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Modio - Interactive sound visualization

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A Thesis submitted to the Faculty of the
College of Imaging Arts and Sciences
in candidacy for the degree of
Master of Fine Arts

Modio - Interactive sound visualization

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Abstract

The word "Modio" is a compound word of Motion and Audio, which I coined for this thesis. The intent of this thesis is an interactive installation project that will explore and convert musical elements into visual elements, which will lead to various responses to the change caused by users' interaction.

Thesis URL

www.kwonjart.com

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Introduction

All music has a musical scale. The musical scale is the basic element that represents the emotions and concepts of music. The diversity of emotions and concepts depends on how the musical scales are composed. This notion can also be applied to visual communication design. Visual elements are created from small cells. In the computer graphic design industry, these cells are referred to as pixels. Pixels are put together to form a visual image, and this visual image represents emotions, concepts, and feelings through movement, scale, color, space, and shape.

In this thesis, I will define a new pixel format that will be converted from a musical scale. It will be projected on a monitor or a different output device, and it will create interactive motion graphics caused by user interaction with background sound effects that show the converted visual musical scale.

The user can freely compose the converted pixels through limited input devices, such as motion tracking, and it will project to output devices. Every time someone composes with the converted pixels, the results will vary.

The images will contain graphic images composed by converted pixels, movement, color, and layout that represent the user interaction.

The beginning of this thesis aims to convert the musical scale into visual elements by varying the input system. My thesis will show that the possibility of a diverse

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visualization of music depends on user interaction, such as through a motion-tracking USB camera system. It is similar with music; music reveals the different feelings of whoever is playing the piece. I will define one or more user interactions with motion tracking that represent the theme.

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Review of literature

When I first started my thesis project,I had to learn about musical elements such as musical scale, pitch, rhythm, and musical interval. I also needed to learn about a MIDI (Musical Instrument Digital Interface) system that could use both the computer and sound system at one time.

I also read the article about human experience interaction at Leonardo on-line published by MIT press, and I found one possibility about human interactions and sound systems. After that, I had to decide which software I would use to analyze the audio signal and turn it into a visual image. I tried to find many ways to analyze audio signals, and I found one website (www.cycling74.com) to use on my thesis project. Cycling '74 is a company that is well known to media artists who create astounding music and art with software.

One program in particular called MAX/MSP is a graphical environment for music, audio, and multimedia. MAX/MSP is a graphical programming environment, which means you create your own software using a visual toolkit of objects, and connect them together with patch cords. This type of software platform is called OOP (Object Oriented Programming). Another program called JITTER can extend the MAX/MSP programming environment to support real time manipulation of video, 3D graphics,

and other data sets within a unified processing architecture.

These programs combine to make it possible to analyze audio signals and convert them into visual images.

Cycling ‘74 -MAX/MSP

Cycling ‘74 -JITTER

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Process

Sketch

The First sketch (Fig 01) shows only the interaction between human and computer: the hardware system of project. At that time, I did not realize what I needed to focus on as the main concept of the thesis project.

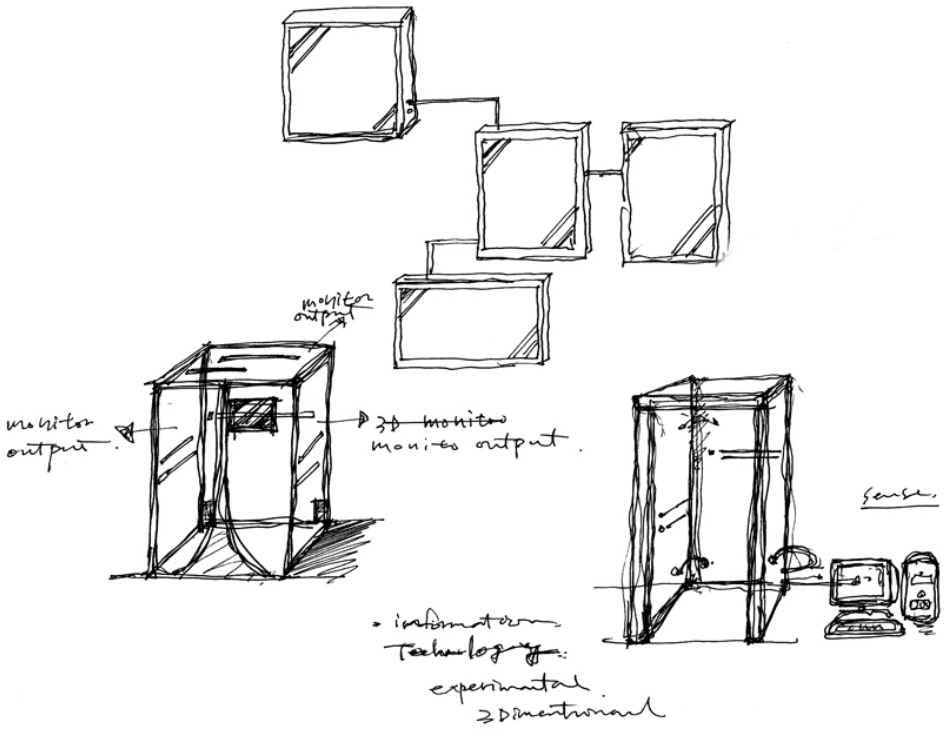

Fig 01

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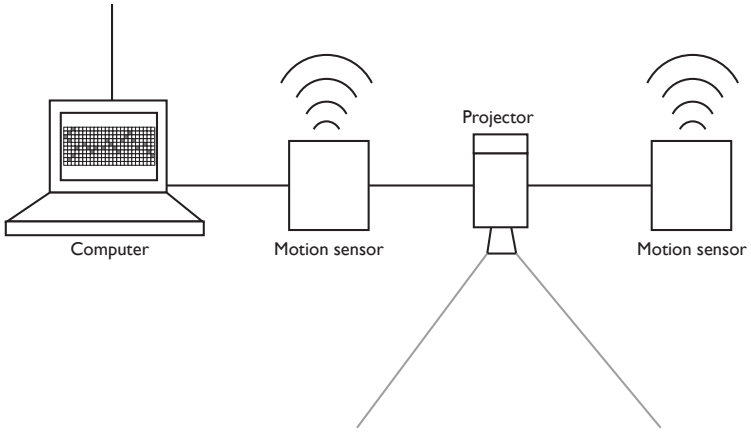
After my first sketch, I focused on the main concept and thought about human interaction and computers to build the theme of my thesis. The major consideration was what will I create with this project, and secondly, how to create human interaction between user and computer. (Fig 02)



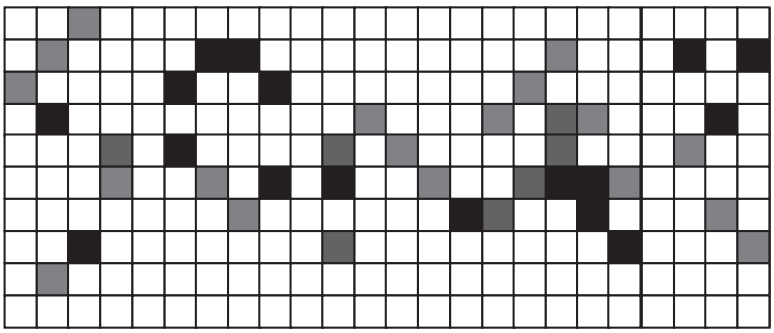


Fig 02

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Basic process

The basic process is based on input from human interaction, then a process of analysis, and finally projection as the output system. (Fig 03)

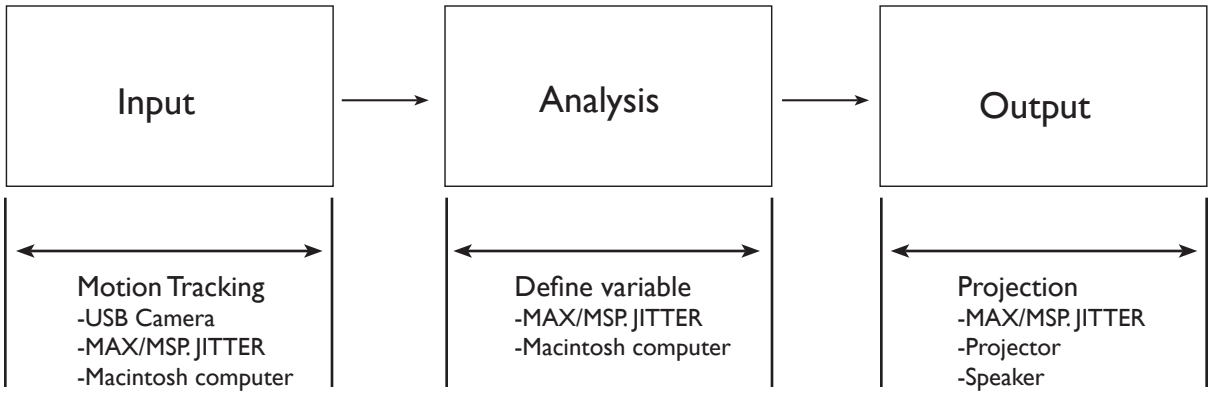

Fig 03

The input stage uses motion tracking technology by USB camera and MAX/MSP to vary the input signal, and the analysis stage uses MAX/MSP, JITTER to convert variable numbers from the input signal.

The final stage is uses JITTER, Projector, and a speaker system to project video and sound that comes from the Macintosh computer system.

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Input stage

The Input stage is sending a digital/analog signal to analyze a variable by human interaction. In my thesis project, I used a USB wireless mini camera for the input system, which made it possible to build a motion tracking system using MAX/MSP. The MAX/MSP will analyze only the converted saturated RGB color chart number captured by camera and it realizes the motions by saturated B/W color. In addition, I divided the image captured by the camera into 3 rows and 3 columns to assign the 4 different musical instruments and 4 different visual effects. (Fig 04)

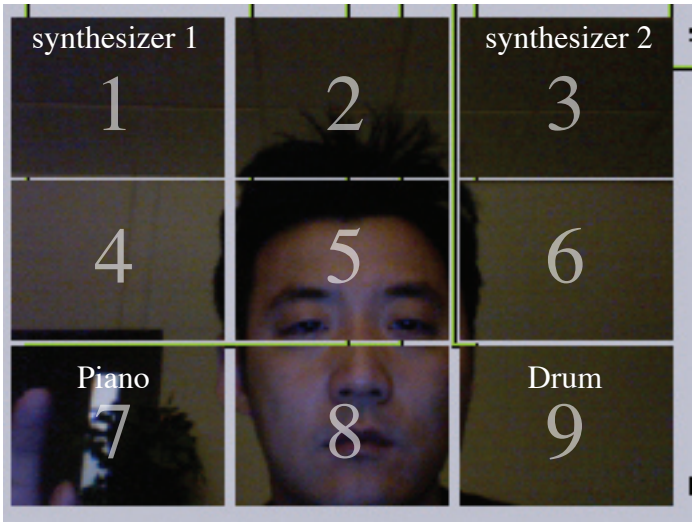

Fig 04

Only 1, 3, 7, and 9 (the four corner cells)are analyzed for motion tracking and musical instrument sounds, such as synthesizer, piano, and drum. As I assigned four corners of the screen I only want users to interact with their hands when standing in front of the

camera.

Each of the four different active cells has four different visual effects on it. The concept of this thesis project is converting sound into pixel images that reflect the audience. It converts to pixel image with unique visual effects related with four different musical instrument sounds.

The motion tracking is very sensitive and can create different sounds by small motions of the hand. For example, once you make a small movement of your finger from the left to right side at cell 7, it will increase the musical scale up to the next octave.

Analysis stage

The Analysis stage is to analyze the variable input motion tracking signal to musical scale and sound. Once MAX/MSP receives the signal from the camera, it will convert to each number and pass to MAX/MSP to create musical instrument sounds and JITTER to convert to visual images. MAX/MSP has a unique feature similar to a MIDI system that can create different basic musical instrument sounds such as piano, drum, and synthesizer. After that, the MAX/MSP signal or number will pass through JITTER and be ready to send the signal to the projector and speaker system. (Fig 05)

Every sound has a range of signal; Fig 06 shows the different ranges of sounds.

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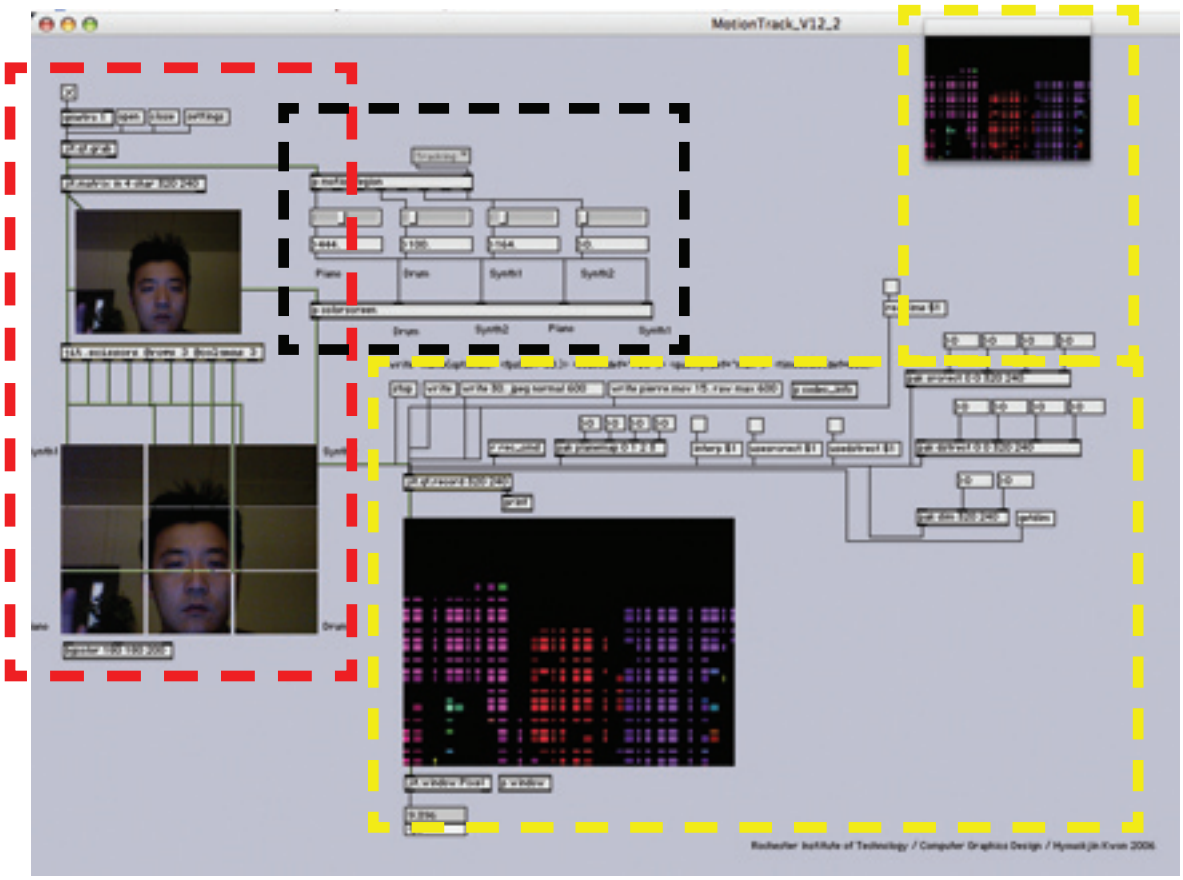

Fig 05

Differences in sound ranges are a concept of the analysis system to convert sound into visual image in MAX/MSP, JITTER. Based on Fig 06, the four different musical instrument sounds that I choose in MAX/MSP have a different sound range by varying of the input signal. So MAX/MSP will send the converted number from input signal to JITTER to create each visual effect.

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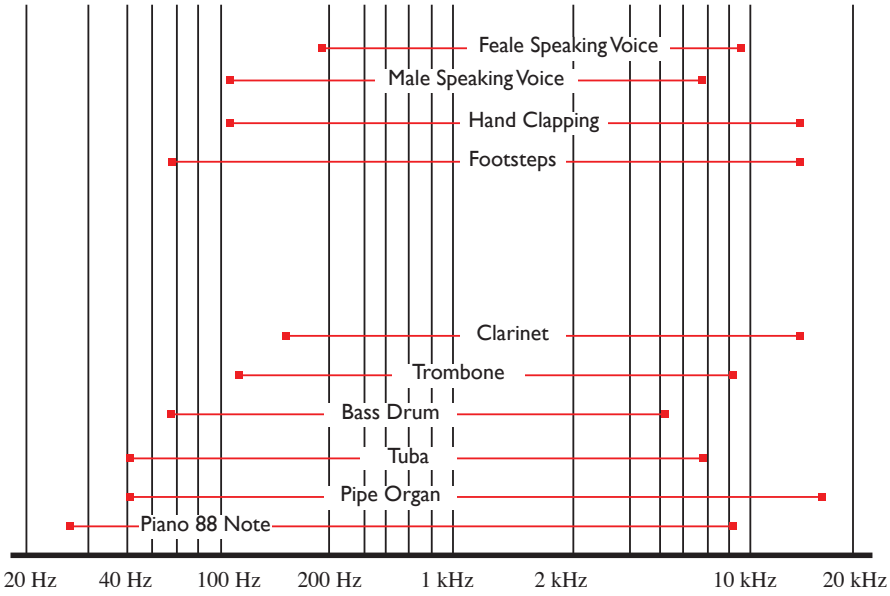

Fig 06

Design element

Each of four different musical instrument sounds must relate with four different visual effects. I chose the range of each musical instrument sounds, musical scale, stress for element of sounds, and color, sharpness of shape, grid range, and pixel size for visual elements. (Fig 07, 08)

Musical Element				
Range of sounds	Piano	Drum	Synthesizer	Synthesizer
Musical scale	Do(C)	Do(D)	Do(E)	Do(F)
Stress	Hard	Soft	Hard-Soft	Soft-Hard

Fig 07

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Visual Element		
Color	Warm	Cold
Sharpness	Sharp	Blur
Pixel size	Large	Small
Grid range	Wide	Tight

Fig 08

After that, I mixed with musical elements and visual elements to define four different visual effects. For more accurate of the analysis, I asked for help from Ph.D. student Hyunjung Oh, an Eastman School of Music piano major. After that, I defined each musical instrument sounds to relate to visual effects. (Fig 09) The result was good enough to user test in the near future.

	Color	**Sharpness**	**Pixel size**	**Grid range**
Musical Instruments				
Piano			●	
Drum	●			
Synthesizer 1		●		
Synthesizer 2				●

Fig 09

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Output stage

Installation

The Output stage includes producing visual images by four different musical instrument sounds and installation. Installation is using a USB wireless camera where the user can't realize how it works when standing in front of the project. The camera is connected to the Macintosh laptop computer by USB and uses a projector instead of a computer monitor that can project a large visual image. It will show a square transparent frame that can represent a captured screen from the camera. (Fig 10)

The user only can play in front of this frame. The camera is placed behind the user so they cannot realize where the projected image comes from.

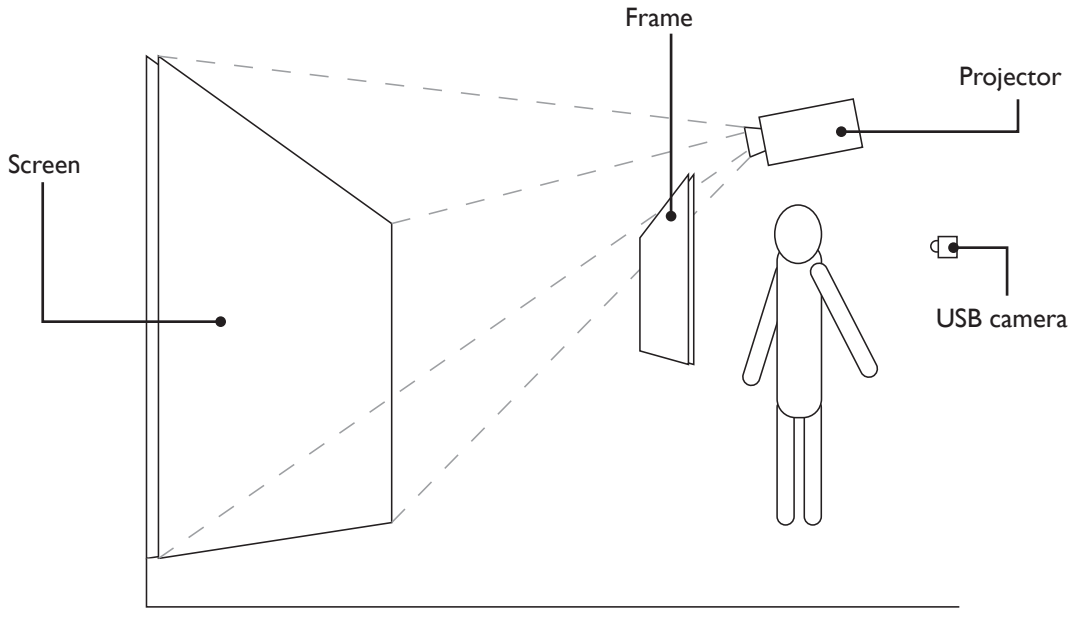

Fig 10

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-Design

Designing the visual image is the most core process of this thesis project. The visual image is created by a real time motion tracking and will reflect users who stand in front of the project. Every visual image will be created by the user's movement. The visual image keeps moving and changing colors and effects while the user interacts. Piano sounds create varying pixel sizes, drum sounds create different colors, (Fig 11, 12) synthesizer 1 sounds will affect the stroke weight on the grid, and synthesizer 2 sounds affects the sharpness. (Fig 13, 14) Those 4 different visual effects will combine two or three visual effects during user interaction.

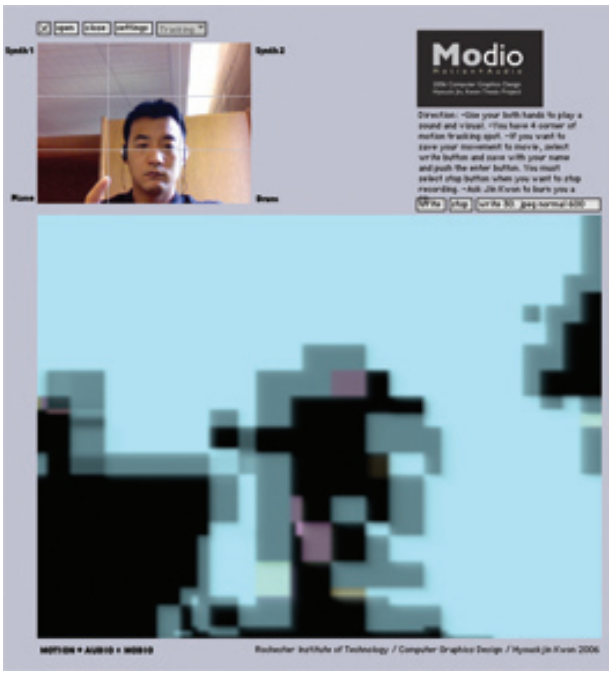

Fig 11

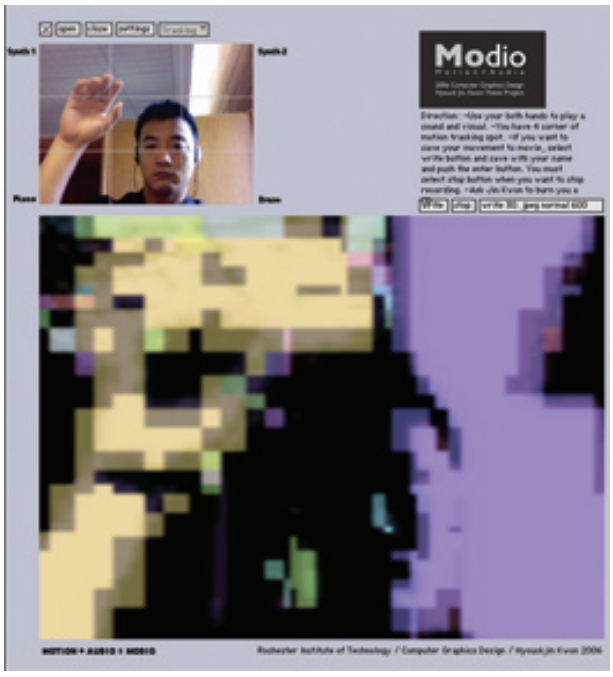

Fig 12

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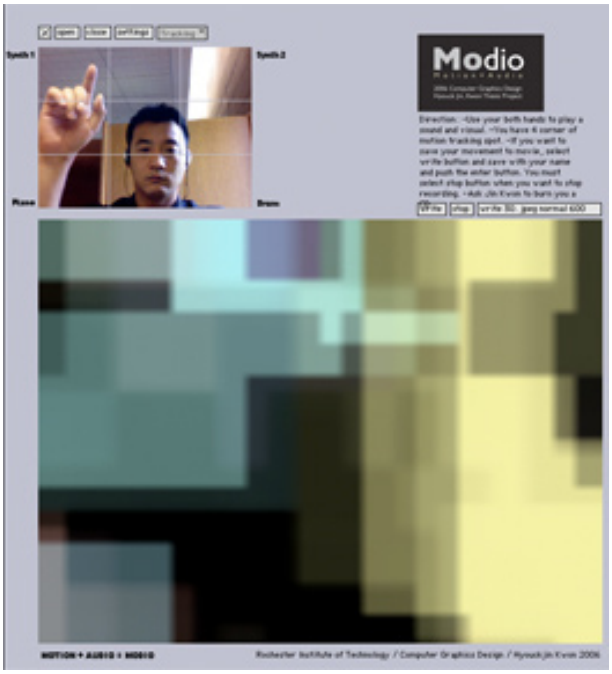

Fig 13

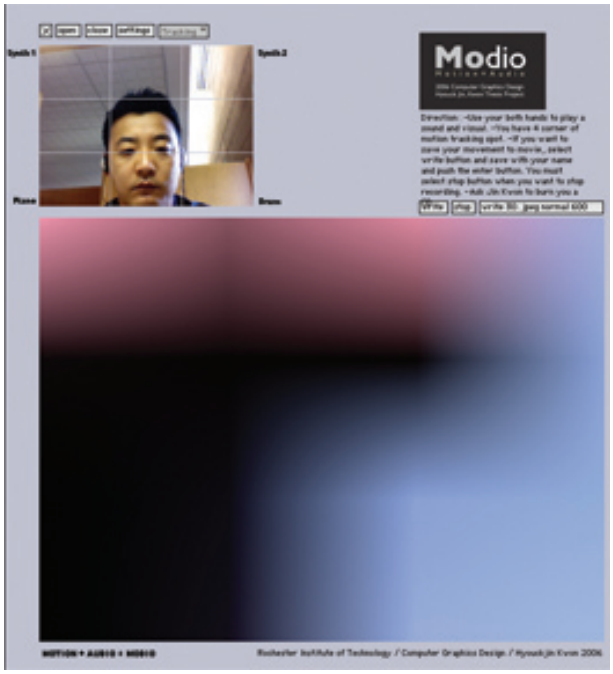

Fig 14

-Sound

MAX/MSP is software that is designed for a real time MIDI system. MAX/MSP can connect to a MIDI controller, sound module, or other external hardware that can be used in a MIDI system, or it can create a default simple sound through its own MAX/MSP software. For this project, sound is defined and created by MAX/MSP and connected to an external speaker system. Sound will be created by the user's motion on four different defined spots. For future work, this project can also connect to an external sound module to create varying sounds.

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Summary

I've used a user test group of 12 people. Most of the people are not involved in the design field. The lowest age is 14 and highest age is 64. Most of the users did not know how it works, and after I explained it to them, they got excited about playing with this project. Most of the users asked me a question about creating specific musical notes instead of random musical notes or sounds. The answer to this question is "negative." If I use a different input system instead of motion tracking, it can have the possibility of a more detailed input signal and output image, but the limitation of technology and only using MAX/MSP, JITTER cannot make more details for this project.

Conclusion

This thesis project is a model of real time installation exhibition, which is playing with motion, sound, and video controlled by user interaction. Physical interaction between user and computer creates new compositions of musical scales, sounds, and visual images. All these sounds and visual elements are defined by the creator, but it makes variables of sounds and visuals by users. I included users' experiences for one of the major elements of my thesis project, which can make it possible to interact between user and computer. Most of the users know how to create their own sounds and visuals through my project, and they left me with a good result for what I wanted to accomplish through this thesis project.

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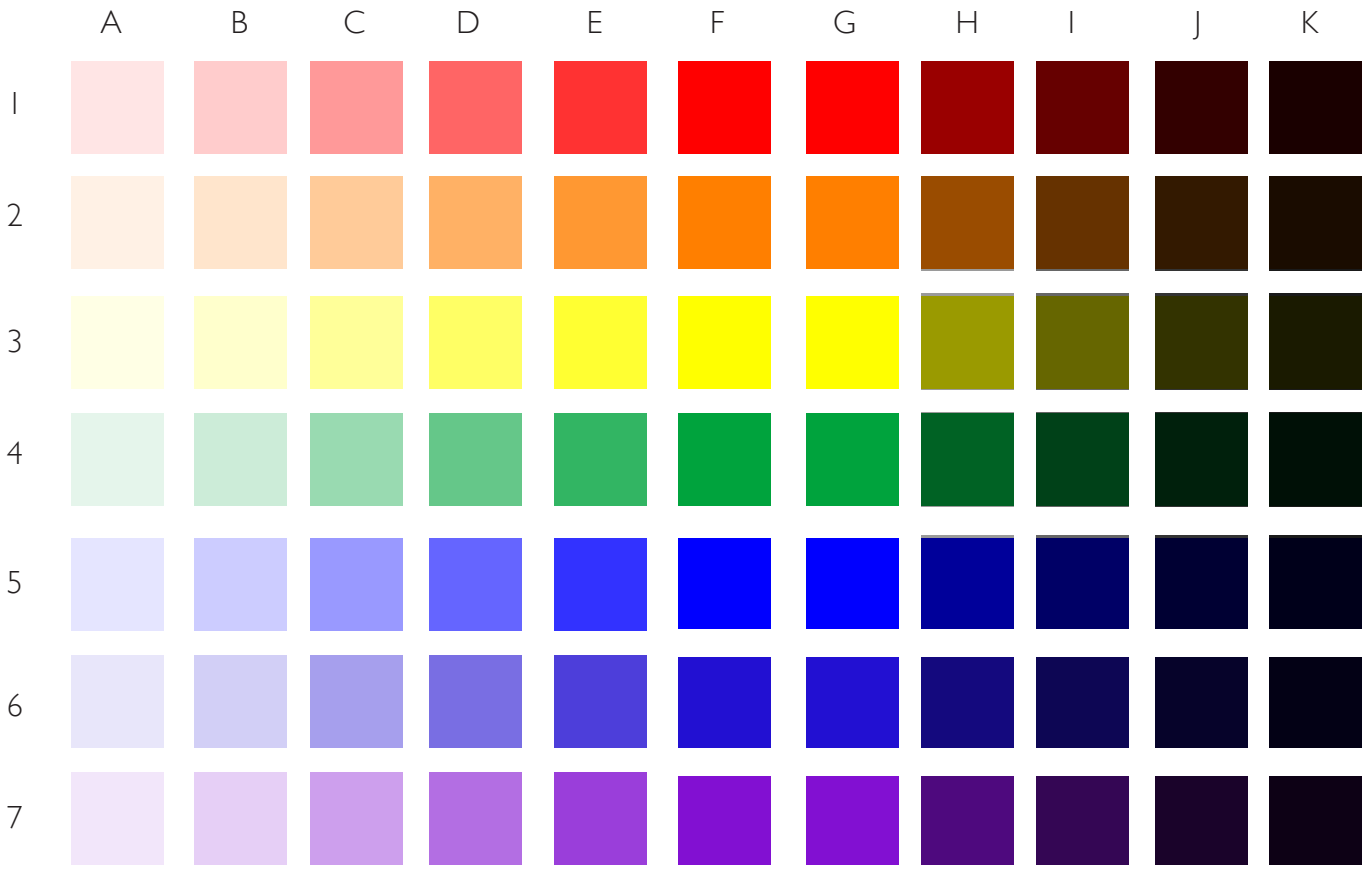
Appendix

Survay 1



Piano:	Do [ ]	Re [ ]	Mi [ ]	Fa [ ]	So [ ]	La[ ]	Ti[ ]
Synthesizer1:	Do [ ]	Re [ ]	Mi [ ]	Fa [ ]	So [ ]	La[ ]	Ti[ ]
Synthesizer2:	Do [ ]	Re [ ]	Mi [ ]	Fa [ ]	So [ ]	La[ ]	Ti[ ]
Drum:	Do [ ]	Re [ ]	Mi [ ]	Fa [ ]	So [ ]	La[ ]	Ti[ ]

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Survay 2

- [ ] Musical scale and color
- [ ] Musical scale and Brightness
- [ ] Musical and Saturation
- [ ] Musical and Pixel size
- [ ] Musical and Fade
- [ ] Musical and Motion

- [ ] Pitch and color
- [ ] Pitch and Saturation
- [ ] Pitch and Brightness
- [ ] Pitch and Pixel size
- [ ] Pitch and Fade
- [ ] Pitch and Motion

- [ ] Rhythm and color
- [ ] Rhythm and Saturation
- [ ] Rhythm and Brightness
- [ ] Rhythm and Pixel size
- [ ] Rhythm and Fade
- [ ] Rhythm and Motion

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Technical requirements

Software

- Cycling'74 MAX/MSP

- Cycling'74 JITTER

Hardware

- Macintosh OS X 10.2 or later/ Windows XP (Home or Pro), with 500 Mhz P3 or better processor

- 256 MB of system memory

- 40GB free disk space

- One or more projector or output devices instead of monitor

- Exrternal speaker

- USB camera or Firewire camera

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-Web Resourses

-leonard journal
http://muse.jhu.edu/journals/leonardo/

-MIT media lab
http://www.media.mit.edu/research/index.html

-Thing that think
http://ttt.media.mit.edu/index.html

-Intercommunicationcenter
http://www.ntticc.or.jp/Collection/Icc/index.html

-Electronic component
http://www.digikey.com/

-MAX/MSP, JITTER
http://www.cycling74.com
http://www.maxobjects.com/
http://arts.ucsc.edu/EMS/

-TELEO
http://www.makingthings.com/

-Processing
http://processing.org/
-http://www.artcom.de

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-Other Resourses

-S. Smith et al, "Visualization of Music" , Technical Sketches, SIGGRAPH 1997

-T. Takala, "Virtual Orchestra Performance", Electric Garden, SIGGRAPH 1997

-B. Repp, "Music as Motion: A Synopsis of Alexander Truslit's (1938) Gestaltung und Bewegung in der Musik", Psychology of Music, 1993

-The SIGGRAPH Art show