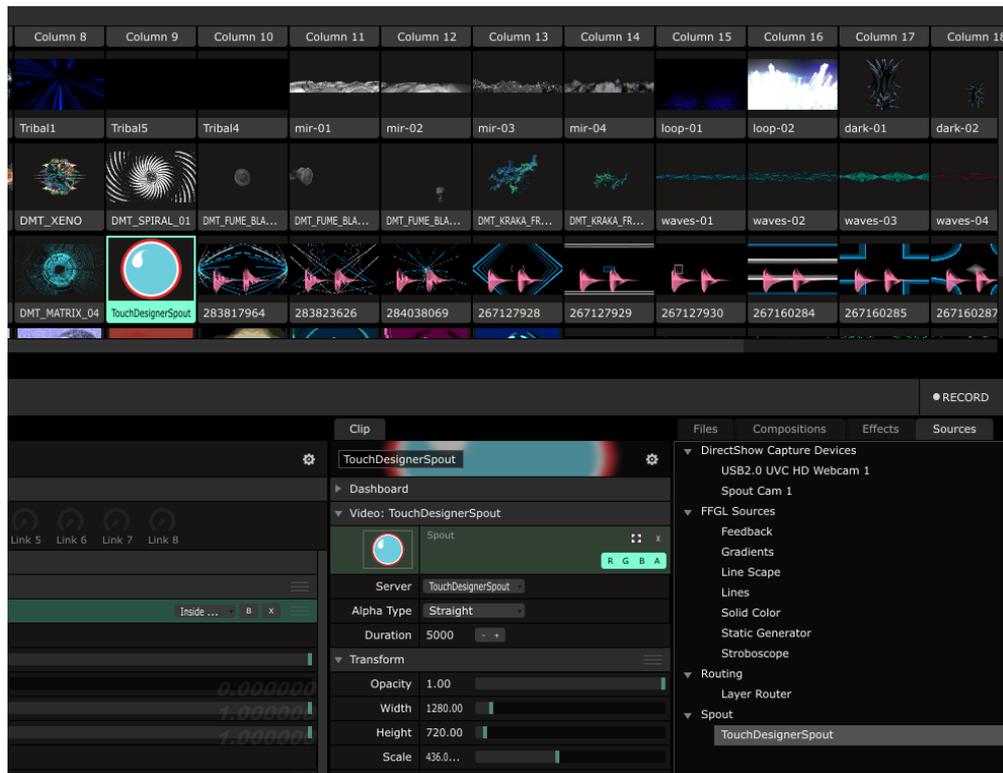
Another important feature of *Resolume Area* is usage of DXV Codec. Running multiple video source, manipulating in real time and playback these videos are very tiring process for computers. If we consider that laptops have limited capacity in terms of power of graphical performance, it would be hard to run many number of high quality video source. Therefore, DXV codec has been developed for *Resolume Arena*, and the videos which are encoded with DXV codec can be played without losing performance.

When we consider feature of *Resolume Arena* including usage of real time stream, video projection mapping, midi mapping, and visual effects, I decided that it is the most suitable VJ software.

In VJing performance, the first step was creation of media library which is generated by generative coding. Real time rendered imagery has been transferred into VJ software by virtue of small application which is called *Spout*. *Spout* is an application that allows user to transfer media between applications. *Spout* can work with both *Resolume Arena* and *TouchDesigner*. Therefore, I have decided to create “Spout Out” function in *TouchDesigner* which made my video source can be seen as a live stream by *Spout Application* (Figure 33), and with the help of this application, *Resolume Arena* has been detected this video source (Figure 34). *Spout* can be accepted as media transfer bridge between two applications.

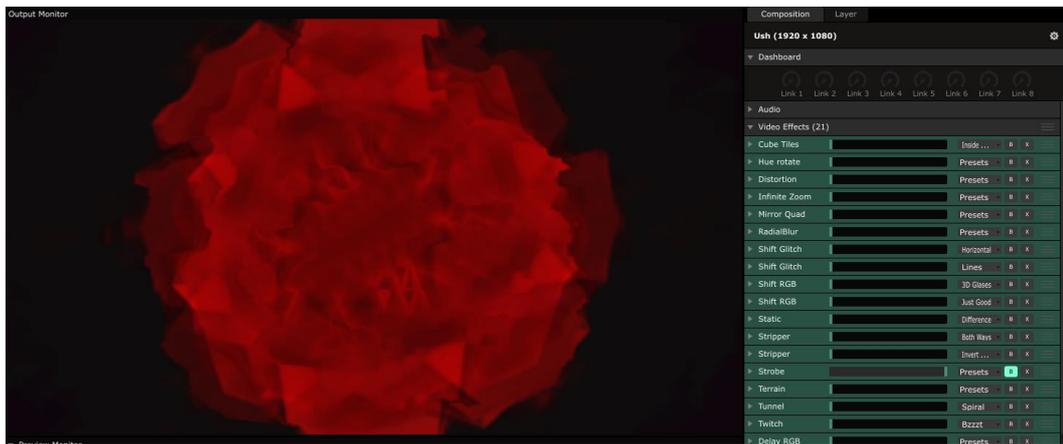


**Fig. 33.** *DISCONNECT*, by Anil Özdem, 2017, “Spout Out” in Touch Designer



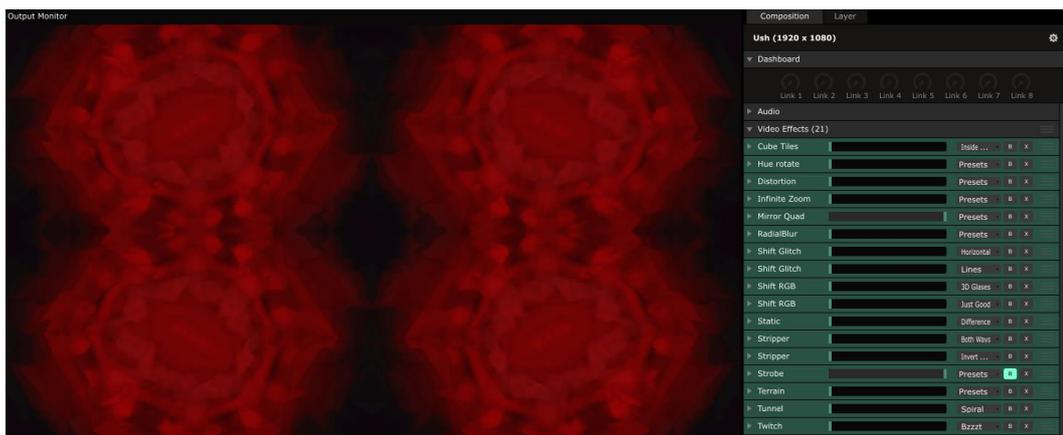
**Fig. 34.** *DISCONNECT*, by Anil Özdem, 2017, “Spout In” in Resolume Arena

After this process, real time rendered video started to be streamed as a video source. In order to create kaleidoscopic effect, two important point were missing in video source including mirrors and motions. As it is seen in Figure 35, my raw visual looks in a circle form. Therefore, I have decided to add visual effects from *Resolume Arena*'s effect library.



**Fig. 35.** *DISCONNECT*, by Anıl Özdem, 2017, Raw Video Stream in Resolume Arena

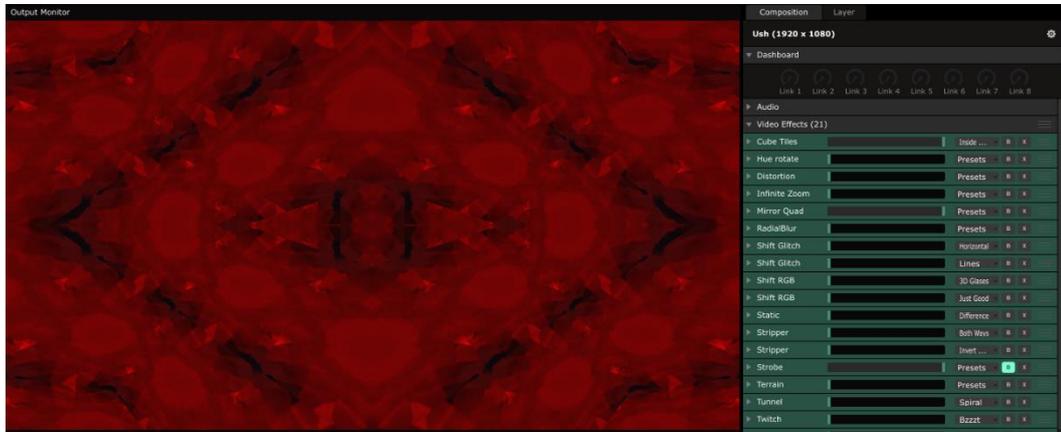
First visual effect was “Mirror” effect which generates 4 reflections of original video source (Figure 36). These reflections provide a fundamental mirror effects like in kaleidoscopes.



**Fig. 36.** *DISCONNECT*, by Anıl Özdem, 2017, Mirror Effect in Resolume Arena

After that I have used Cube Tiles' Inside Cube effect which generates controllable movement with composition (Figure 37). These effects create multiple composition

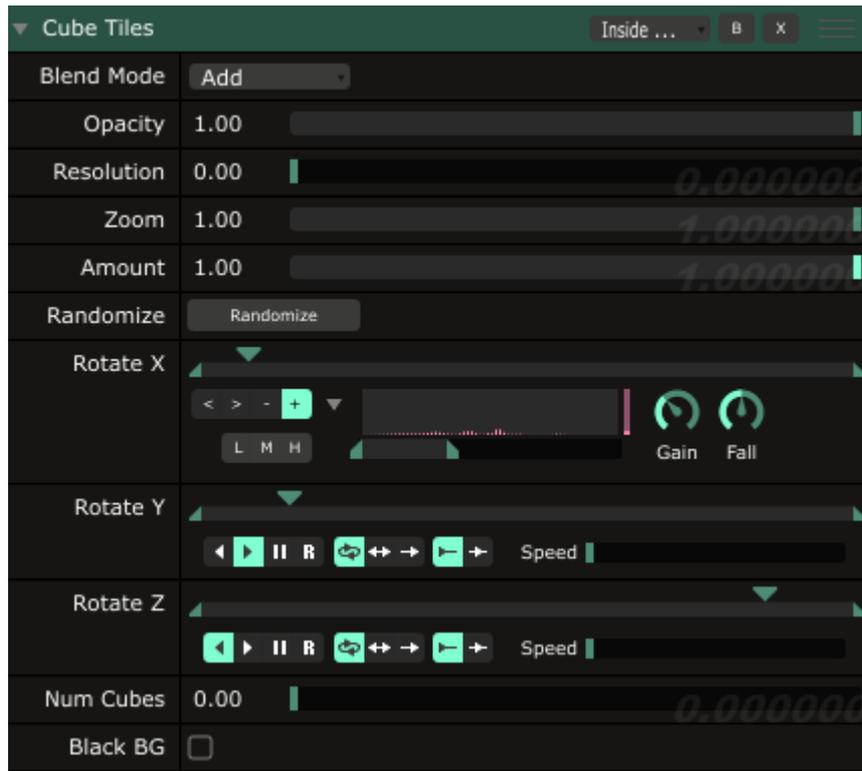
which are located like inside a cube. It is possible to rotate these compositions in x,y and z coordinates.



**Fig. 37.** *DISCONNECT*, by Anıl Özdem, 2017, Combination of Mirror and Cube Tiles Effect in Resolume Arena

These movements can be controlled by virtue of each coordinates' speed. The parameters of speed can be changed in real time, therefore, the movements can be totally controlled by human computer interaction. I assigned these coordinate's parameters into midi controller's knobs and when I increased the level of these knobs, the pattern started to move.

Although, this circumstance provides total control over motions for VJs and visual artists, I have decided to give a role to participants in order to make them part of the show. One of microphone's real time data had been assigned to one of these movement parameters and they had allowed to create motion with voice input. In the project, "Rotate X" had been assigned to voice input which can be seen in Figure 38. This circumstance provided an interaction between audiences and sound reactive visuals.



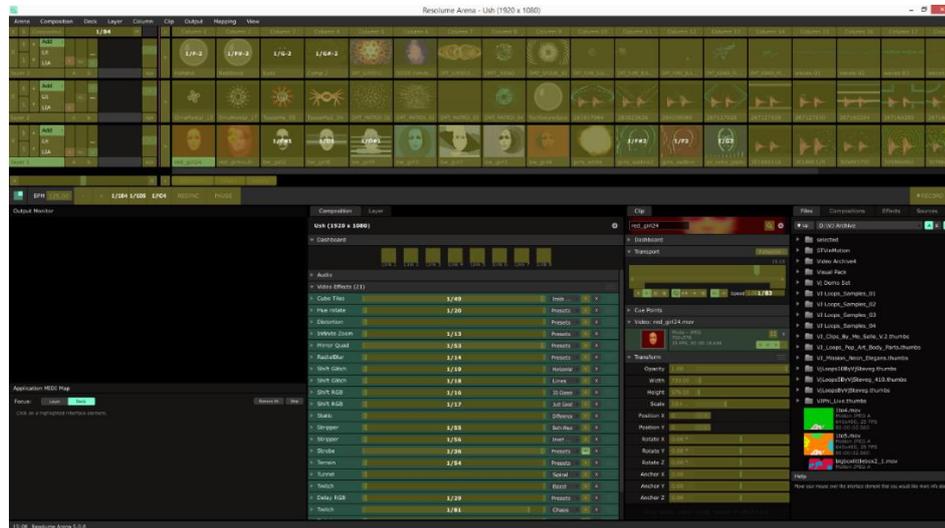
**Fig. 38** *DISCONNECT*, by Anil Özdem, 2017, Sound Reactive Rotation in Resolume Arena’s Cube Tiles Effect

### 5.2.2.1 Hardware

In the project, I have used input and output devices. Input devices including midi controller and sound board have been used to control visual parameters in order to create real time manipulation. As output devices, video projector has been used in order to display visual performance and speaker has been used to give ambient sounds during performance.

First of all, I used *Novation Launch Control XL* which is a midi controller, in order to control visual effects parameters in VJ software. The method of midi mapping which means assigning controllable value to software parameters allows that VJs can liberate themselves from keyboard and mouse and they can use input devices like

midi controller. In *Resolume Arena*, the software allows users to create midi map or key map. Users can assign the keys, faders, and pots to video source or parameters by virtue of *Resolume Arena*'s midi mapping interface (Figure 39).



**Fig. 39** *DISCONNECT*, by Anil Özdem, 2017, Resolume Arena's Midi Mapping Interface

I have assigned most used effects' opacity into pots. Opacity means that if the opacity is full, effect is completely visible. Therefore, the pots allowed me to turn on and off the visual effects with physical device. I used faders in order to control opacity of layers, and master opacity. Lastly, I have used the buttons in order to control video source. It allows me to switch video source in very quick way.



**Fig. 40.** *DISCONNECT*, by Anıl Özdem, 2017, Hardware: Sound Card (left), Laptop (middle), Midi Controller (right)

### 5.2.2.1 Audience Engagement

Traditional VJ performance includes visual performance which is made by VJ or visual artist. VJs are responsible to select video source, mix videos, manipulate and synchronize. However, If the audiences have a role on this process, they become also part of the show. Therefore, I have decided to give role for the audiences via getting real time data from them. The interaction had made with audio devices and 2 microphones had been set up in exhibition hall in order to provide data for interaction.

By virtue of well-developed feature of *TouchDesigner* in terms of real time audio processing including filters, compressor, limiter, and spectrum analyzer, I was able to get usable data from sound interaction. I have decided to manipulate my visuals with the data which is taken by audience engagement.

In the project, participants can talk or scream to microphones, and this action has automatically turned to data in coding environment (Figure 41). Next step was selecting which parameters can be usable for my visuals and I have decided to select maximum level of the sounds, and the spectrum of the sound. These data were changing in real time via getting live input with 2 microphones and these variables was assigned into my visual's parameters as color, and rotation. This circumstance made that my visual can react to sound in interactive way.



**Fig. 41.** *DISCONNECT* by Anil Özdem, 2017, Audience Interaction

### 5.2.3 Output

This section means that visual performance need to be displayed via output devices. In VJ practice, there are a certain number of alternative devices including led displays, video projectors and screens. By aid of development of computer and

software technology, multiple output devices can be used at the same time.

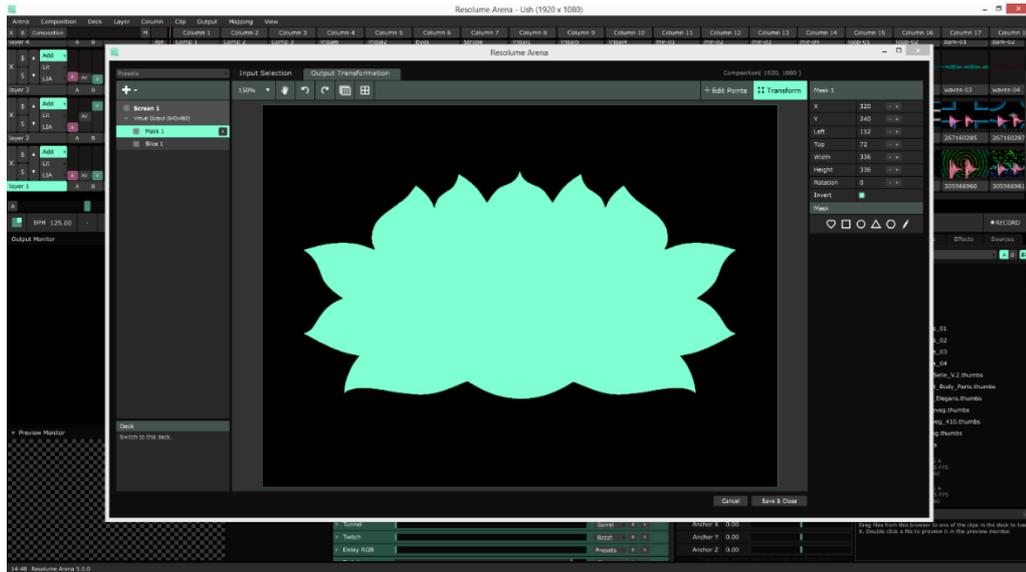
According to *Resolume Arena*'s features, "amount of outputs limited only by the number of output ports on video card and it is possible to add more outputs by using a splitter like the *Matrox TripleHead* or *Datapath X4*" (Resolume Arena, n.d.).

*Resolume Arena* allows to control all video source and devices one by one. Visual artist can create own output design including multiple screen, slice and masks and it is possible to individually select video source for their output design.

I have decided to use video projection mapping technique in order to use custom shaped projection surface. This method allows to mask unused areas according to my projection surface.

### **5.2.3.1 Video Projection Mapping and Masking Process**

After installing mapping surface into exhibition hall, the projector calibrated to it from 1-meter distance and the mapping surface had been digitally mapped via software which is named *Resolume Arena*. The software allows designers to create masks which provides custom display areas rather than rectangle traditional display area. Visual artist can draw a mask with using pen tool or defined shapes as rectangle, triangle, circle and warp video to projects onto objects. In my project, I set advanced output settings in *Resolume Arena*, and I had drawn a mask according to my lotus shape. With the help of this feature, my visuals have been displayed on certain area.



**Fig. 42.** *DISCONNECT*, by Anil Özdem, 2017, Video Projection Mapping Masking Process

### 5.3 Related Works

#### Ali M. Demirel’s Hawtin Show

As I mentioned previous chapter, Ali Demirel who is Turkish visual artist and VJ, uses computer generated imagery by generative coding in his VJ performances. One of the most inspiring work for me is Ali Demirel’s Hawtin Show. Ali Demirel works with musician Richie Hawtin which is known as Plastikman and he produces video clips and live visual shows with him.

The video “Hawtin Show” which is available on Youtube (Figure 17), shows that how he uses generative coding in his visual performance and as a VJ how he can manipulate visuals and synchronize with the live musical performance (Hawtin Show, 2012, Retrieved April 25, 2017, from <https://www.youtube.com/watch?v=4HHnqmC8J2I>).



**Fig. 43** Ali Demirel's Interface in "Hawtin Show", by Ali M. Demirel

He has also speech in *Music Tech Festival Berlin* about usage of generative coding in VJ performance. He has developed his own VJ software which is named *2V-P* and he uses generative coding as a video source. (#MTFBerlin Ali M. Demirel - 2V-P, 2015, Retrieved April 25, 2017, from <https://www.youtube.com/watch?v=YeArZNGkeTk>). He called his work as "a visual performance based on real time controlled generative images".

The idea of having total control over visual parameters is completely matched with my ideology and my aim about usage of coding to generate visuals. He designed his visuals via coding and algorithm and, with the aid of interface of *2V-P* software (Figure 43, Left), he can manipulate designed parameters in real time. In this way, visual artist can be accepted as performer. If the artist does not perform, there will be nothing to watch. I think that VJing is totally different then creation of music videos. It is based on real time visual performance which is considering to live musical performance and performative side of VJing makes the term of VJing. In this way,

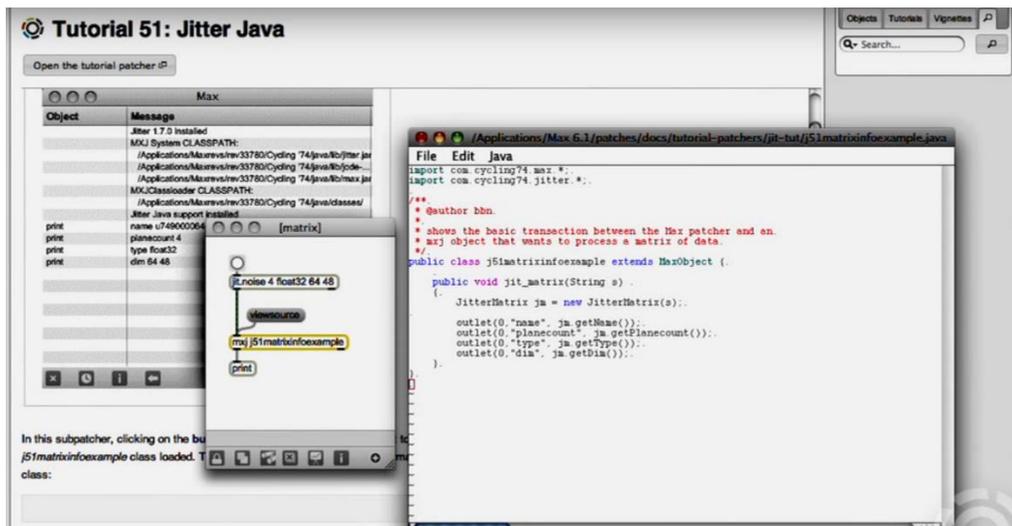
Ali M. Demirel's VJ performans shows that the role of VJs is totally important with real time control over visuals.

### **Monolake Visual Performance by Tarik Barri**

Tarik Barri's works are also another explanatory example to show generative coding in VJ Performance. According to his biography in his personal website, he creates live visuals for artist like Thom Yorke, Monolake, and Nicolas Jaar and he uses generative coding in order to generate visuals (Tarik Barri, Retrieved April 25, 2017, from <http://tarikbarri.nl/cv>). In his words, he uses coding in order to generate visuals and make audiovisual performances.

“There I saw that the methods I used to create music could also be applied to create moving images. With tools like Max/MSP, Java and Supercollider I now develop software for audiovisual performance and composition. Using these tools, I search for new synergies and aesthetics in the combination of image and sound.” (Tarik Barri, Retrieved April 25, 2017, from <http://tarikbarri.nl/cv>)

“An Interview with Tarik Barri on Tour with Monolake” had been published in Cycling 74's website which is publisher of generative coding software known as “Max MSP”. Barri uses Java programming language and generative coding platform Max MSP in order to generate visuals and he has also created relation between musical performance to trigger video scenes in real time.



**Fig. 44.** “An Interview with Tarik Barri on Tour with Monolake”, Cycling ’74, Tarik Barri’ Java Patch in Max MSP.

Another inspiration point is that he also used alternative input device like 3 dimensional space navigator in Monolake’s performance. According to his explanation, in this performance, he had created a 3 dimensional virtual space in which you could see virtual instruments that he controls and he decided to fly through all these instruments. He used 3D space navigator joystick in order fly through objects in his composition. In 3 dimensional virtual space, he created a virtual camera and he controlled the movement of the camera with the alternative input device 3D space navigator joystick.



**Fig. 45.** “An Interview with Tarik Barri on Tour with Monolake”, Cycling '74, Tarik Barri's Input devices including 3D Space Navigator and Midi Controller.

His work is important for me because Barri is very talented to extend limitation of coding environment with unique solutions in context of VJ performance. Coding provides huge range of possibilities in terms of technical capacity, however it is important that how these possibilities can be used in order to cover designer's needs. Tarik Barri's work in Monolake's live visualization is an expressive example which claims that limitation of traditional coding environment can be extended with supporting input devices and external coding patches. There is no doubt that data can be provided by various type of devices, and in case of Tarik Barri's performance, 3D Space Navigator had been used for the control camera movements in 3 dimensional virtual space.

## 5.4 Analyzes

*DISCONNECT* had been developed to show alternative methods of visual creation in order to use in visual performance. Hence the media is converted into data, and the term of digital media was born, computer technology has become natural partner of artists, designers, film makers, creatives and more who are in visual production. This circumstance provides a unique environment to generate, manipulate, and create visuals via computer software even coding.

I studied Computer Science and Education and I have worked as coder and web developer for a while. When I started to coding, I firstly learnt the term of variable and algorithm. Variable means simply a location in memory that will hold a piece of data and algorithm means steps of actions. Nowadays, I am working about audio visual art and VJ performance and when I consider the needs of VJing, it is simply based on manipulation and synchronization of visuals to accompany live musical performance. I thought that the term of variable and algorithm can be useful in visual creation in VJing, because step by step design which is called algorithm allows designer to control all steps of generation process, and variable's value in code can be change by user interaction which offers manipulation on visual. This circumstance makes the coding is useful environment to generate visual for VJ performance which is based on manipulation and synchronization. By virtue of this method, I can control all parameters and steps in real time visual creation, and as a VJ, I provide total control over my visual.

Another reason to use coding that data can be converted into another data. VJing is based on live musical performance and one of fundamental element of VJing is synchronization with the music. With the help of today's software technology, it is possible to provide data via different types of input devices as microphone, motion sensor and controller. Generative coding environment is designed for artists, creatives, and designer to generate mostly audio visual based expressive works. The environment provides necessary tools for audio and visual analyzes and creation. In case of VJing, I thought that getting live input with audio devices can provide a way to synchronize with the musical performance. Audio data can be converted into data which can be used to make my visual sound reactive and this circumstance provides synchronization of visual with live musical performance.

In this point, variable term in coding allows designer to assign a value and if it is needed, this value can be manipulated via interaction. The source code is consisted by variables which define properties of visual including position, motion, color, size and behavior. The value of variable should be assigned at the beginning, however, it is possible to change these values in real time via human computer interaction or automated systems.

*DISCONNECT* offers an interaction model for both visual artist and participants. In traditional VJing, visual artist has all responsibility over visual performance.

However, in this project, audiences have also role over visual performance. The interaction had been designed based on audio data which is taken by 2 microphones in exhibition hall. Audio data has been analyzed and used in order to manipulate visual, and audience engagement become a fundamental point of the visual

performance. Considering these reasons, this circumstance stimulate audience to feel as part of the show.

In this project, the projection ideas are designed for creating immersive space and audience can create their own experience. As we seen in Gene Youngblood's expanded cinema example, it is possible to generate environment for experience and they have started to challenge the conventions of spectatorship with creating more participatory roles for viewers. Traditional relation between art work and audience was single way, and audience is identified as only spectators. Spectators are forced to be experienced art work in single way. However, giving a participatory role to viewer makes them as part of the art work. They can create their own content and experience by virtue of having the spectatorship in more participatory way. This circumstance can also be explained the one of theory investigated by Henry Jenkins which is named participatory culture. According to Fuchs (2012), considering the definition of participatory culture by Henry Jenkins, "participatory culture as culture in which fans and other consumers are invited to actively participate in the creation and circulation of the new content" (Fuchs, 2012). According to this view, the participants are not only consumer, but also contributors. This circumstance can be also applied to art works which includes participatory roles for viewers. According to Jenkins' paper which is named as "*Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*", it is described as inviting audience to actively participate "relatively low barriers to artistic expression and civic engagement" (Jenkins, 2009). *DISCONNECT* offers an interactive environment that audiences can be engaged with art work and create their own experience and content.

I think that this circumstance turns the visual show into an experience where audiences are not only consumer, but also contributors.

## **CHAPTER 6**

### **CONCLUSION**

There is no doubt that technological developments on computer and software technology have great impact on media industry and art. Software have started to be used as a fundamental tool and partner of visual creators since computer graphics have been developed. Media has converted into computational data and the term of digital media was born. This circumstance extends visual creation methods and interaction level of the media.

The methods of visual creation have been extended by virtue of development on computer graphics and software technology. The software which are designed for artistic and visual production have started to be used for modelling, texturing, matte painting, composing and designing. With the help of this circumstance, the term of computer generated imagery has become noticeable in art and media industry.

Early pioneer researches about computer generated imagery started with programming and coding in Bell Labs, 1960s. They have used programming language and algorithm in order to generate computer graphics. Nowadays, design and production software which have graphical user interface are using by designers,

artists and creatives, but, it is also possible to generate visual via coding. In this way, generative coding is designed for audio and visual artist, designer and creatives in order to provide user friendly environment to generate visual.

Although coding is generally used for creating functional solutions, generative coding platforms are designed for creating expressive solutions. It is an intersection between art and programming which allow creatives to express themselves via coding. I think that these platforms are very useful for artist designer, who has little programming background. User friendly interface, ready to use libraries and native support on device and libraries make these platforms noticeable in art and visual production.

In this project, *TouchDesigner* has been used as a generative coding environment and the visual was created in this software. This circumstance allowed me to generate real time rendered motion graphics in order to use in live visual performance. In visual creation process, my visual was algorithmically processed which is step by step, and with the help of this method, each steps can be visible and editable in real time. Considering my research question as “How VJ can have total control over visual during visual performance”, this circumstance gives a chance to have total control over visual parameters for visual artist. Considering needs of VJ performance as manipulation and synchronization of visual with live musical performance, generative coding platforms can provide a unique environment in terms of having control over visual’s parameters.

Generative coding environments like *TouchDesigner* provides live coding environment which means manipulation of variable's value in real time. It makes possible to get real time feedback as data with the aid of human computer interaction. This interaction can be made with input devices like keyboard, mouse, sensors and other devices like microphone, camera, motion trackers. The way of interaction can be developed according the project's needs. In this point, considering second need of VJing as synchronization of visuals with music, the data which is taken from musical performance, provided a way to visually accompany to music. Real time data which was taken by audio device allowed me generate audio reactive visual patterns. It is clearly to see that generative coding is also applicable for further interactive art installations and new media art as much as VJing by virtue of live feedback method.

In traditional VJ performance, VJs have all responsibility in terms of performing with the visuals. However, in this project, participants can also meet and engage with the artwork in immersive environment. This circumstance makes audience as the part of the show. Live feedback method allowed me to control visual's motions considering real time data which is taken by audience's interaction. As it is referred to theory of participatory culture, the role of audience can be more participatory where audiences are not only consumer, but also contributors.

This project demonstrates how computation could be used in aesthetic production. As it is referred in "Aesthetic and Computation" part of thesis, computation has great impact on aesthetic productions since ancient ages. Mathematic, geometry and logical operations can be applied into artistic productions and it supports each other. In this project, numerical and logical operations provided by coding environment

have been used to generate visual patterns which are based on reflection and mirror effect. In this point, algorithm art is expressive example to explain my reason to use coding that logical operations can create complex patterns considering designed logic and operations. It provides a way to solve complex problems, and helps to create aesthetic beauty by virtue of computational methods.

In this project, projection surface is shaped via digital cutting machine which is controlled by numerical software operation. The design has been made in virtual environment, but with the help of software technology, It is allowed to convert virtual object to physical object. This circumstance claims that computer generated imagery can be applied into production and industrial processes. This method allowed designers to shape material in automated and accelerated way without any human based mistakes. It provides an environment to apply complex designs into production. There is no doubt that, converting irregular and complex shape into real object is a painful process and it is possible to make mistake in production process because of human factor. This method gives chance to eliminate human based errors in production and provides easy, and accelerated way to convert digital design to physical design. In today's world, 3D printers and cutting machines like CNC are often used to convert computer generated designs to touchable objects, and there is no doubt that this circumstance will continue to grow with the aid of development of technology.

Another significant point is that usage of computer generated imagery in art and media removes limitation of producers and provide controllable environment to generate imagery. As it is mentioned in CGI in Media chapter, for the movie

production, this circumstance gives the power to directors to have total control over what viewers would see. They allowed to create any character, place, motion and more in a realistic or fictional way. Especially, in genre of science fiction and fantasy, many number of movie started to use computer generated imagery in order to create controllable photorealistic scenes and characters. According to my personal perspective, this circumstance provides a freedom for creatives with removing limitation on imagination.

Computer technology is dynamic and it is growing with the new features. Hence media is converted into data, computers had become a common tool to contribute to the media and art. The method of visual creation by computer technology had been highly developed since 1970s, and there is no doubt that it will continue to be developed in the future. New algorithms, methodologies, devices and interaction models will be available to generate visuals by computers. I think that this circumstance blurs the technical limitations on media production and art. As we have seen in the project of usage of computer generated imagery in VJ practice, computer technology provides controllable and extendable environment to generate art works and it is clearly to see that development on technology will continue to offer new ways and methods in the future.

This research suggests that computer generated imageries which are provided by generative coding environment can be applied to audio visual, and interactive art works as well as VJ practice. Considering all of reasons written above; VJs, audio visual artists, and new media artists can be benefited by virtue of generative coding environments as an alternative way of visual creation.

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