

Perceiving Interaction
Audrey Yen-Ning Fu

Perceiving Interaction
Between Light and Illusory Perception of Space.

This thesis is submitted in partial fulfillment of requirements for the degree of Master of Arts in Design and approved by MFA Design Review Board of Massachusetts College of Art and Design in Boston.

May 2010

Jan Kubasiewicz, Thesis Advisor
Coordinator of Graduate Program in Design, Professor of Design
Dynamic Media Institute,
Massachusetts College of Art and Design, Boston

Joseph A. Quackenbush,
Associate Professor of Design
Dynamic Media Institute,
Massachusetts College of Art and Design, Boston

Gunta Kaza
Professor of Design
Dynamic Media Institute,
Massachusetts College of Art and Design, Boston

Brian Lucid
Associate Professor of Design
Dynamic Media Institute,
Massachusetts College of Art and Design, Boston

Acknowledgments

I would like to express my gratitude to:

Jan Kubasiewicz for your insightful advising, precisely point of view, wisdom notions, great sense of responsibility and certainly intelligent knowledge.

Joseph A. Quackenbush for your faithful critiques, patience, and helping with my thesis writing.

Elaine Froehlich for your limitless kindness, tireless support forever and powerful assistance in thesis writing process.

Gunta Kaza for your encouragement, taking care always, understanding and being as a mentor as well as a friend.

Michael Golembewski for your conceptual inspirations and brilliant consultations.

Brian Lucid for your technical guidance and deeply narrative thought.

My family for your unbeatable LOVE.

Abstract

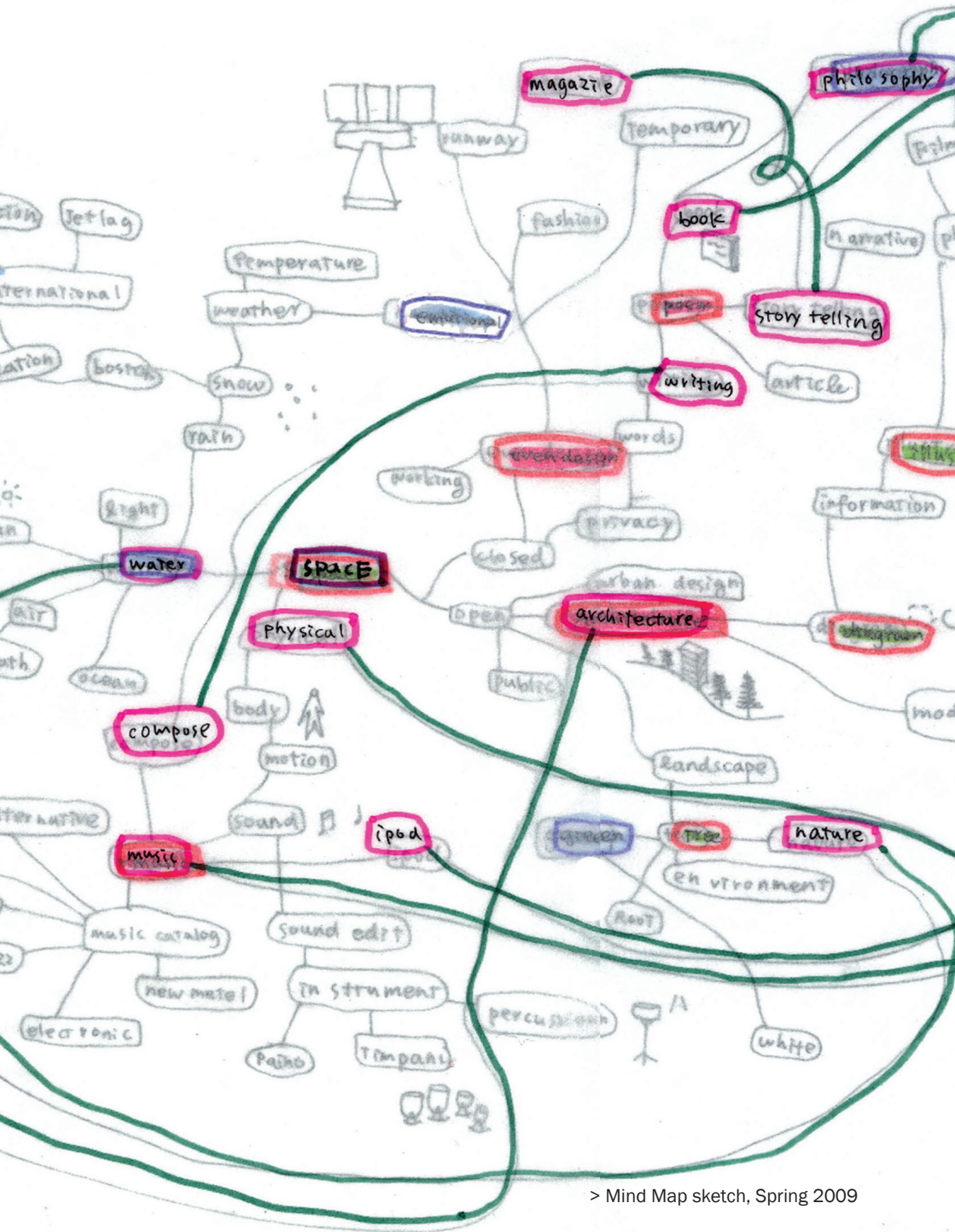
This thesis focuses on light as a tool to recreate the perception of space.

I created a series of experimental case studies to observe the interaction between light, physical filters and space. The experimentation was based on a three-layer projection system with light sources, physical filters and spatial surfaces including balloons, paper waves, and foam core triangular structure, among others. For each layer of the system, I used a manifold projection of image, motion and sound content, as well as various materials, textures and shapes, to test multiple variables and possibilities.

For my main thesis projects, human motion is the key variable of the experiment. Humans interact with projected light manipulating our illusory perception of space and creating a sort of performance.

Table of Contents

Abstract		Zebra Shadow	79
		Water Drop	91
Introduction		Primary Thesis Projects	
Motivation	1	Four Explorations	107
Mind Map		Lighting Bodies	
Art as Experience		Interactive Light	
Dynamic Media Age		Light as Dream	
		Moving Light	
Related Theoretical Quotations		Day Dream: Group Users Experiences	129
Perceived Self	7	Heart Beat: Language of Performance	147
Interactive Environments	8		
Seeing Illusions	10	Conclusion	
Projection Light in Art	12	Experience and Thought	169
Altered Space Perception	14	Bibliography	171
Experimental Case Studies			
Tool: Light, Physical Filter and Space	17		
Sound Wave	31		
Lightness	47		
Narrative Blind	63		



> Mind Map sketch, Spring 2009

Introduction

Motivation

Mind Map

The word “space” was coming out naturally when I drew my mind map. Space is like the first stop of the tramway when I commenced sketching my own mind trip; the paths, which are connections and connections, in between what I take interest in and what I learned.

Architecture and exhibition design background are extremely significant parts of my early creative enlightenment.

Five years undergraduate study in architecture brought me to another life adventure different from traditional force-feeding education I began with. Designing, prototyping, case studying and pulling all-nighter; I was exhausted, but I learned more than people could imagine. I also learned about space. Exhibition design work gave me practical trainings after my studies. For performing the product’s character, quality and the attainable idea of each event’s theme, space was always emphasized. I began to perceive and manipulate multitudes of space.

“Space” is naturally the beginning place for me to investigate in my thesis mind map.

Art as Experience

Gradually, I understood how important “having fun” in design is.

“For to perceive, a beholder must create his own experience. And his creation must include relations comparable to those, which the original producer underwent. They are not the same in any literal sense. But with the perceiver, as with artist, there must be an ordering of the elements of the whole that is in form, although not in details, the same as the process of organization the creator of the work consciously experienced. Without an act of recreation the object is not perceived as a work of art.” John Dewey, Art as Experience.

“Design as Experience” was the most impressive course I participated in. I learned how to create with my personal experiences and how that made me think about the experience of the final user for my design work. Gunta Kaza, as the instructor, is a great thinker and supporter. I couldn’t describe how much this course guided me. I didn’t quite know how experiences could lead my approach; I wasn’t quite sure what the character of the spatial experiences could be for my thesis progress. But I know that the most beautiful thought is experience.

“I believe that design education, at the most fundamental level, views complexity as a problem to be overcome through reductionist artifacts, not as an inevitable and pervasive attribute of life in the post-industrial community. So if the future is about an ever-expanding web of connectedness, how are we preparing students for meaningful work in this complex world? I’d like to suggest that we’re not. Despite the obvious emotional impact of Glaser’s poster, he

belongs to a generation in which the goal of design was to make things simple. Negroponte, on the other hand, is a technologist for whom the design goal is to render the complex manageable and to make complicated things meaningful.” Meredith Davis, Massaging Media Two Conference Keynote Presentation.

Over and above, the quotation that I knew from Joseph Quackenbush’s “Design Studio Two” class was a strong motivating impulse for me to think about how to create a meaningful and simple design work with experience.

I made my spatial experiences to be a motivation with my new media learning during DMI program.

Dynamic Media Age

“All media work us over completely. They are so pervasive in their personal, political, economic, aesthetic, psychological, moral, ethical, and social consequences that they leave no part of us untouched, unaffected, unaltered. The medium is the message. Any understanding of social and cultural change is impossible without a knowledge of the way media work as environments.” Marshall McLuhan, The Medium is the Message.

Dynamic media is a new design medium for me.

When I was seven years old, the voice from the radio station’s DJ was the first sound I heard every morning. The radio was a tool for waking me up. When I was thirteen, my parents bought a 256-generation PC for home. My sisters and I tried hard to figure out what the computer is. At last, we start our game playing life with it. I sent

my first e-mail when I was seventeen. E-mail was a tool that connected a boy and me without my mom finding out. As an architecture student in my undergraduate years, the most useful tool for me for building 3D models, calculating and drawing the floor plan was a computer application.

For now, new media technology is important tool for breaking the limitation of creativity. I can have a dream. I can have imagination and build it up. The communicated activities are changed and developed. The “tool” is a tool for this incoming world and for bringing the world into another dimension. New media is evolving, and we are learning from it.

For exploring and approaching my thesis intention, I adopted projection light as new media technology to experiment and experience the possibilities and effects between light and space.



Related Theoretical Quotations

The theoretical foundation of my thesis is based on various concepts of multiple authors referring to “Perceived Self,” “Interactive Environments,” “Seeing Illusions,” “Projection Light in Art,” “Altered Space Perception.”

In this chapter I’d like to bring the most important quotations from selected authors, which I found most relevant to my thesis investigation.

Perceived Self

People perceive every event in the whole environment with the senses of sight, smell, taste, touch, and hearing. At the same time people sense and perceive themselves.

“As far back as the 1760’s, the famous philosopher Immanuel Kant proposed that our knowledge of the outside world depends on our modes of perception. In order to define what is “ex-trasensory” we need to define what is “sensory”. Traditionally, there are five senses: sight, smell, taste, touch, and hearing. Each of the senses consists of specialized cells that have receptors for specific stimuli. These cells have links to the nervous system and thus

to the brain. Sensing is done at primitive levels in the cells and integrated into sensations in the nervous system. Sight is probably the most developed sense in humans, followed closely by hearing.” Antonio Zamora, Anatomy and Structure of Human Sense Organs.

To paraphrase: people use the sense of sight and hearing more than other senses to feel and understand a “thing.” Therefore, the sense of sight and hearing would allow people to experience the events in the environment more deeply. Also, Nathan Shedroff, have being inspired by Diane Ackerman’s book, “A Natural History of the Senses,” made a great “Taxonomy of the Senses” That shows the sense of sight and hearing receive more information than the others.

In my thesis statement, I emphasized the perspective of human interaction between projection light and space; I adopted the virtue of human senses; especially using the reaction of the sense of sight and hearing to explore human motion.

Interactive Environments

Development in new media leads to the improvement of interactive environments. The interaction between new media technology and space interests designers, artists and scientists. They research and invent within new media technology to create understanding in interactive environments.

“Interactive environments are spaces where the interactive media determine the space and its behaviour. For example, Interactive floors and walls, allow the immersive and reactive change of the space according to the visitors behaviours.

Such interactive spaces are usually multiple user environments where varying numbers of visitors may have shared experiences. Visitors should achieve equal grades of interactions with other visitors as well as experiencing the content.”

“As technology increasingly permeates people’s everyday lives all over the world we as people change, our lives change, how we do things, what we expect from the “stuff.” around us. Human nature has it that we experience these changes as very subtle and indiscernible. We only recognize that we have lost something long after we actually have lost it. Suddenly a new house stands there, and we cannot remember the house that stood there before.

While we think we are doing something with technology, it is actually technology that is doing something with us. Technology has become something we do and this changes us as human beings. I am interested in these changes. Do our essential ideals, dreams and desires stay the same or do they change as well? If so, we change.” Michael Hohl.

In interactive environments, the degree of human interaction is increasing more than in static space. Moreover, creativity and imagination are inspired more in interactive environments.

People look for inspiration in art installations and design work. In the same way, more ideas are inspired in interactive environments, and then they take the ideas into their own designing, creating and working. I believe design of interactive environment may help people work with more conceptual thoughts. I made use of the potential of interactive environments in my projects.

Seeing Illusions

Scientists explain how human brains perceive illusions. They have a system to investigate the function of the brain using consistent research methodologies.

“The Human brain put images together because they have learned to expect things, and sometimes the data might get a little confused. We may see an illusion because we know what we are expected to see, even though part of a picture or design may not be completely there. The basis of this is in how we perceive things. That almost explains everything right there. If our brain and eyes did not function like they do, we would not see illusions like we do.” From: Indianchild.com

In other words: *“Illusions are images that use your EYES to confuse your BRAIN” From: sciencebob.com*

Neurologists and philosophers moreover discover, search and clarify how to create illusions, what causes the brain to see illusions.

“Errors of perception (phenomena of illusions) can be due to knowledge being inappropriate or being misapplied. So illusions are important for investigating cognitive processes of vision. Acceptance that knowledge makes a major contribution to human vision is recent, remaining controversial. This applies even more to the machinevision of artificial intelligence. Perhaps progress in artificial intelligence has been delayed through failure to recognize that artificial potential intelligence of knowledge is needed for computer vision to be comparable to brains.”

“There are two clearly very different kinds of illusions: those with a physical cause and cognitive illusions due to misapplication of knowledge. Although they have extremely different kinds of causes, they can produce some surprisingly similar phenomena (such as distortions of length or curvature), so there are difficulties of classification that require experimental evidence.

Illusions due to the disturbance of light, between objects and the eyes, are different from illusions due to the disturbance of sensory signals of eye, though both might be classified as physicals. Extremely different from both of these are cognitive illusions, due to misapplied knowledge employed by the brain to interpret or read sensory signals. For cognitive illusions, it is useful to distinguish specific knowledge of objects, from general knowledge embodied as rules. Either can be misled in unusual conditions, and so can be revealed by observation and experiment.” Richard L Gregory, Priscilla Heard, Knowledge in Perception and Illusion.

Margaret S. Livingstone has been working on how an artist produces a dynamic illusion and why learning disabilities may be associated with artistic talent.

“Artists have been doing experiments on vision longer than neurobiologists. Some major works of art have provided insights as to how we see; some of these insights are so fundamental that they can be understood in terms of the underlying neurobiology. For example, artists have long realized that color and luminance can play independent roles in visual perception. Picasso said, “Colors are only symbols. Reality is to be found in luminance alone.” This

observation has a parallel in the functional subdivision of our visual systems, where color and luminance are processed by the newer, primate-specific what system, and the older, colorblind, Where (or How) system. Many techniques developed over the centuries by artists can be understood in terms of the parallel organization of our visual systems.” Margaret S. Livingstone

I gained a lot from Margaret S. Livingstone’s lecture and books on the research she has done such as *“Vision and Art: The Biology of Seeing.”* The conceptual idea she explored above was what I assumed centrally in my experiments.

Projection Light in Art

“Since the early 80s, the use of rapidly-developing slide and video projection technologies and illumination systems has become increasingly popular among artists and media professionals. These forms stand today as standard presentation and artistic techniques,” Krzysztof Wodiczko.

Many artists use projection light to create their work such as James Turrell, Polygon Playground, Bill Viola, United Visual Artists, Anthony McCall and more. Light is an attractive stimulus for most people; it’s called “phototropism.” Artists furthermore extend the light as projection light to deliver their ideas with computer operations.

One of the most famous light artists: Olafur Eliasson, made many amazing works with light. He not only adopted the characteristics and qualities of light, he created narrative in his projects. He inspired a lot of artists in the same field, included me.

“I use light to dematerialize space. As my ideas and the work developed, I found I could dematerialize architecture by combining light, space and movement. I had always been fascinated with the light and space artists such as James Turrell; his perceptual light illusions transform our experience of architecture. Following this tradition, I investigated how light could create an illusionistic sense of space and dimension. Unlike the light space artists, I added the component of motion to my light projected illusions that made the architecture appear to dematerialize. I first came across this visual phenomenon when I created Untitled (1993), a floor projection piece. A colorful water animation was projected from the ceiling down across the floor. The inanimate floor seemed to breathe; the architecture was transformed by light. The viewers perceived the non-physical components of the imagery and light corporeally. People actually experienced the physical sensation of seasickness. Ever since creating Untitled, I set out to investigate illusions that transform the viewer’s perception of actual space in a synthesis of the real and virtual,” Jennifer Steinkamp.

I found the artist “Jennifer Steinkamp” to have a similar idea and notion with the thought and imagery I pursued in my thesis writing process; which is using projection light to dematerialize the perception of space. My objective is to create my projection lighting system to alter the perception of the space; then, to see how people react and interact with in this illusory space.

Altered Space Perception

“Quite a different approach to the problem of visual space perception is to focus on visually guided action, such as reaching, throwing, and locomotion, the goal being to determine which aspects of visual stimulation control the action and the process by which they do so. Some advocates of this approach (Gibson, 1958; Lee, 1980; Turvey & Remez, 1979; Warren, 1988) have eschewed the notion of an internal perceptual representation as a necessary construct in any explanation of visually controlled action and prefer instead to look for optical variables in the static or dynamic optic array that might be tightly linked to aspects of the controlled action. For example, theoretical studies (Lee, 1976, 1980; Lee, Lishman, & Thomson, 1982) have shown how the locomotor flow line in the optic flow field and the optical invariant specifying time to contact could be used to control steering and approach to a surface, respectively. Given the effectiveness of visually controlled behavior in such organisms as birds and insects (Gibson, 1958; Lee, 1980; Tvey & Remez, 1979; Warren, 1988), there is good reason to question the need for visually perceived space as an explanatory construct of the locomotory behavior of such species. However, in the human and other higher organisms for which the concept of visual space has greater cogency, it remains to be seen under what conditions the nonveridical aspects of visual space manifest themselves in visually guided behavior,”

*Jack M. Loomis, Naofumi Fujita, Josi A. Da Silva,
Sergio S. Fukusima.*

As people walk into a space, a room, the order of the space they know existed already. They know how the space looked; they know where each object and piece of furniture is.

Once I took an element of the order away and changed it, the atmosphere, ambience, quality and “sense” of space changed. People will feel and experience the change, and then react.

Not only do they see, but also they feel the difference. As a creator, I design a wonder, and an experience, to inspire people to rethink and re-imagine the space and light.

The element I changed in space was to add light projection systems and create the illusory perceptions in my thesis investigation. Furthermore, I focused on perceiving the action of people interacting in space and with other people, when I altered the quality of perception by projection light into that space.



> Final Installation: triangular structure, human motion, light

Experimental Case Studies: Tool_ Light, Physical Filters and Space

Overview

Inspiration

The inspiration for this study came from a project assigned by Mike Golembewski in his “Interactive Media Project” class in spring of 2009, which was to create a tool to help my thesis project. The aim of my case study was to re-imagine what space could be.

For most people, space is what they see. And they only believe what they see. However, for me, space is not merely physical aspects: walls, furniture, object, etc. I found that light could have a dramatic influence on the atmosphere, ambience and perception of space. Light was a great guest or “tool” for me, to re-imagine space. In addition to light, I added “physical filters” into my design process such as water, paper, rice, and sugar, among others.

Objectives

At the time, the “Tool” project was a short-term study. The objective was to explore light, physical filters and space.

Nevertheless, it grew into the beginning of my thesis process. Instead of pursuing a practical design project, I developed a series of experiments that investigated the effects between light, physical filters, and space.

Experimentation

The three-layer projection system was made with a light source, physical filters and spatial surfaces.

In the first exploration, the projection light was the light source, which passed through various materials such as physical filters and onto the spatial surfaces such as shaping walls, iron panels or white board. In the next step, the light source was two projectors at different angles. The people's bodies became both physical filters and spatial surfaces.

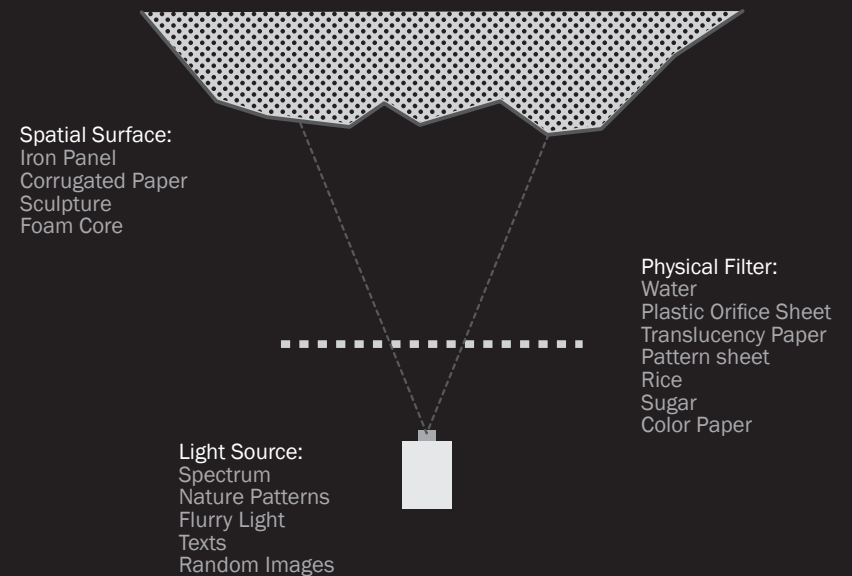
Light transmitted through the body filter brought the shadow on the spatial surface and changed the former perception of space.

Process

In the beginning, I modeled from the three-layer system to create a series of experimental studies and made a replacement of different materials for each layer:

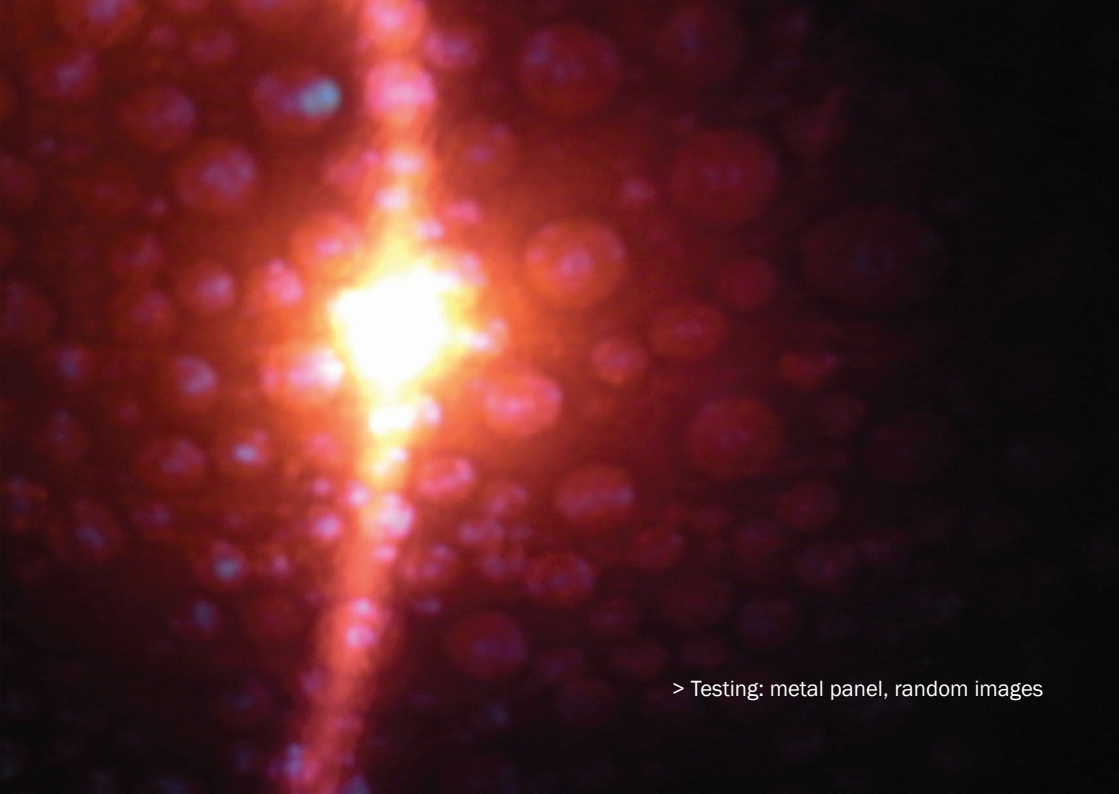
- Light source: spectrum, nature patterns, flurry light, texts.
- Physical filters: water, plastic orifice sheet, translucency paper, pattern sheet, rice, sugar, color paper.
- Spatial surface: iron panel, corrugated paper, sculpture.

Testing Experimentation:





> Testing: corrugated paper, water, random images



> Testing: metal panel, random images



> Pre-prototype: foam core, 7x7x7 model, random images



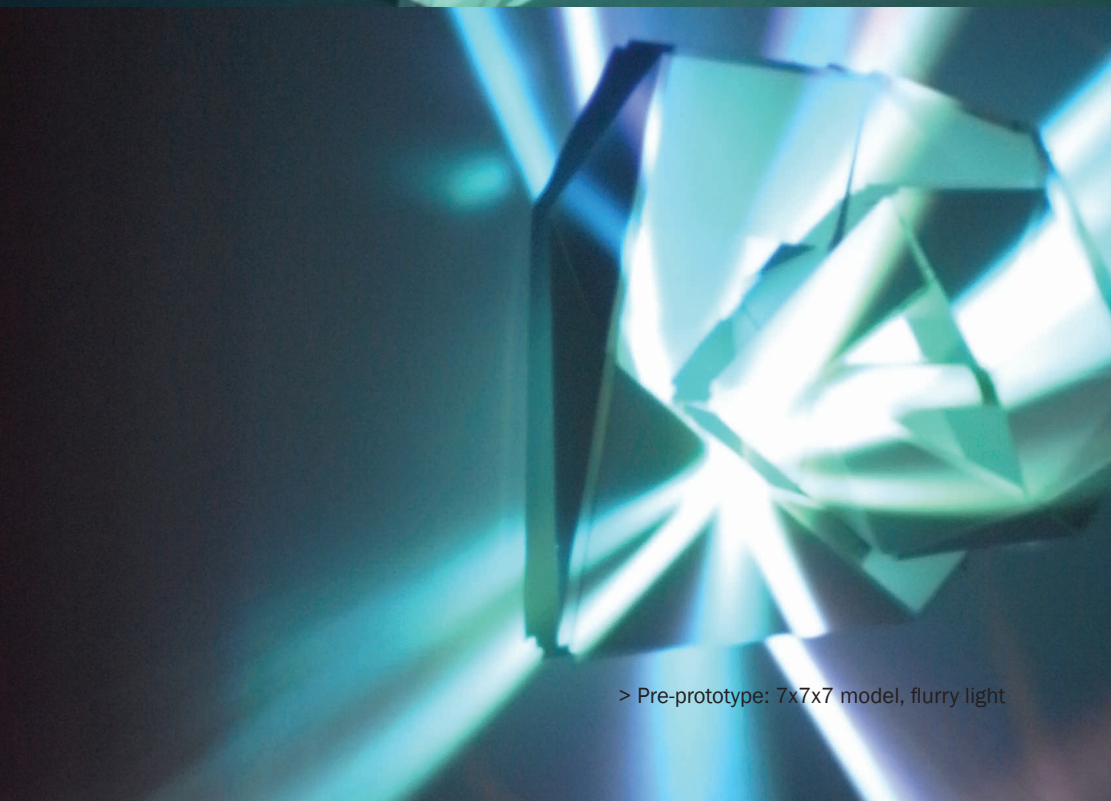
> Testing: corrugated paper, translucency sheet, random images



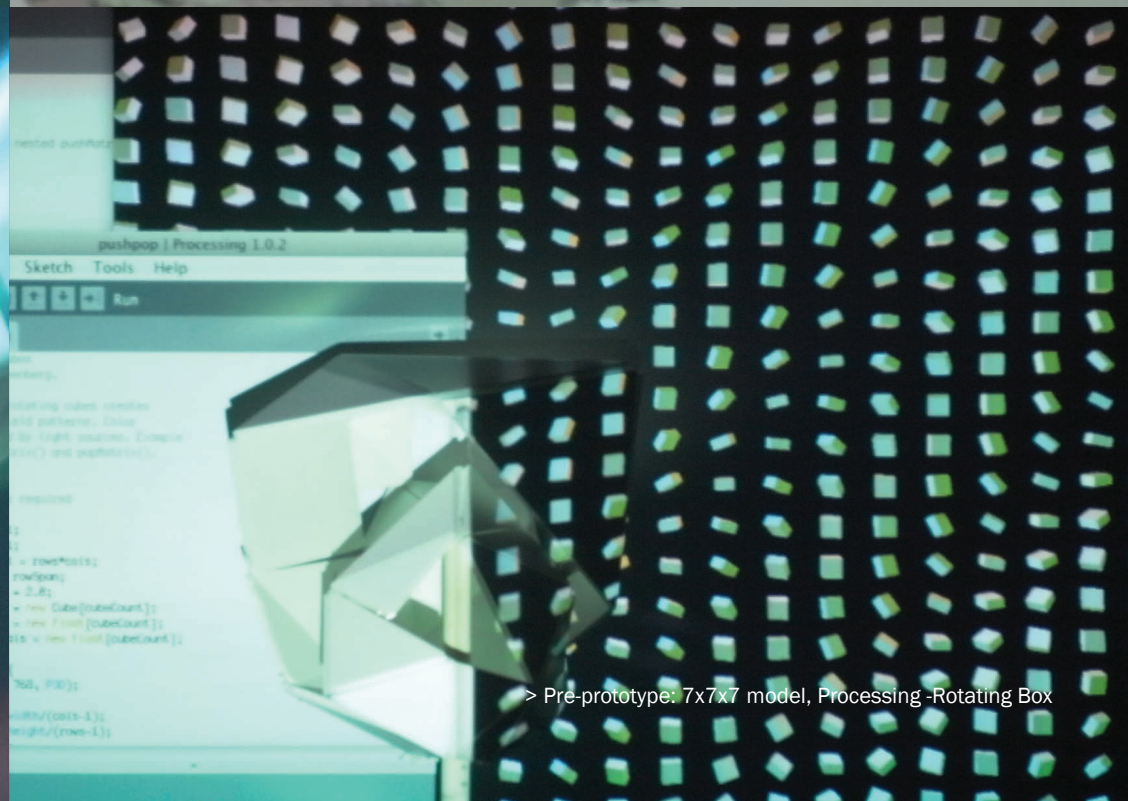
> Pre-prototype: 7x7x7 model, Processing_Drawing-Tool



> Pre-prototype: foam core, 7x7x7 model, texts

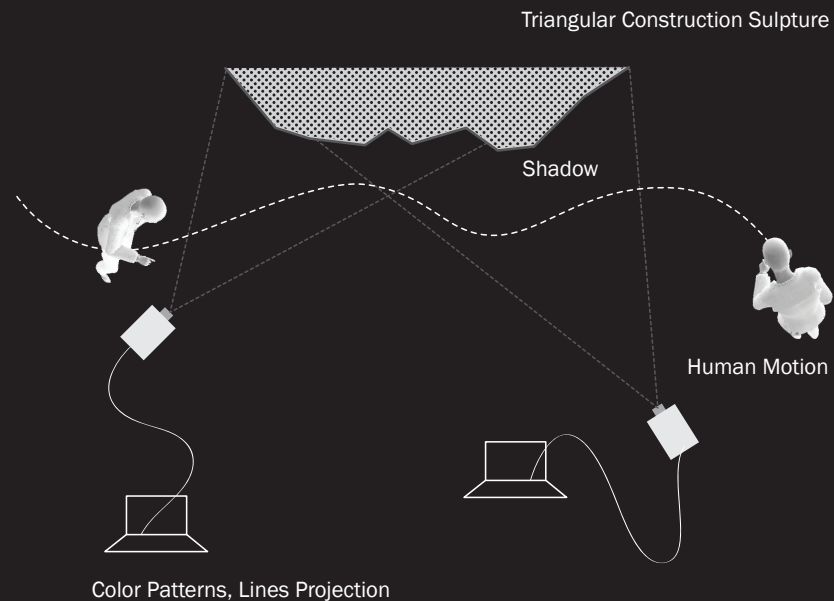


> Pre-prototype: 7x7x7 model, flurry light



> Pre-prototype: 7x7x7 model, Processing -Rotating Box

Final Experimentation:

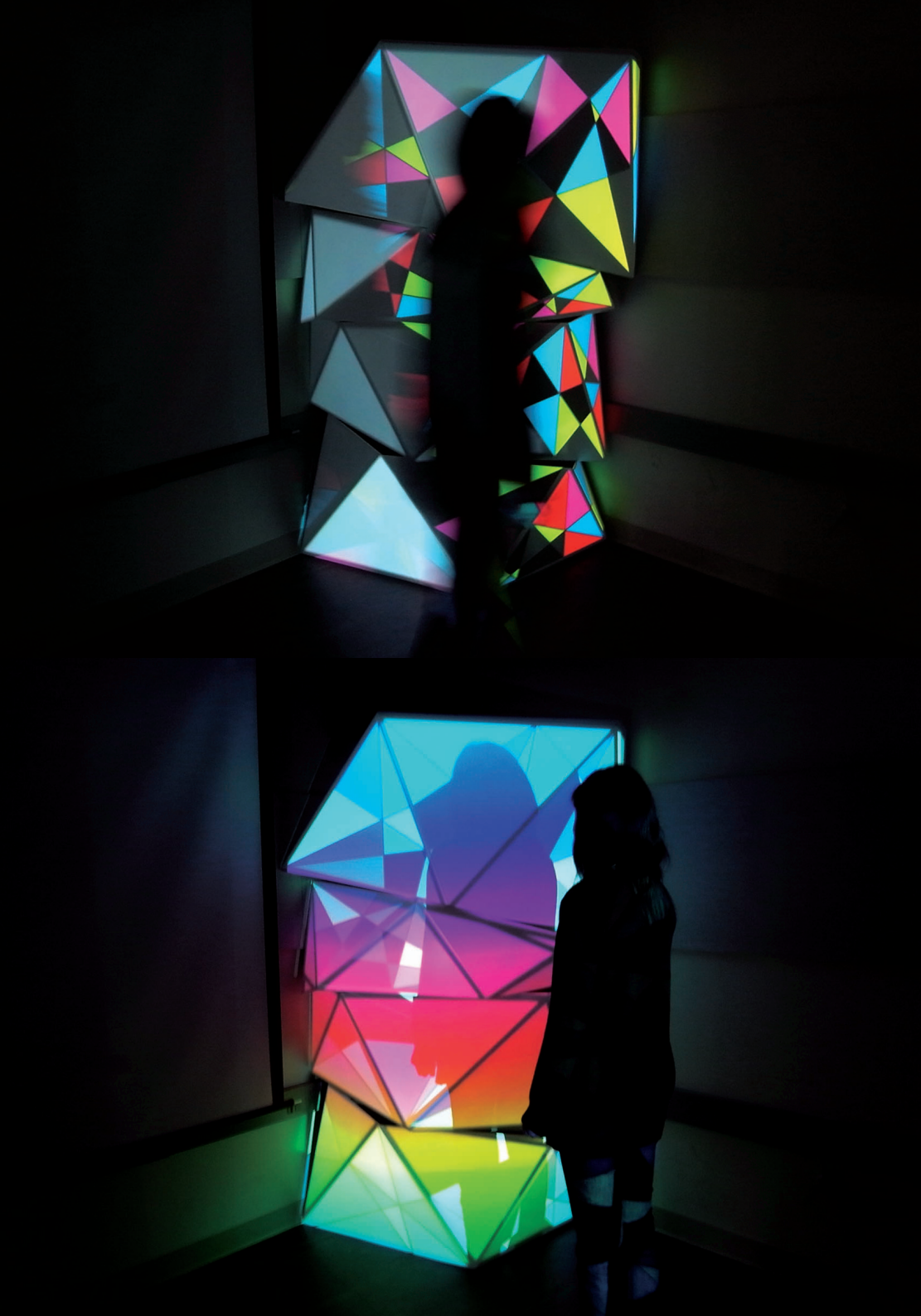


When I discussed my ideas with Mike, he suggested using projections as light sources. Projection had great potential for development. Light projected from computer operations was more flexible than traditional light sources. I used patterns, images, flurry light animation and everything I could find from the Mac's original built-in photos and videos for the light sources. The materials for physical filters were numerous to test. And then, I was concerned with the textures of the spatial shapes. I adopted the small structure sculpture to be my pre-prototype, which was triangle construction and about 7x7x7 inches based on what I learned from architecture study. I further modeled a huge shape for people to interact with. I attempted to leave the structure inconspicuously in the corner of the room. Subsequently, I kept experimenting.

The experiments surprised and fascinated me, although parts of the testing didn't work as well. Discovering the materials, textures, contents and shapes, I realized this project might become a never-ending lab. Consequently, I considered user testing. How would a user interact with this device? How would a user sense the space? How would a user manipulate the light?

Then I figured out the system with two light projections and used the human body as a physical filter.

I designed simple clear color patterns and lines to fit the sculpture. The depth and gradient of the overlapped patterns and lines created new perceptions of the spatial surfaces. The illusion invited the audiences to walk closer to the installation to interact with their own shadows. Instead of the black shape people are accustomed to seeing, their shadows turned into part of the color pattern



> Final Instllation: triangular structure, human motion, light

projections. The perception of space shifted, their shadows merged, and the audiences changed their body experience through their motion. Users were naturally included in the effect of the project.

During the final review spring 2009, I invited all DMI faculty and students to participate in this experience.

Project Reflection

The experience that the audiences gained was a sensation of space through a sense of sight. The position of the audiences moved from the observer to the observed. Their acting created the light affect for the space. Some of the audiences were the observers all along. For only observers, what they saw was an interactive illusion between the light and human's bodies. They experience and meditate on space.

Whether observer or observed, the value of the project was the interaction and communication between people, and my pattern projections were the medium. The audiences tried to play with the projection and made projection on their bodies. They sensed the space-light. They made funky gestures and negotiated with each other to choreograph their shadows dance. They talked and moved a lot. The space became a point of creating a conversation. What the audiences learned from the experience was to re-imagine what space could be and to inspire their imagination.

Light is the main point for representing spatial perception. Physical filter was an unpredictable variable for reimagining the space. For future projects I'd like to design more interaction for

audiences, which may allow user to learn the system and further create their own pattern shadow to interact.

Experimental Case Studies: Sound Wave

Overview

Inspiration

Because of my background in music and architecture, sound and space have been significant elements of my work.

The conceptual basis of Sound Wave was to investigate sound principles of rhythm, melody and frequency. Specifically, I was interested in the intersection between the sound that we hear and the sound that we “see,” and how it shaped a new space.

Objectives

My purpose for this case study was to discover an interaction between human’s voice and the visual sound wave and to see how the perception of space would be changed by the interactive sound wave as the projected light source.

The second focus in the class was to learn programming, which would help to detect and code the sound in a visual way. The

detected sound, which triggered the projection light through the program, transferred motion to the visual sound wave.

Experimentation

The idea was a three-layer projection system, which worked with light source, physical filters and spatial surface.

The physical filter was a sound that was detected in real time. The microphone detected either voice or music in the room. The sound was detected and translated by the computer into a visual sound wave projection as the light source. The spatial surface was made by two walls shaped into waves fabricated from two kinds of materials. One was a solid panel, the other was a translucent plastic wall material perforated with small holes. Both of the walls created a narrow pathway, a half-open space for a person to walk through.

The projector projected the visual light projection, which was changing and responding to the surrounding sounds, on the double walls pathway.

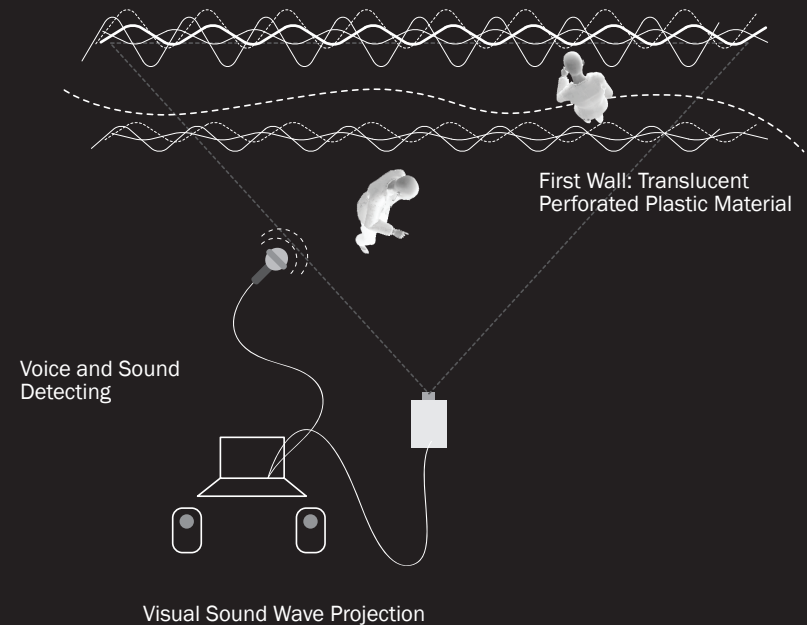
Process

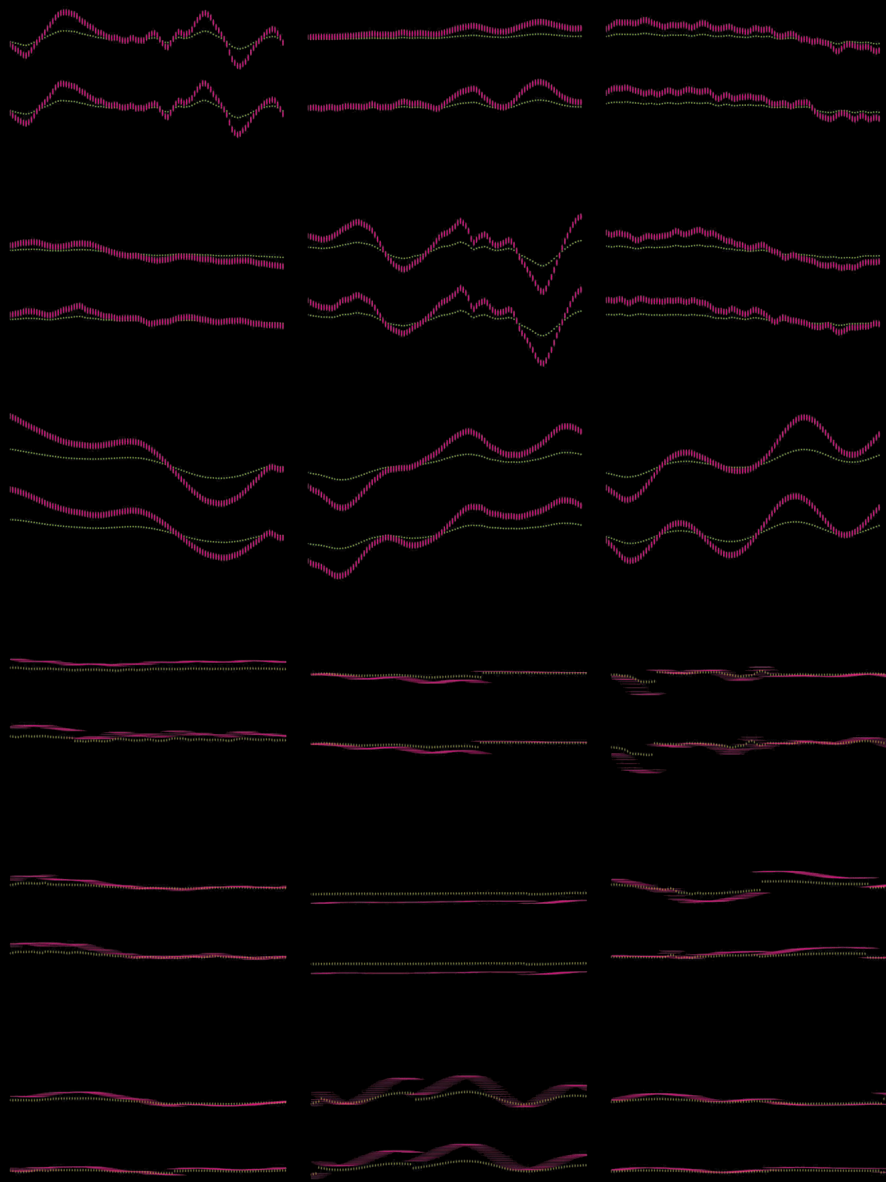
The “Get-Line-In” demo from Processing by Damien Di Fede was the original source code for the sound visualization. The lines moved distinctly to display high and low volume. After Colin Owens shared the “Minim-Beat-Detect” example in his “Design with Sound” class in summer of 2009, I invested in learning “Processing” coding. Under

Experimentation:

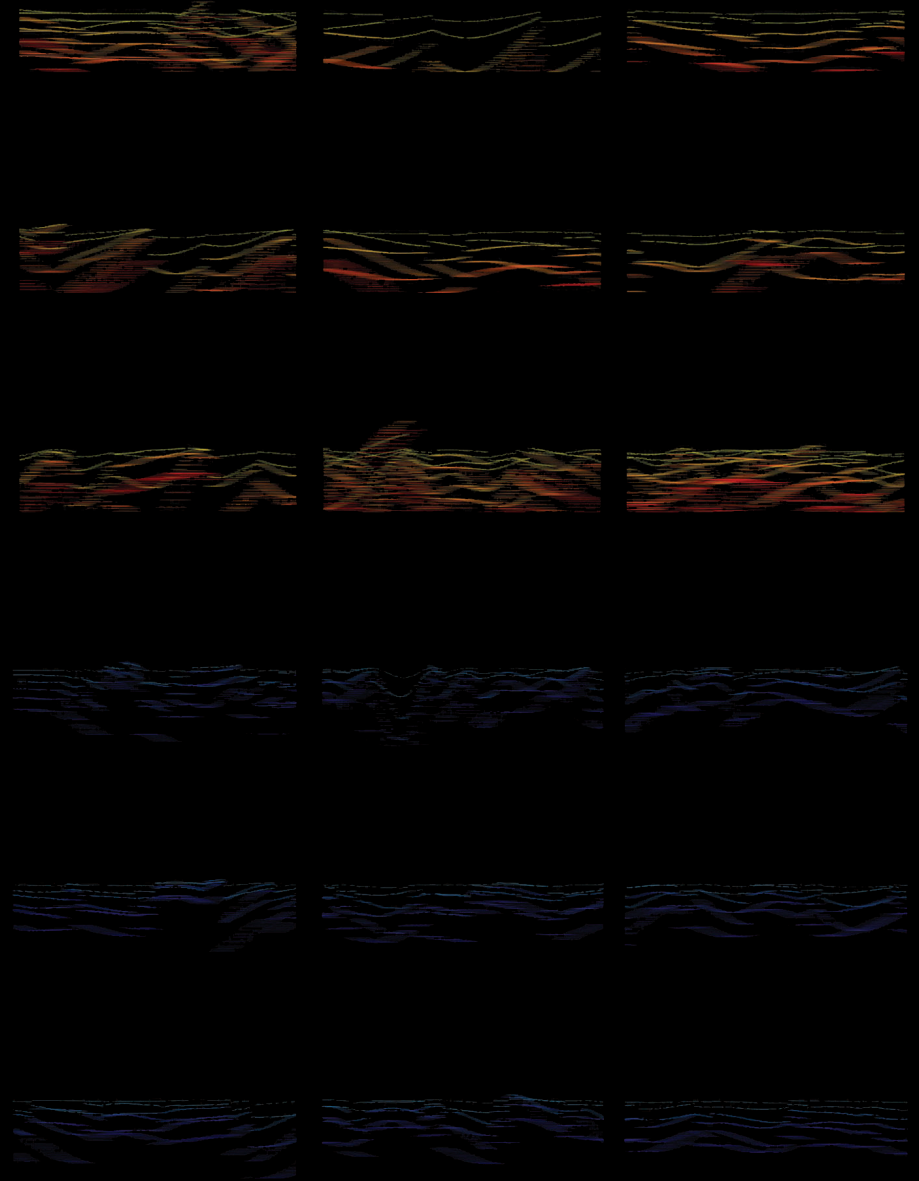
Double Wall Pathway

Second Wall: Solid Paper Waves

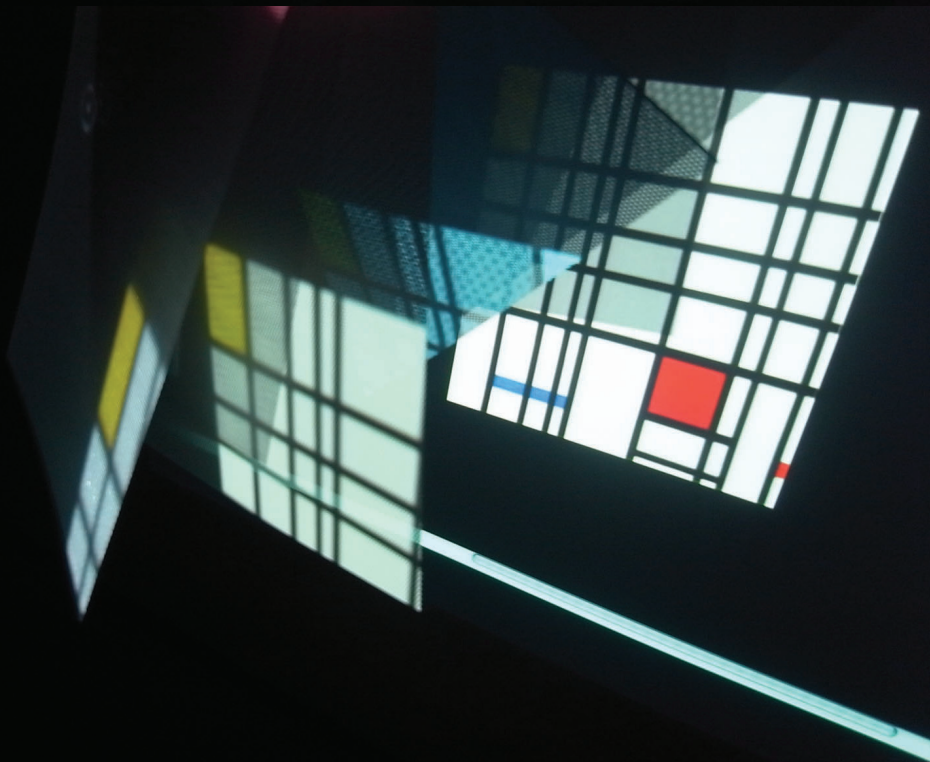
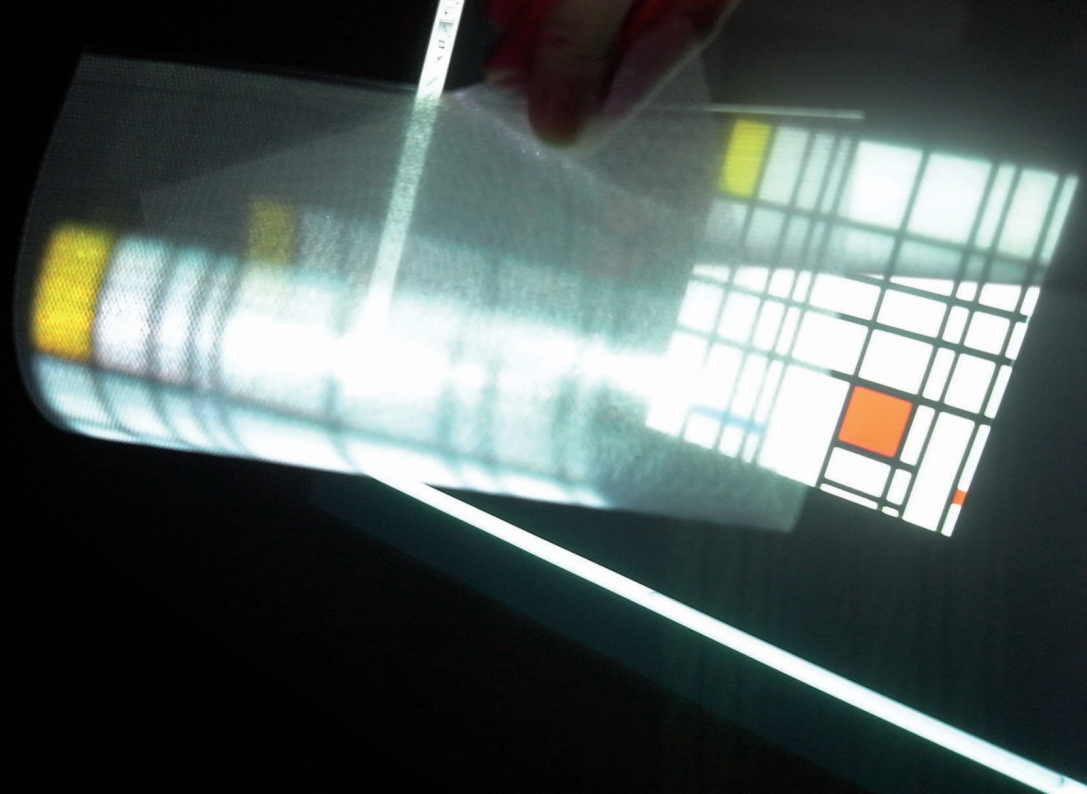
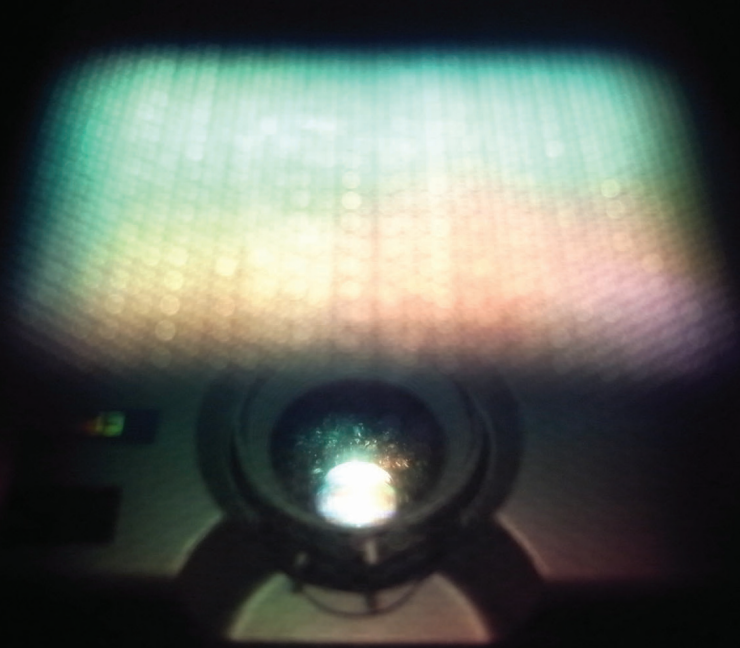




> Testing: sound wave visualizations, Processing_Minim-Beat-Detect



> Testing: sound wave visualizations, Processing_Get-Line-In



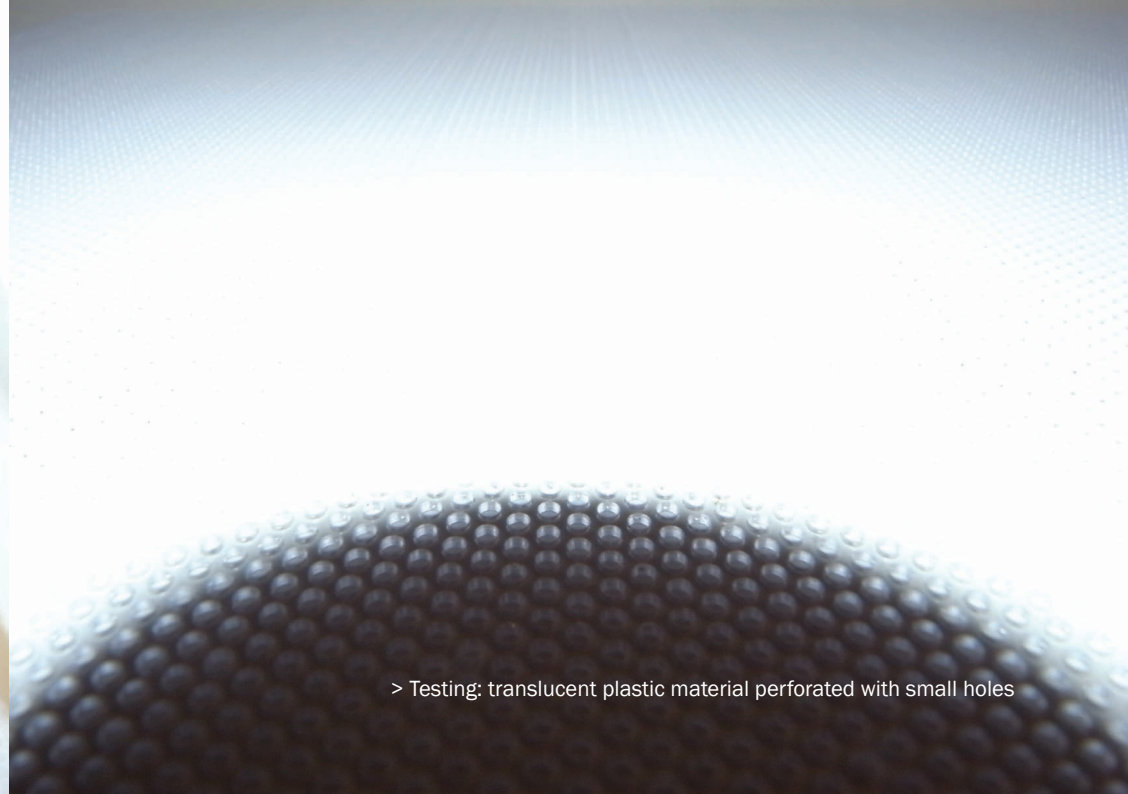
> Testing: translucent plastic material perforated with small holes



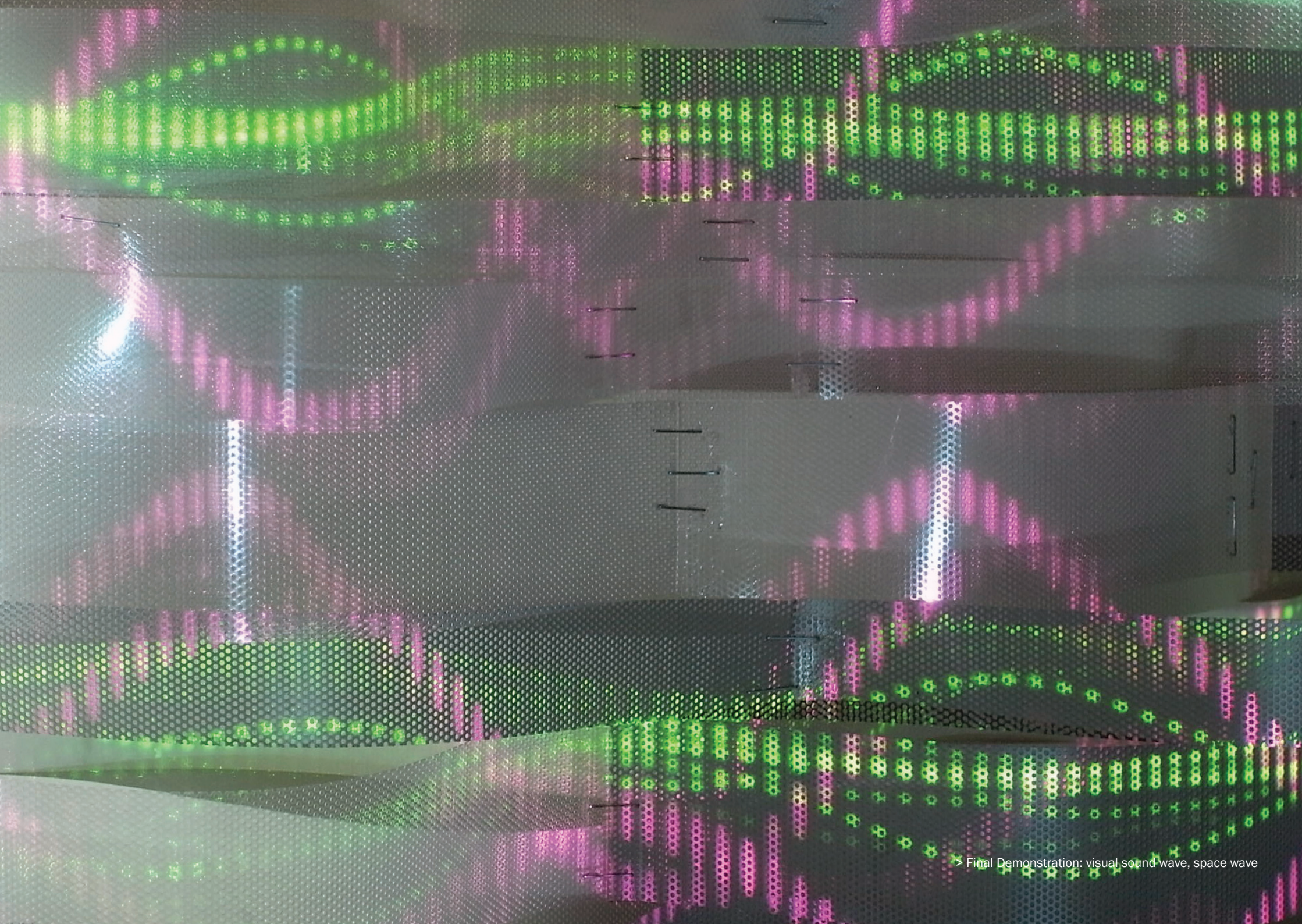
> Prototype Model: Double Wall Pathway



> Prototype Model: Double Wall Pathway



> Testing: translucent plastic material perforated with small holes



> Final Demonstration: visual sound wave, space wave

the “Minim-Beat-Detect” example, I developed several generations of sound wave visualizations, which looked interesting and attractive.

Afterwards I spent more and more hours to figure out how to put into use the “Audio-Input In” feature for detecting sound and interacting, although it was a short and easy coding. Instead of loading mp3 music from a computer file, the sound I kept working with was detected in real time. Adding a different pitch between lines could create gradients, which gave further depth of field. Then I edited colors on the line, to the point where the wave looked like a water wave. This process was fun.

My first pre-prototype model of the space wave was made by “foam core.” This material was too thick to measure the wave perfectly. In the next model, I made a replacement of “foam core” with normal sketch papers to be the spatial surface, which had beautiful light and shadow before I projected. I could not wait for experimenting and building the light tests on it. Besides, I made another space surface with translucent plastic material perforated with small holes. Not only did the transparent quality create a double image in the space but also the materials reflected the lines back and forth between themselves for unexpected brilliant effects.

The final prototype model was determined when I discussed my plan with Jan Kubasiewicz, who was my thesis project advisor. We had an idea with the double wall structure. I turned the double wall into a narrow pathway to influence audiences to walk through and experience the installation. Sound was detected in real time and translated to a visual sound wave and projected onto the spatial surfaces. The interactive part was taken from the user’s voice.

In the end, I made a proto-simulation and documented it in my thesis case study process.

Project Reflection

Most audiences enjoyed the sound wave visualization. They saw the sound they heard. Lou Susi, my classmate, asked an interesting question: we can see the sound, can we hear the light? Which was a simple and deep notion. It was a case that needed the user's voice and sound for interacting. Sound made from the audiences was the key point to push the whole system to the point of interaction with space and sound itself.

For the prototype model, there were a couple of stairs leading down into a narrow path. The gradual process of walking down stairs helped the audience to sense the tension in between the walls. The path was extremely narrow. The audiences were made to experience a dramatic adventure inside. Otherwise, the characteristics of the back and forth reflections and transparency of the translucent plastic wall material perforated with small holes were agreeable and impressive. Sound Wave was the first interactive sound project I developed. I was interested in how audience interaction could be an ingredient in further projects.

Experimental Case Studies: Lightness

Overview

Inspiration

In the spring of 2009, our seminar class reviewed and discussed Italo Calvino's "*Six Memos for the Next Millennium*" and Gui Bonsiepe's "*Some Virtues of Design*." According to "*Six Memos for the Next Millennium*", lightness, quickness, exactitude, visibility, multiplicity and consistency would be the focus of literature in the next millennium. Although Calvino's article was primarily written in regards to literature, the point of view can also relate to the fields of art and design. In "*Some Virtues of Design*," Bonsiepe also discussed the importance of lightness.

Based on the readings and discussions, my initial concept was that light could possess thought and spirit. In addition, I have always been fascinated by the properties of light. Unconsciously, it has frequently appeared in my previous work. As such, I wanted to understand the meaning and quality of light.

Objectives

Experimenting with the effects between light and materials' characteristics was the main objective in this case study. I observed the shapes, textures, and reflections of projecting on the spatial surfaces.

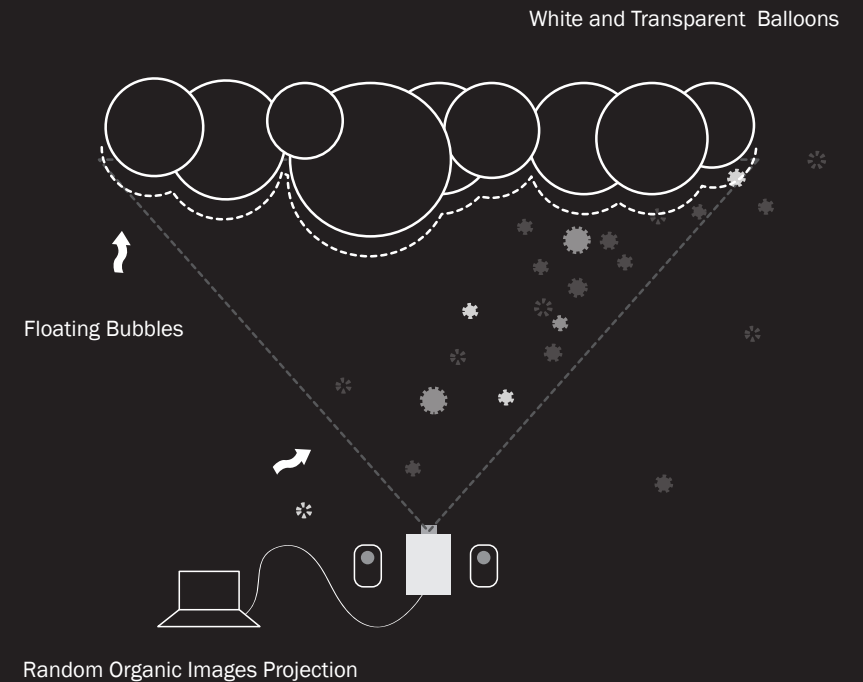
Moreover, I researched artist works that were related to light and the meaning of light. My findings became the reference materials for my thesis theoretical research. I compared the resources and discussed with Gunta Kaza, who was my project adviser, then explored my thoughts in my study.

Experimentation

The first projection system had two layers with light and objects. Here I used projection as light sources onto objects with specific characteristics such as iron panels with circular holes, reflected aluminum foils, among others.

The second one was a three-layer projection system, which worked with light source, physical filters and spatial surface. The spatial surface, in this case, was balloons. Bubbles, similar in visual form to the balloons, were the physical filters. Organic random pictures were projected through the moving bubbles onto the floating balloons.

Experimentation:



Process

LIGHT [ˈlɪt] Etymology: Latin [luc], [lux] light, [lucēre] to shine, Greek [leukos] white.

Noun

something that makes vision possible; the sensation aroused by stimulation of the visual receptors; electromagnetic radiation of any wavelength that travels in a vacuum with a speed of about 186,281 miles <300,000 kilometers> per second; specifically, such radiation that is visible to the human eye / daylight; dawn / a source of light, as a, a celestial body; candle; an electric light / archaic, sight / spiritual illumination; inner light; enlightenment; truth / public knowledge; a particular aspect or appearance presented to view / a particular illumination / something that enlightens or informs / a medium <as a window> through which light is admitted / plural, a set of principles, standards, or opinions / a noteworthy person in a particular place or field / a particular expression of the eye / lighthouse, beacon ; traffic light / the representation of light in art / a flame for lighting something <as a cigarette> / in the light of, from the point of view of; in light of, in view of.

Adjective

having light, bright / not dark, intense, or swarthy in color or coloring, pale; of colors, medium in saturation and high in lightness / of coffee, served with extra milk or cream / having little weight, not heavy; designed to carry a comparatively small load; having relatively little weight in proportion to bulk; containing less than the legal, standard,

or usual weight / of little importance, trivial; not abundant / easily disturbed; exerting a minimum of force or pressure, gentle; resulting from a very slight pressure, faint / easily endurable; requiring little effort / capable of moving swiftly or nimbly / frivolous 1a; lacking in stability, changeable; sexually promiscuous / free from care, cheerful / less powerful but usually more mobile than usual for its kind / made with a lower calorie content or with less of some ingredient <as salt, fat, or alcohol> than usual; having a relatively mild flavor / easily digested; well leavened / coarse and sandy or easily pulverized / dizzy, giddy / intended chiefly to entertain / carrying little or no cargo; producing goods for direct consumption by the consumer / not bearing a stress or accent.

Verb

to become light, brighten, usually used with up / to take fire / to ignite something <as a cigarette>, often used with up / to set fire to / to conduct with a light, guide; illuminate/ animate, brighten.
From <http://www.merriam-webster.com/>

The word light, whether in noun, adjective or verb form, has many different meanings. Many artists such as Olafur Eliasson, Bill Viola, and the design group, Polygon Playground, and more have examined light through numerous projects. These were among the projects that I researched in preparation for my own experiments. At the same time, I made light effect experiments. I was thinking about the shapes and textures such as square, circle, sharp or smooth. I collected many objects with different shapes and textures to consider



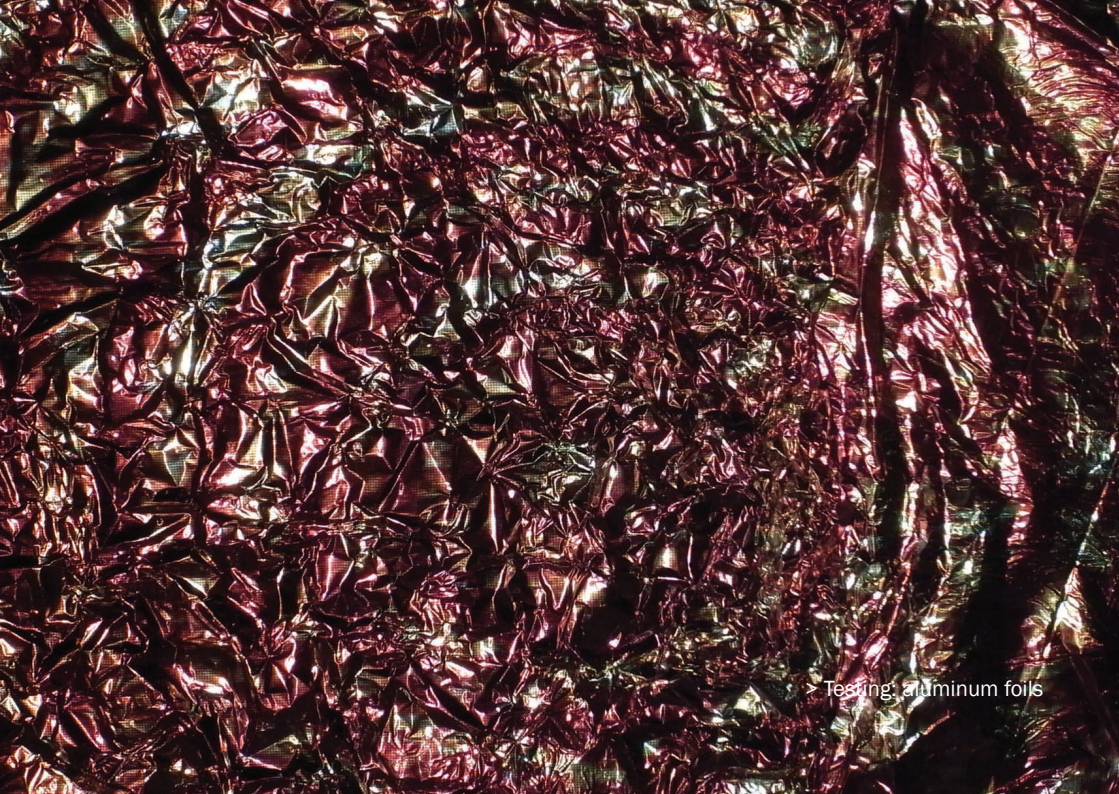
> Testing: metal net



> Testing: wax paper



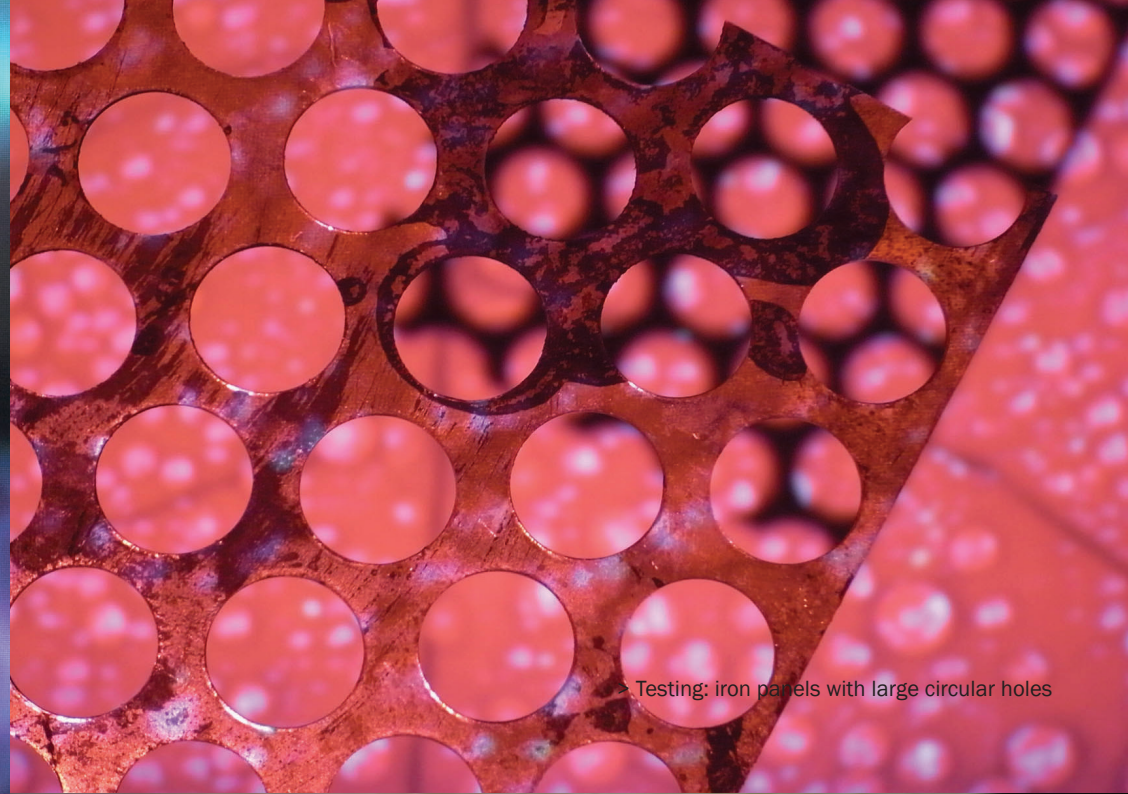
> Testing: metal panels with circular holes



> Testing: aluminum foils



> Testing: wire, ababesque light



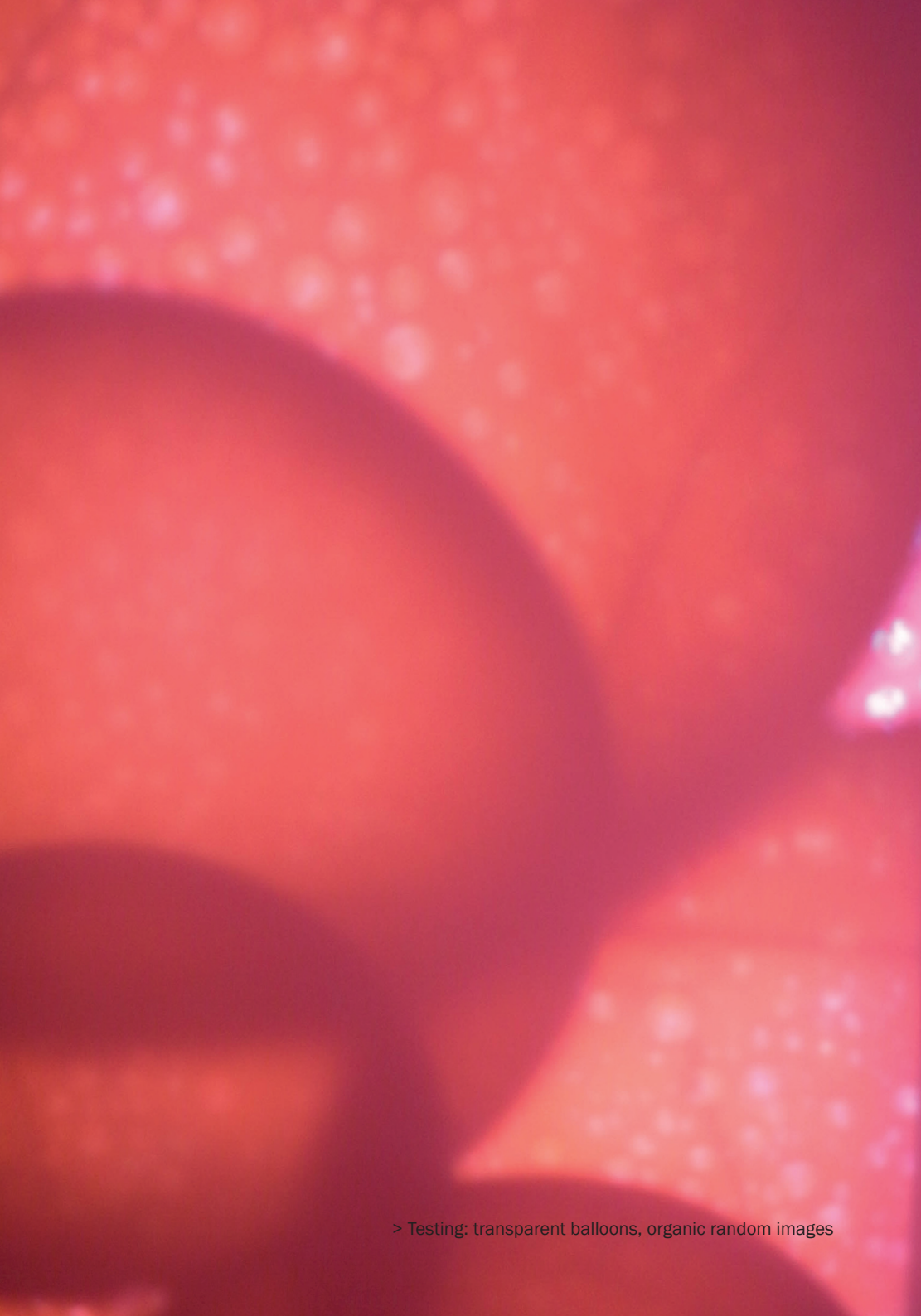
> Testing: iron panels with large circular holes



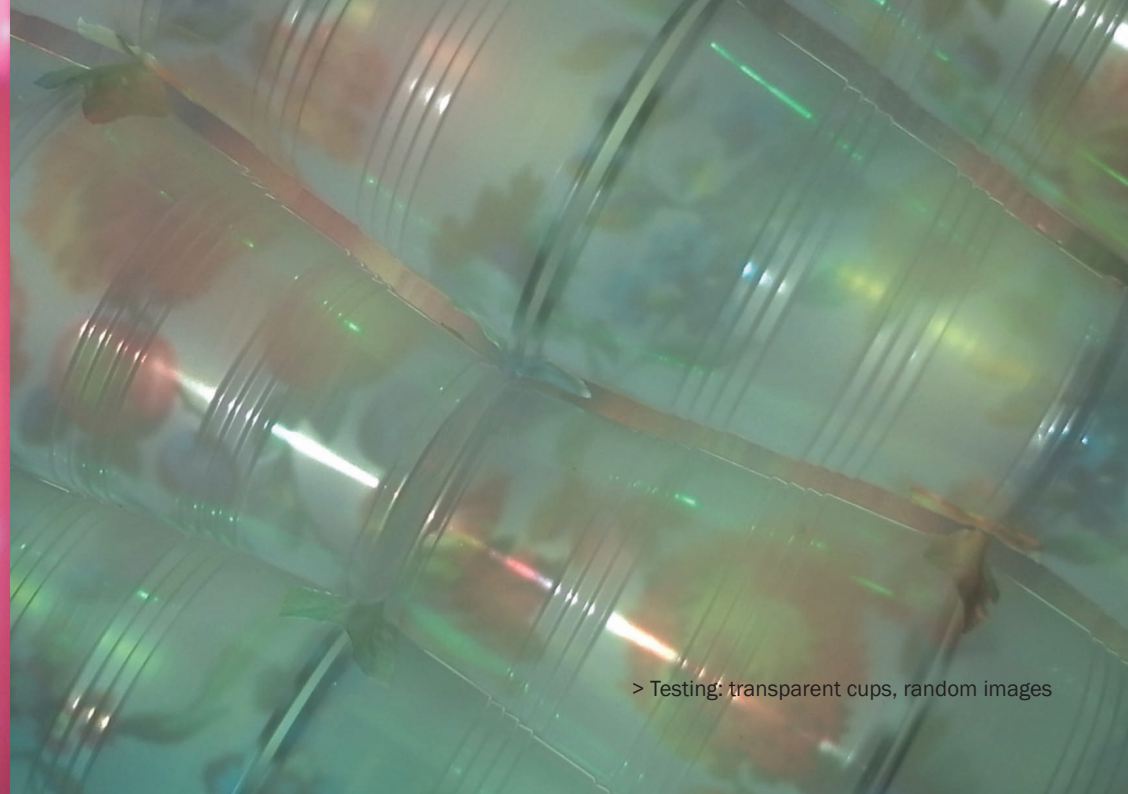
> Testing: transparent cups, random images



> Testing: transparent cups, random images



> Testing: transparent balloons, organic random images



> Testing: transparent cups, random images



> Final Demonstration: white, transparent balloons, organic random images

their effects with light and made observations. For example: plastic wrap, wax papers, clear cups, aluminum foils, bubble wraps, iron panels with circular holes, curtains and more. I not only cared about object's function but also textures. I fully experimented with the influences between objects and light and documented my investigation.

Next step, I focused on the balloons. I injected helium into the balloons. The balloons floated around the ceiling during the experimental process. I selected white opaque and transparent balloons to project on. The projections lighted on the rounded form and passed through transparent ones onto the ceiling and it wrapped around the opaque ones, creating organic and lively scenes. I felt like a cell was born as a new life on the balloons. Otherwise, the helium made the balloons move slightly and float poetically.

In picking and selecting the projection images, I intuitively set up the theme as life. So the photos were about organic, alive, cells or plants. For the previous project experiences, I worked on three layer projection systems, which were made up of light sources, physical filters and spatial surfaces. The circular form was the main visual language in this study. I used bubbles as my physical filters for their sensitive motion and fragile nature, and projected selected photos through the bubbles onto the balloons to be my final output.

Project Reflection

The audiences could not interact directly but they observed both the balloons and bubbles slightly swaying in the breeze. The ambient motion resembled a life form similar to a sea anemone and became a pleasure for audiences experiencing this project.

Elaine Froehlich, who is my classmate told me: "*research on the physiology of visual system indicates that the human brain is keyed to motion, specifically organic motion,*" Semir Zeki, *Vision of the Brain*.

From the quotation, I understood that the audience's visual physiology was influenced by the moving organic images I used to project. The organic motion as output was my exploration. In my opinion, the final output in the process was simplified and meaningful. I'd like the audience to sense the live quality of light.

Although "Lightness" was a small case study, which I worked on during the summer vacation, it influenced most of my thesis subject matter: light.

Experimental Case Studies: Narrative Blind

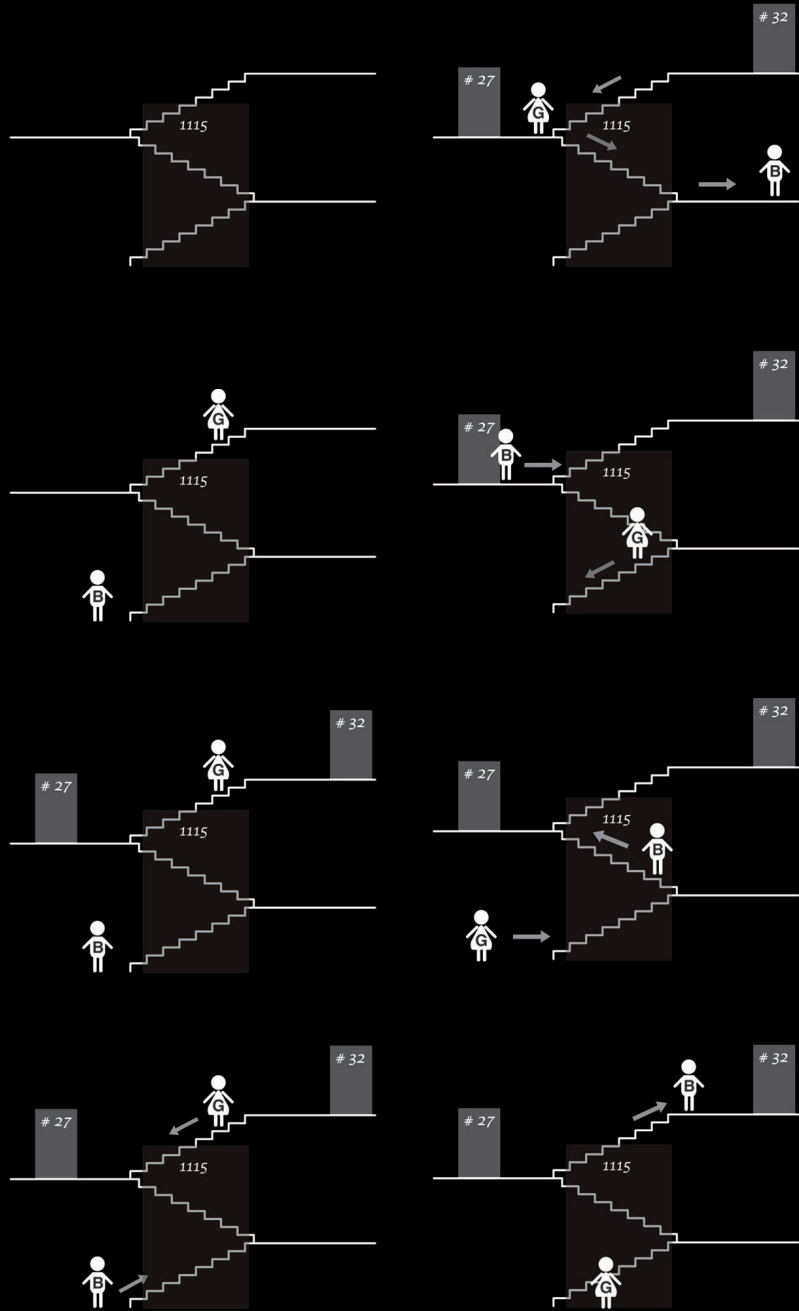
Overview

Inspiration

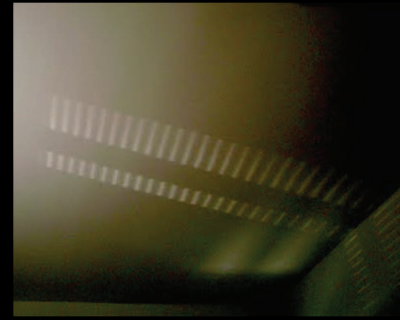
The concept of this project was “unpredictable meeting” which was inspired by the movie *“Turn Left, Turn Right.”* A girl and a boy both lived in the same apartment but on different floors. The boy always turned left when leaving the building, and girl turned right. On a rainy day, they met each other by chance in a bookstore, they exchanged phone numbers but they both lost them. They both waited for the phone call from the other and couldn’t make contact for a long time. One day, the boy turned right after walked out of the building. He met the girl.

Objectives

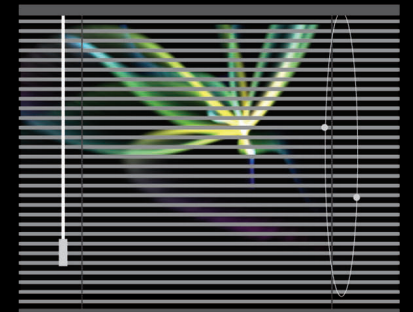
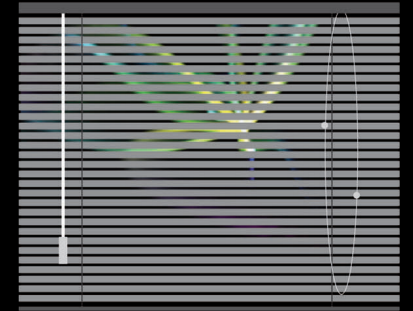
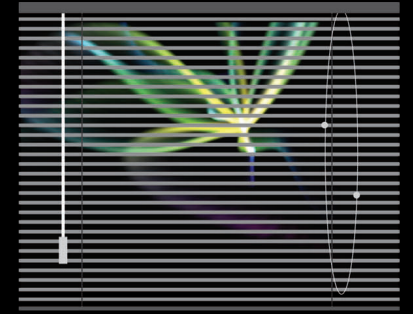
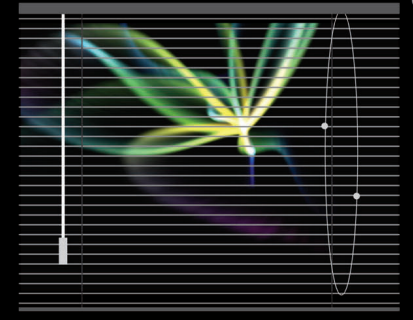
I attempted to create an interactive narrative with my three-layer projection system. The plan was to build an installation, which worked with narrative, projecting the story contents and then using a venetian blind as the physical filter to filter the light.



> Turn Left, Turn Right _Unpredictable-Meeting



> Shadow of blind



> Pre-simulation: blind tilt cord system

The intention of this installation was to use the blind tilt cord to recreate the story line. The tilt cord was rebuilt with an accelerometer sensor to work both from analog and digital perspective. Learning “Flash Action Script 3.0” for operating sensors was another goal in this study.

Two projectors projected two stories in different positions and angles. The blind was the physical filter. The user could interact with the narrative by tilting the blind and made a new meeting.

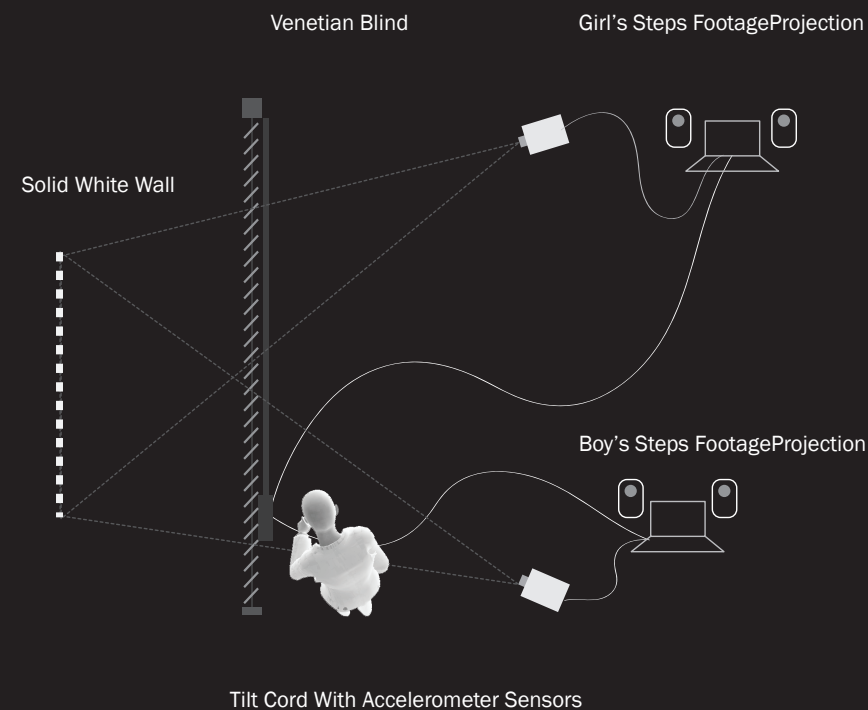
Experimentation

The idea was a three-layer projection system, which worked with light source, physical filters and a solid wall as a spatial surface.

The light sources were two projectors. One projected the boy’s story from the top; the other projected the girl’s story from the bottom. Both of the projections were projected on the same position on a solid wall. The physical filter was the movement of the blind. The blind tilt cord could be rotated to control the incoming and outgoing light in general. In addition, an accelerometer sensor detected the angle of the tilt cord and transmitted the data to a Flash Action Script 3.0 program running on the computer. Depending on the angle the accelerometer sensor detected, the footage on the screen would flip.

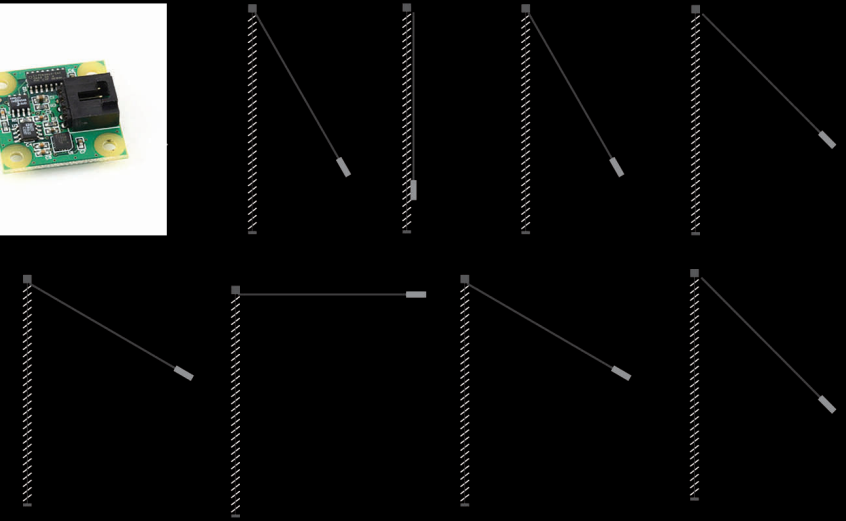
At last, two stories merged by projecting footage on the solid wall though the physical filter of the blind that was controlled by the users.

Experimentation:





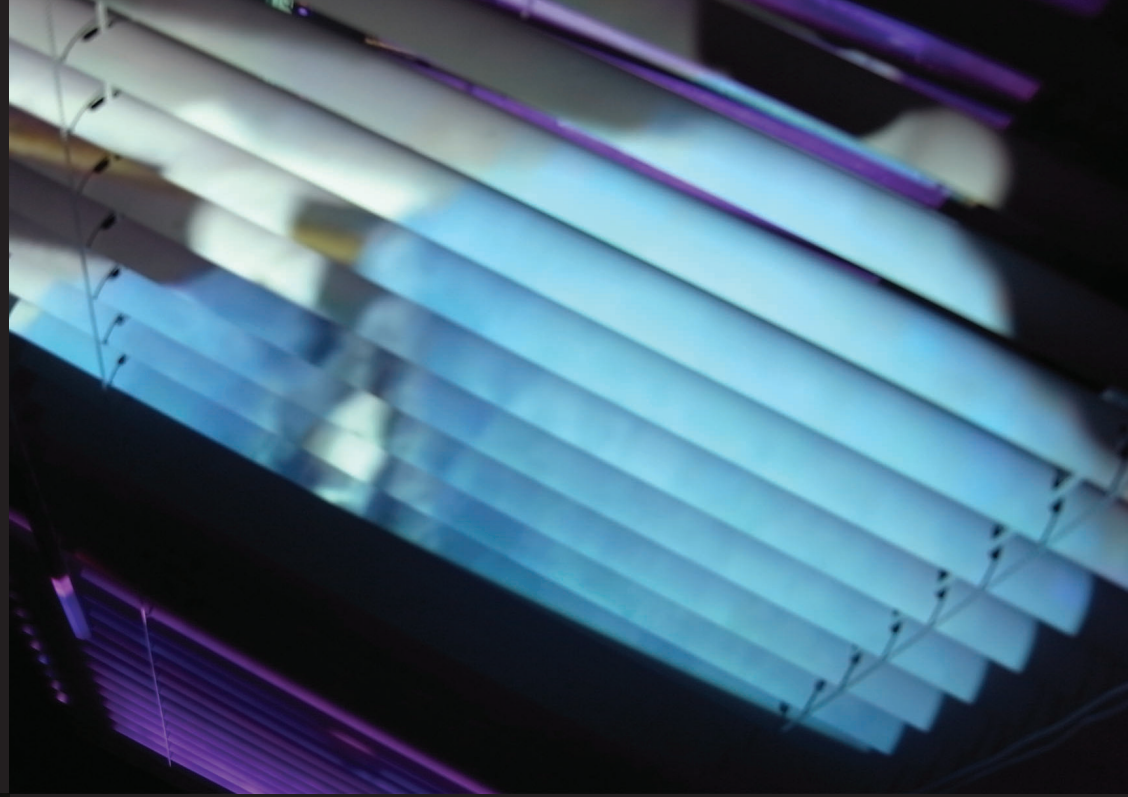
> Simulation: two blind tilt cord system, footages



> Device Simulation: accelerometer sensor, blind tilt cord system



> Simulation: four possibilities footages







Process

I adopted a story from a film I watched: *“Turn Left, Turn Right,”* and recreated a new video to be the narrative content that I projected as the light source. The couple’s meeting was unpredictable in the original movie. I set up the goal to make a predictable meeting in my installation.

For this concept, I looked for physical filters. In the story, the boy and girl passed on the stairs, which was the important element and scenery in the film. Using the same horizontal aspect of the stairs, the transition of the blind’s shadow looked like a ladder on the floor, on the ceiling and on the wall. Consequently, the dialogue happened between the blind’s shadow and the stairs in the film that I made. The blind became the physical filter in my projection system. I tried to build the simulation of the incoming and outgoing light through the blind controlled by the tilt cord.

The footage showed the steps of the boy and girl, who walked up and down the stairs. I only took the shoot of the feet to make it clear and simple: the boy’s feet with jeans and sneakers and the girl’s with skirt and high heels. I demonstrated the blind system with projections and adjusted the angle of the projectors for three possibilities: boy’s feet, girl’s feet and both of their feet. Each layer needed to be defined clearly.

Subsequently, I put the accelerometer sensor in the blind’s tilt cord. The accelerometer sensor connected with Flash on the computer and detected the angle from the blind cord. Brian Lucid, who was my project advisor, helped me to figure out how to fully control the I designed a flip action for the projection footage that the sener here.

I designed a flip action for the projection footage that the sensors detected. The steps changed direction from up to down or from down to up visually. There were four possibilities in this device:

- The boy and the girl both walked upstairs.
- The boy and the girl both walked downstairs.
- The boy walked downstairs and missed the girl walking upstairs.
- The boy walked downstairs and “met” the girl walking up stairs. For only a one in four probability, the boy’s steps would meet the girl’s.

The final demonstration prototype was built and documented as a video file for one of my thesis case studies.

Project Reflection

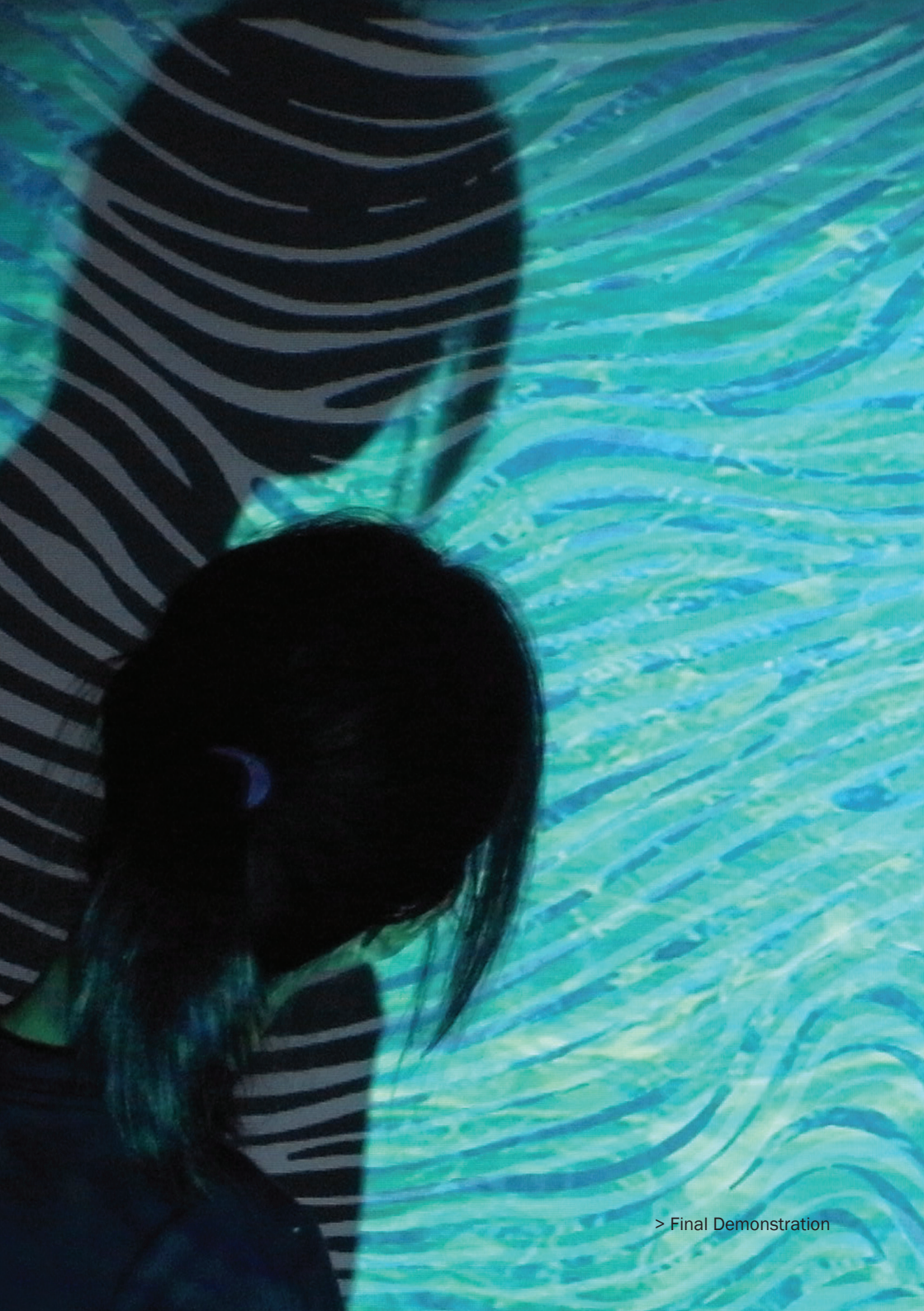
Audiences were expected to interact with this demonstration and experience the story lines changing. People look forward to having a nice relationship in the real life, but a true relationship is not easy to get. This project has the similar experience as people reading a love story.

I had two key objectives for the project. First, I wanted have a playful experience with the interactive narrative for users. Second, I wanted users to put themselves in the shoes of the characters and to experience the transition of light and shadows made by the blind.

I learned more Flash Action Script for setting sensors in this term. Otherwise, I enjoyed the process when I used the tilt cord to flip the footage and recreate a new story. This project experimented with

narrative as the projection contents. The meaningful content created the interactive narrative experience.

Fall 2009
Project Advisor: Brian Lucid
Equipment Support: Jan Kubasiewicz
Story Reference: Jimmy



Experimental Case Studies: Zebra Shadow

Overview

Inspiration

In Krzysztof Wodiczko's "Interrogative Design" class at Massachusetts Institute of Technology, he assigned a project called "Projection as Intervention."

The idea of this project came from the shadow in the "Tool" project, which was using two projectors that projected overlapping images on the wall. From the project reflections, I was interested in the interaction between the audiences and their shadow's effect. The audiences think of their shadow as a black shape. If the shadow was not a black shape, was the shadow still the "shadow"? Would audiences recognize their shadows if they were altered? The audiences may act and make some gestures for testing the shadow's movement with them. The audiences may look around to see other people's reactions to check if it was an illusion.

In the "Tool" project, the shadows that I displayed on the wall transmitted color patterns. The audience's curiosity became relevant

in this process. I'd like the audience to think more deeply, to experience more than just the visual.

Objectives

My "Intervention" was to bring a question: what was it that people were looking at?

People recognize the world from what they have seen and believe what they see. I didn't want to offend what they believe; I created an experience for the audiences to think about this question: what were people looking at? to make their own personal assumptions.

Experimentation

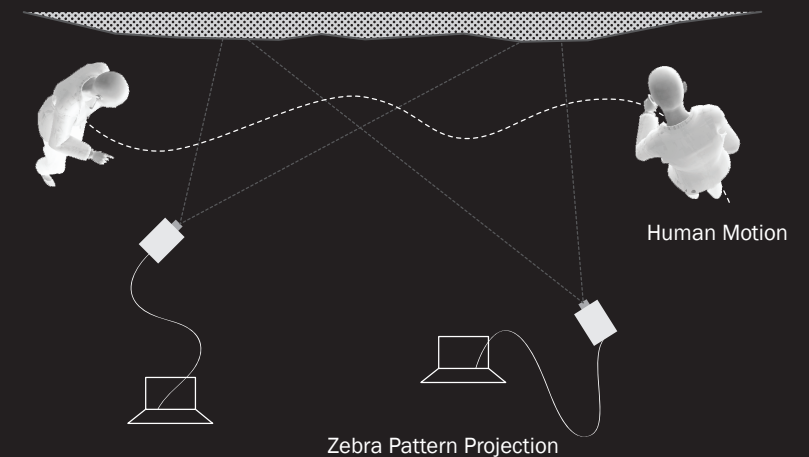
The projection system had three layers with light source, physical filters and spatial surfaces.

The light source had two kinds of pattern projections. One was the physical filter and two was the movement of the human bodies on the spatial surface of a solid wall.

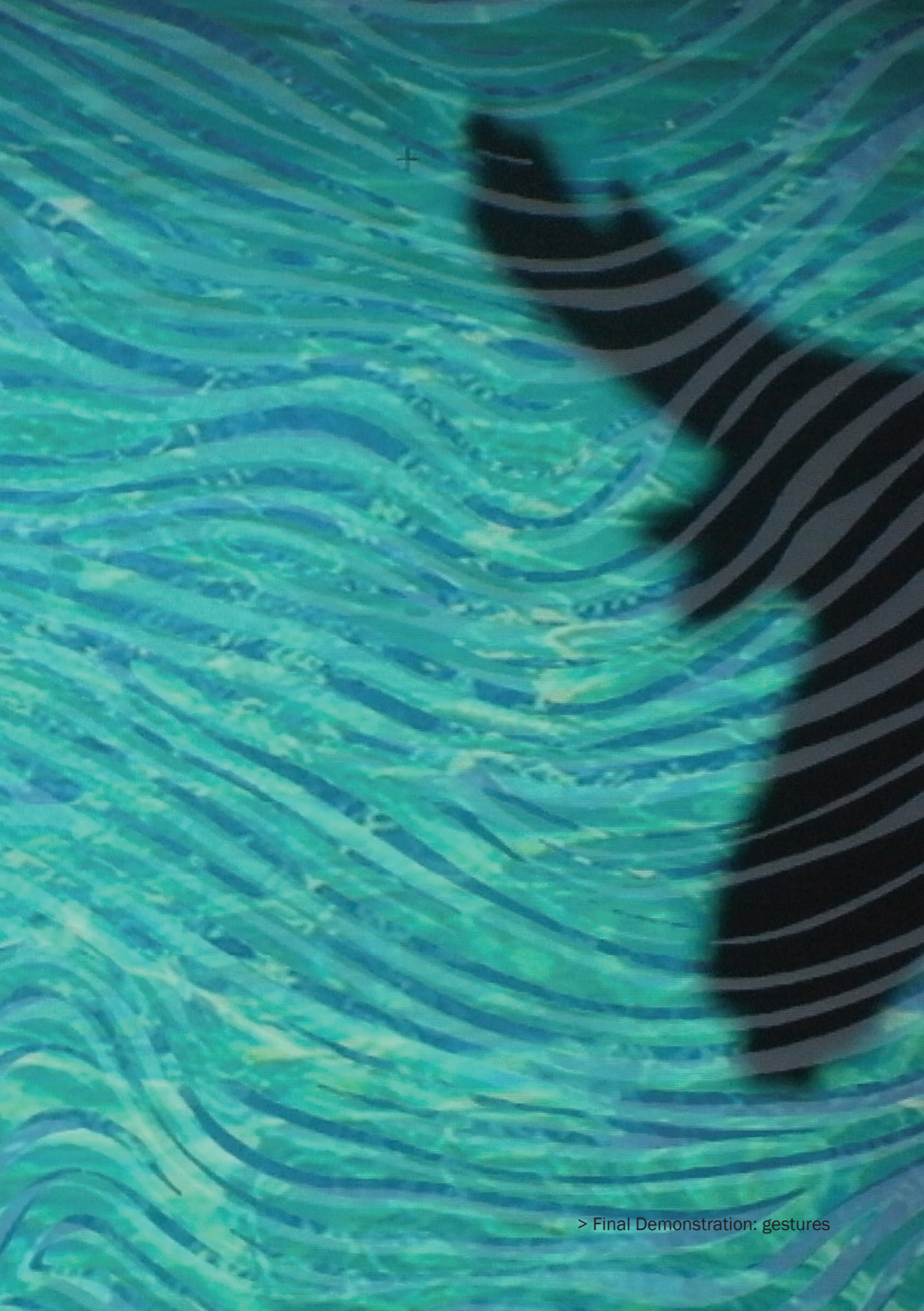
Both light projections transmitted through the human body filter, brought the shadow on the spatial surface, and changed the human perspective of the black shadows into a zebra pattern.

Experimentation:

Solid White Wall



Water Pattern Projection



Process

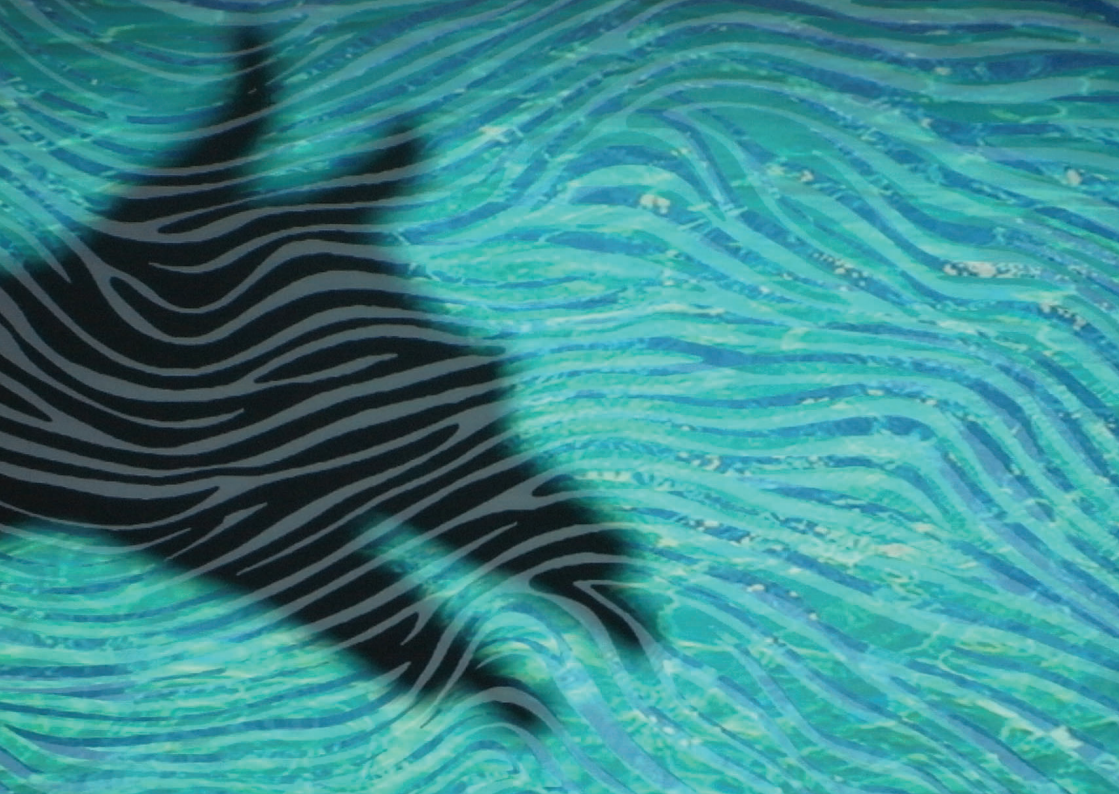
People sometimes meet a person, who looks cruel and evil, but s/he actually is kind and nice. Some people are friendly, but they want to take advantages of one, in fact. How people look at the world is not what they actually see. Therefore, I raised another question: What are you looking at?

I researched the animal patterns such as the cow, leopard, giraffe, and tiger among others. Each animal has its own unique pattern. We could recognize an animal from the fur pattern. Nevertheless, what's the human being's pattern? Was that white with some dark spot? Did that look like hair? Was that smooth or rough?

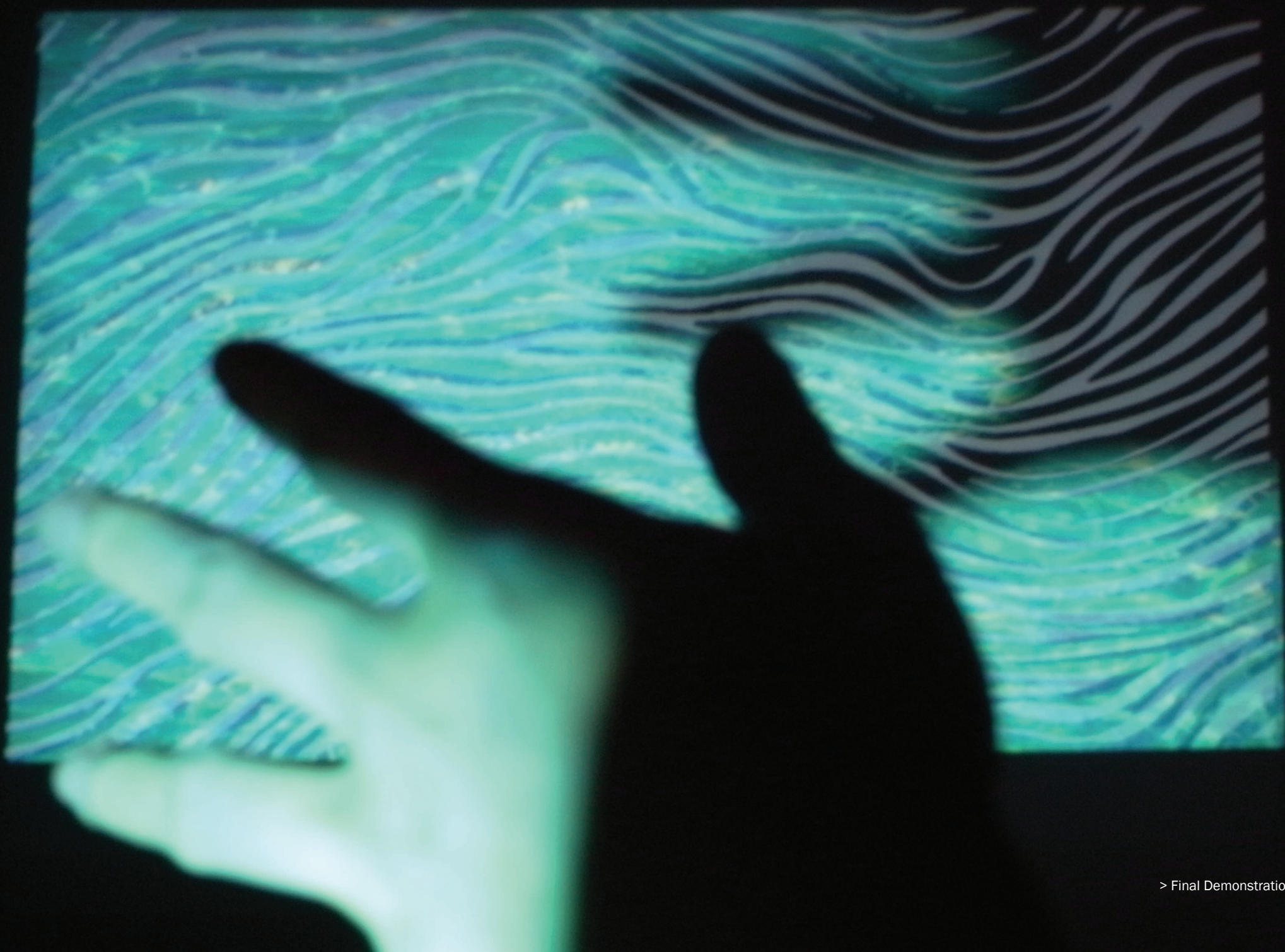
I continued the system from the "Tool" project for these projections. There were two projections overlapped on the wall. The illusory pattern was created with a water wave image and the zebra's pattern. The water warps what people see, when people look into water, they usually see things unclearly and blurred. Then, that sense of distortion I used to represent how people look at the world. Then, I used the same lines for both water and zebra's pattern but one was black and white, the other was light and deep blue.

In this demonstration, I could only see the blue water on the wall until I walked into the projection light. Then the shadow was formed. The shadow was not a black shape as expected. The shadow created a zebra looking pattern from the image of the second projection.

Afterwards, I tried to form different gestures in order to experience my shadow. I made some gestures to create other forms, which



> Final Demonstration: gestures



were like: dog, bird and more. The shadow still looked like zebra's pattern in the water.

Between the light and body, the shadow was created.

Some questions that came from this, what was merged? What has emerged? What am I looking at?

Project Reflection

The illusion for the audience was what I expected. They saw the zebra's pattern as their shadow on the wall. Were they wondering if that was their shadow? They would make some gestures and acts to manifest themselves. I'd like the audience to keep thinking about how their shadow is transforming in motion. The black shape was the shadow, or the shadow should be a black shape. Either way, my intention was to explore what were they looking at.

Krzysztof Wodiczko is internationally renowned for his large-scale slide and video projections on architectural facades and monuments. He had a great influence on projection art and design and overall it was a good experience taking this class.

In the class, we discussed many projection artists' work. Most of them started with big issues and wanted to use their work to influence people. We considered our issue's value and used design as the medium to explore the ideas and put them back into the world.

From this exercise, I not only brought the message the question I wondered about to the audience, but also gained more inspiration in the process. I collected my thoughts and made made

self-examination to ask myself "what am I looking at?" and "how each person perceives me."

Experimental Case Studies: Water Drop

Overview

Inspiration

In Krzysztof Wodiczko's "Interrogative Design" class at Massachusetts Institute of Technology, he assigned a project called "Projection as Intervention" that required linking projection into a big issue in the news.

"United Nations warns of 70 percent desertification by 2025. Drought could parch close to 70 percent of the planet's soil by 2025 unless countries implement policies to slow desertification, a senior United Nations official has warned. Drought currently affects at least 41 percent of the planet and environmental degradation has caused it to spike by 15 to 25 percent since 1990, according to a global climate report."

"Rise in sea levels can't be reversed. Even if carbon emissions were cut to zero immediately, sea levels would continue to rise through the coming centuries, scientists say. A likely projection is an increase of up to five meters over 300 years." From: UN Climate Change Conference 2009

I was shocked by this news.

I am from Taiwan, a little island by the side of the mainland of Asia. In accordance with the above-mentioned, if the sea levels continue to rise through the coming century, my hometown, my country, my birthplace, will be submerged sooner than I can imagine. Therefore, where will my family, friends and my memories go? It is a hopeless future for my life.

Objectives

The land was badly affected because of over building by human beings. The land, the place that human beings stand on is full of trees, is full of natural life. People cut the trees away and made their houses. People constructed the tall and large building and built the cities. Too much pollution and too many artificial constructions brought too many problems.

One was “global warming.” Global warming is the increase in the average temperature of Earth’s near-surface air and oceans. Since the mid-20th century the problem has escalated and is projected to continue. Warming is expected to be strongest in the Arctic and is associated with continuing retreat of the glaciers, permafrost and sea ice. In another word, the sea level will rise to gradually submerge the land.

I am not a scientist. I do not understand how to change this fact. I am not a great speaker. What I could do was to make a small but meaningful experience to bring this message to people, to keep it in their mind and to be concerned about this problem, hopefully, to send out a warning to the whole world.



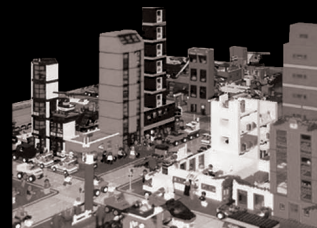
Trees



Move trees away



Housing



City



Buildings



Warm



Sea level raising

Experimentation

The projection system had three layers with light source, physical filters and spatial surfaces.

The projector was set on the floor to project up. The light source was an image of trees, which were shot from the bottom toward the top of the trees. The spatial surface was the undecorated ceiling in the building. Water in the transparent container was the physical filter hanging in the air above the projector. A sensor connected with a Processing program running on the computer was set up on the container. When a coin dropped into the water causing a ripple, it was detected by the sensor to play an animation of the tree exploding on the ceiling above.

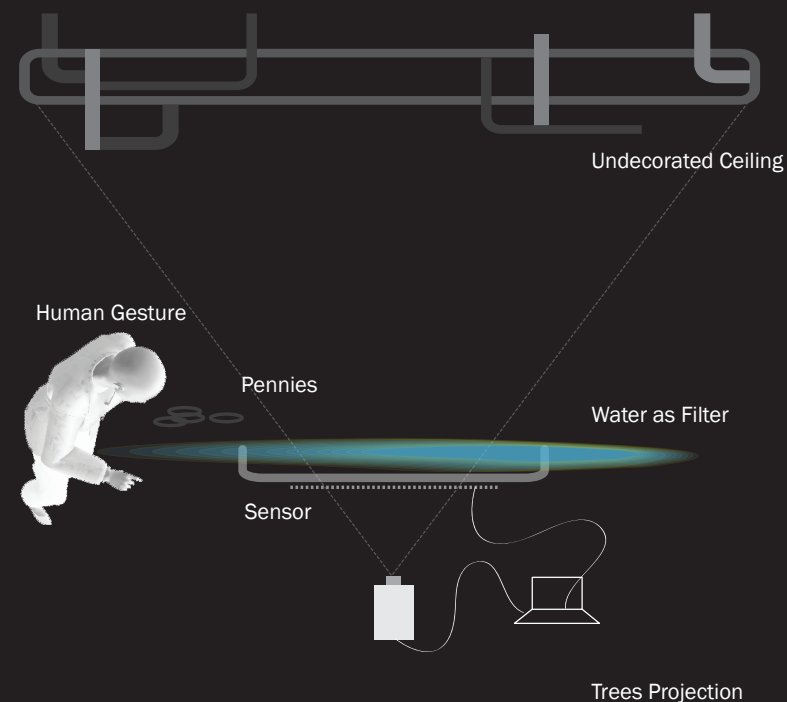
Once the sensor detected the dropping coin in the water filter, the tree projection running on the computer projected up onto the undecorated ceiling and played the exploding animation.

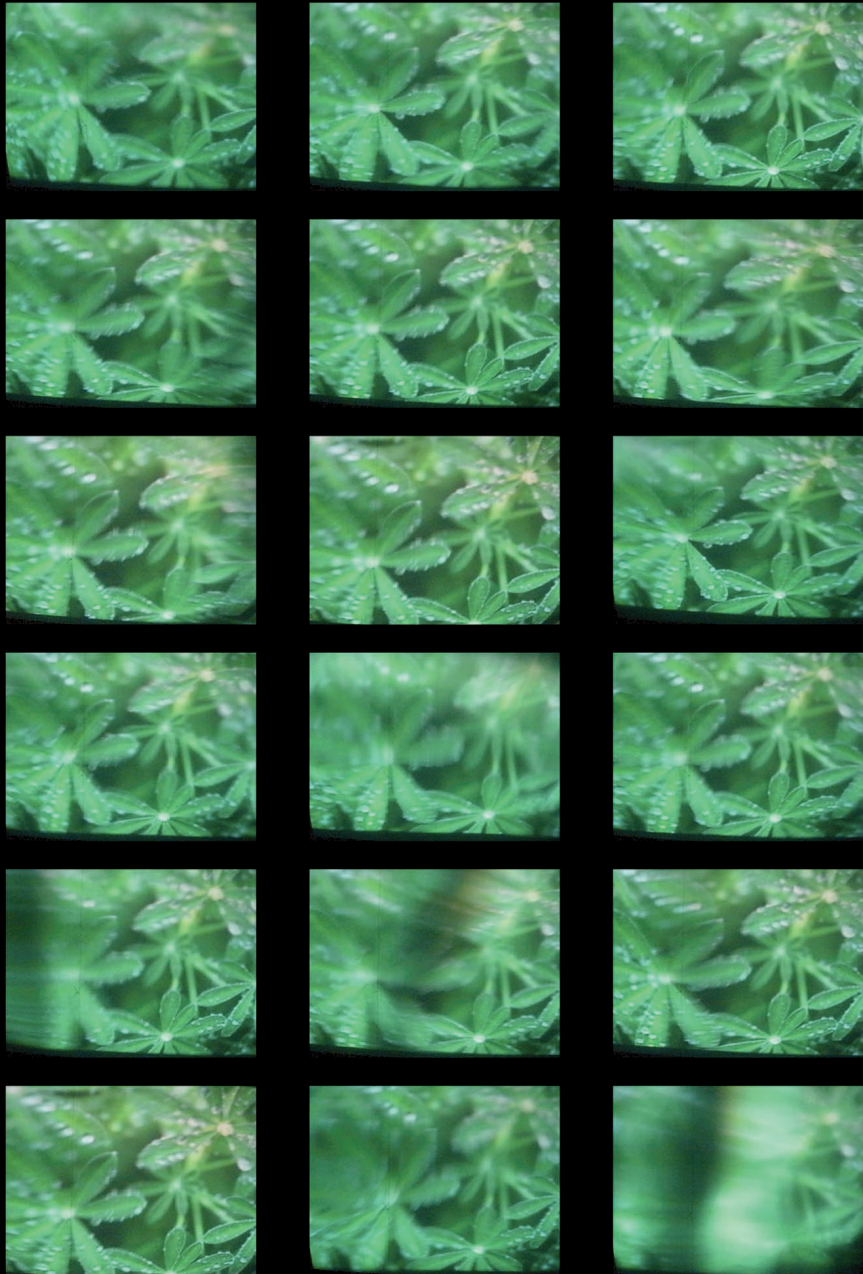
Process

For the projections, I used the view with elevation angle to take multiple pictures of a tree. Trees were the nature world metaphorically in this case. The projector was set up to project on the undecorated ceiling inside of a building. The undecorated ceiling was the spatial surface in this study.

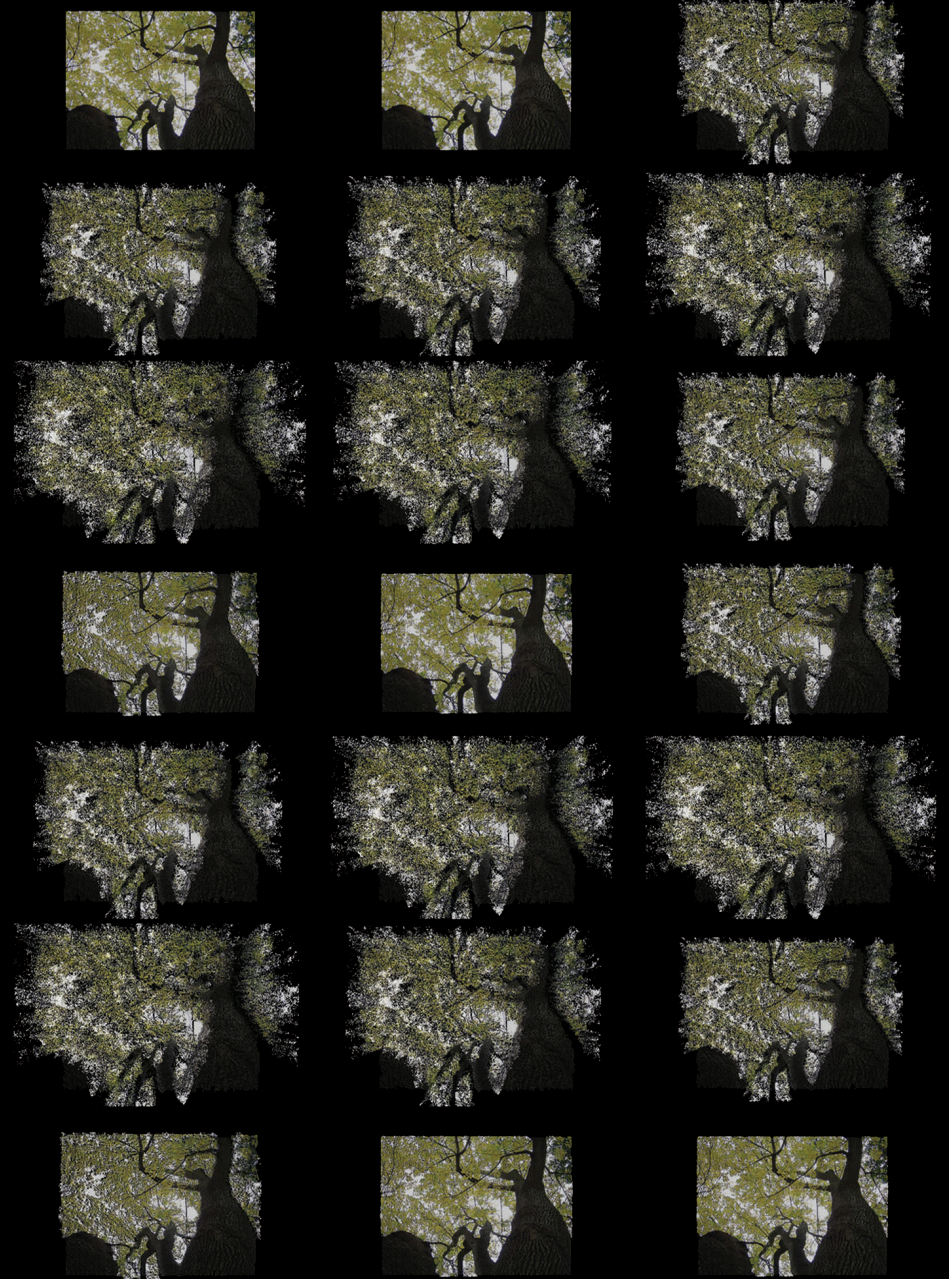
The rising sea level was the main focus in this issue. So, the water became the physical filter explored as the topic in my projection system. I'd like to experience the effect of the tree's projection with

Experimentation:

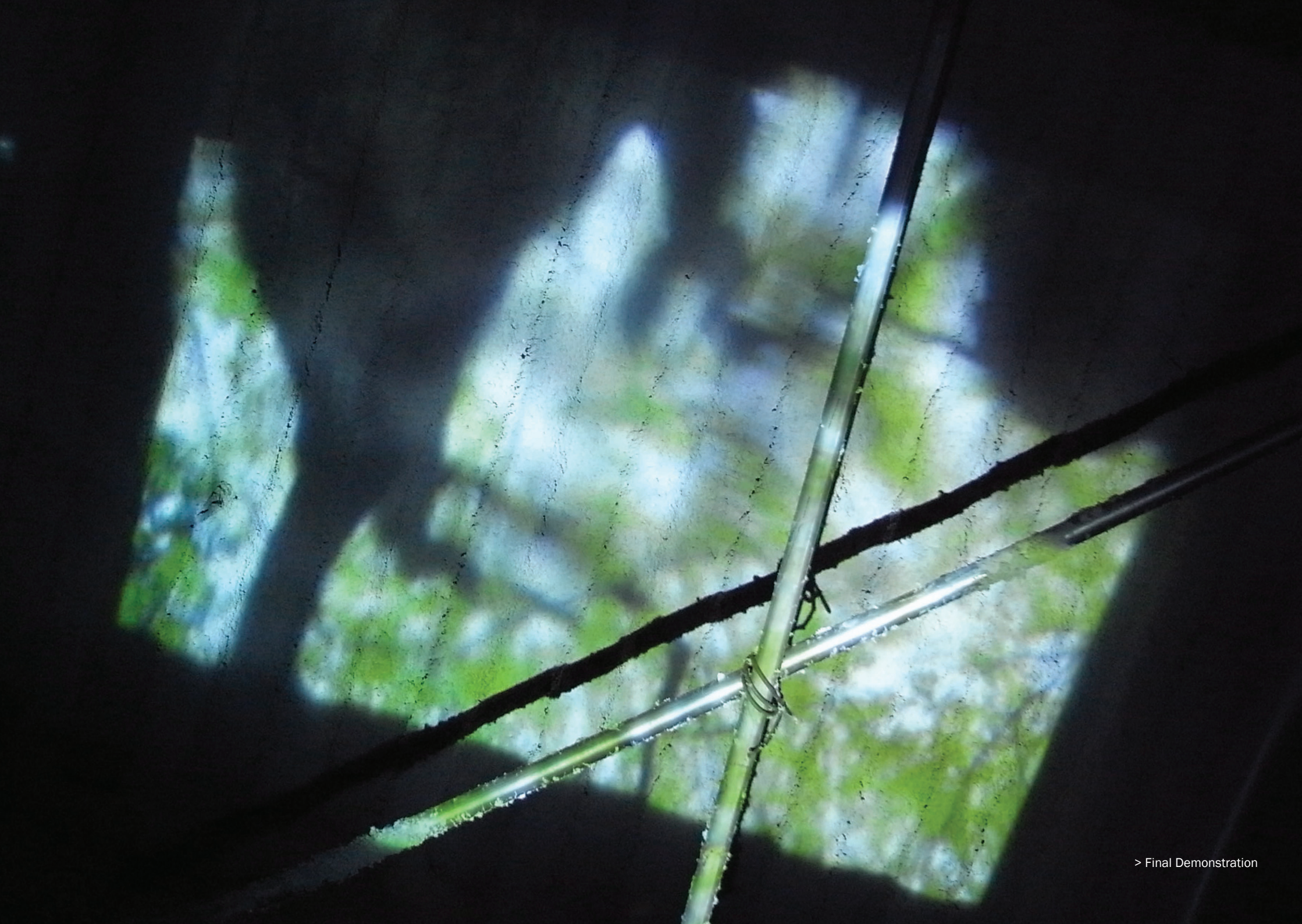




> Testing: water, random images



> Testing: tree images, Processing _Exploding



ripples. Moreover, I designed the projection to be projected from the floor to the ceiling to give the feeling of being under the water.

On the other hand, dropping a coin was the gesture I took as the metaphor of people's ambition for making money. The dropping coin gesture would be used in this project. Whenever the user dropped the coin into the water, the sensor on the container detected it and connected with Processing program on the computer to animate the tree's explosion. Then, people would be shocked as I felt by seeing the animation when I read the issue on the new papers.

The project scale was a challenge for me in this case. I was advised to bring a huge warning into the projection. But I didn't take this suggestion. I hoped I could deliver my affection for the trees in my hometown and my feeling of helplessness.

Finally, I made a prototype to test and documented the effect in the thesis case studies.

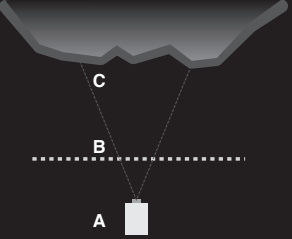
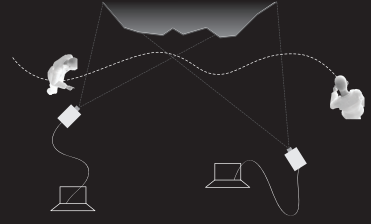
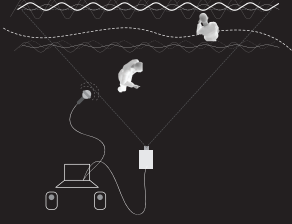
Project Reflection

The students in the class considered that this project was too soft, too general and too nice. The issue is a serious problem that actually needs to be solved or improved. Other audiences accepted the experience well; they felt my intention through the sensitive use of the delicate effect of water and tree animation. They thought it was a gentle way to present the issue to people.

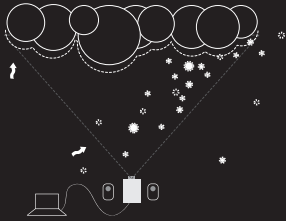
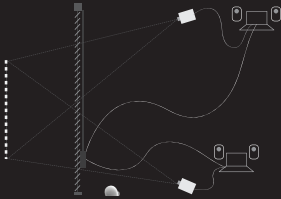
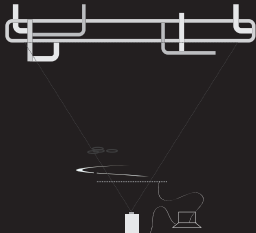
What I'd like audiences to take away after looking upon the tree projection under the rippling water was the sense of the land submerged under the sea.

To warn was upsetting for me. Everyone had different perspectives and different thoughts they wanted to explore. I had faith in myself to express my feelings.

Case Studies Matrix:

	Experimentation	Light Sources	Physical Filters	Spatial Surfaces
Experimental Process		<p>Spectrum Nature patterns Flurry light Texts</p>	<p>Water Plastic Orifice sheet Translucent paper Pattern sheet Rice Sugar Color paper Plastic Cups Plastic Wrap Wax Papers Aluminum Foils Bubble wraps Metal Panels With Holes</p>	<p>Iron panel Corrugated paper Sculpture Foam core Vapour Water</p>
Tool: Light, Physical Filter and Fspace		<p>Two Projections With Color Lines Patterns</p>	<p>Human Motion Gestures Shadows</p>	<p>Triangular Structure with Foam Core</p>
Sound Wave		<p>Interactive Visual Sound Wave Processing</p>	<p>Interactive Human Voice Periphery Sound</p>	<p>Double Wall With Papers Translucent Plastic Perforated Sheets Wave Shape</p>

Case Studies Matrix:

	Experimentation	Light Sources	Physical Filters	Spatial Surfaces
Lightness		Organic Random Images	Breezed Bubbles	Floating White and Translucent Balloons
Narrative Blind		Interactive Narrative Action Script 3.0 Footages with two stories	Interactive Blind Tilt Cord Accelerometer Sensor	Solid White Wall
Zebra Shadow		Two Projections With Zebra and Water Patterns	Human Motion Gestures Shadows	Solid White Wall
Water Drop		Interactive Trees Animation Processing_exploding	Water Human Motion Gestures Pennies	Undecorated Ceiling



> Testing: human motion, random patterns, white fabric

Primary Thesis Projects: Four Explorations

Preparation

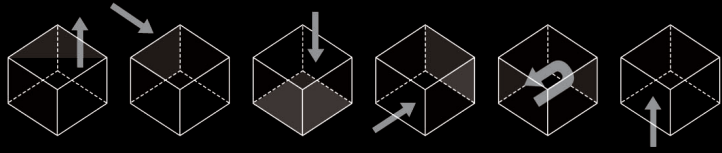
The projection system for my primary thesis project was created after a series of experimental case studies. The three-layer projection system with light source, physical filters and spatial surface was rebuilt. I developed a system with three projectors.

Three projection light sources in the large triangular shape projected and interlocked in the room. There was nothing in the room except humans' bodies, humans' motions, and humans' gestures as both physical filters and spatial surfaces.

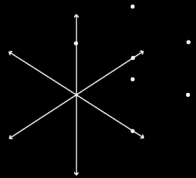
Description

Lighting Bodies

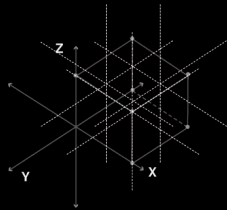
In my first tests, the projections were color patterns, which were simply created with lines and circle forms. The yellow, white and red patterns randomly projected from three positions and triangularly interlocked in the center of the room.



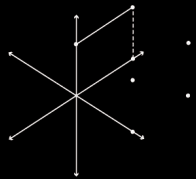
Observe from Points of View



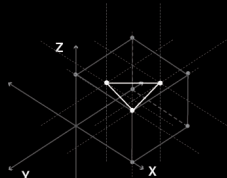
Points



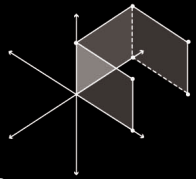
Axis



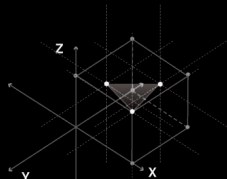
Lines



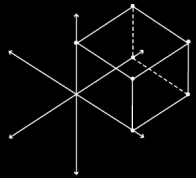
Add points and lines in axis



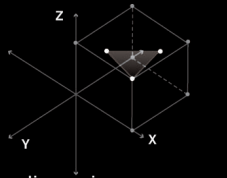
Planes



Create planes in axis



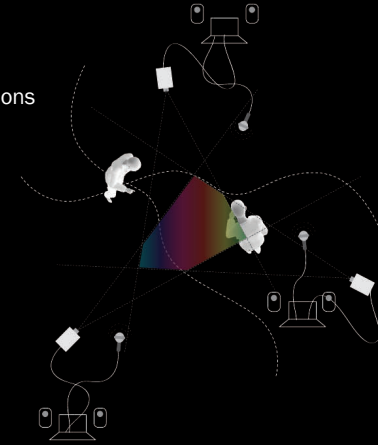
Space



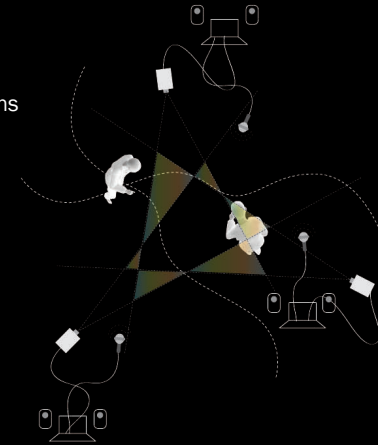
Three dimension

> Space Space Space

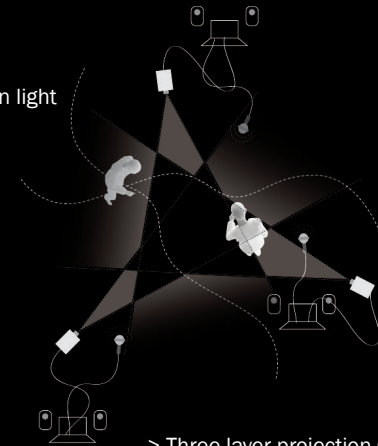
Center:
section with three projections



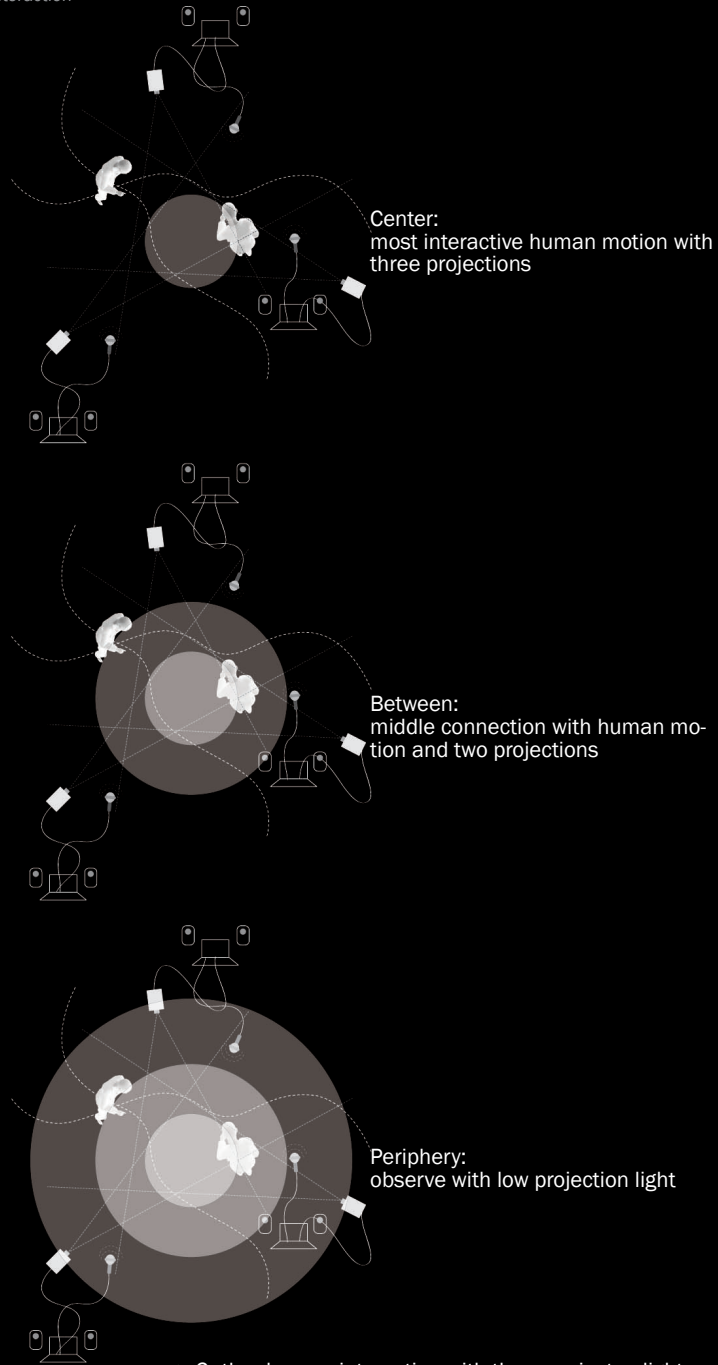
Between:
section with two projections



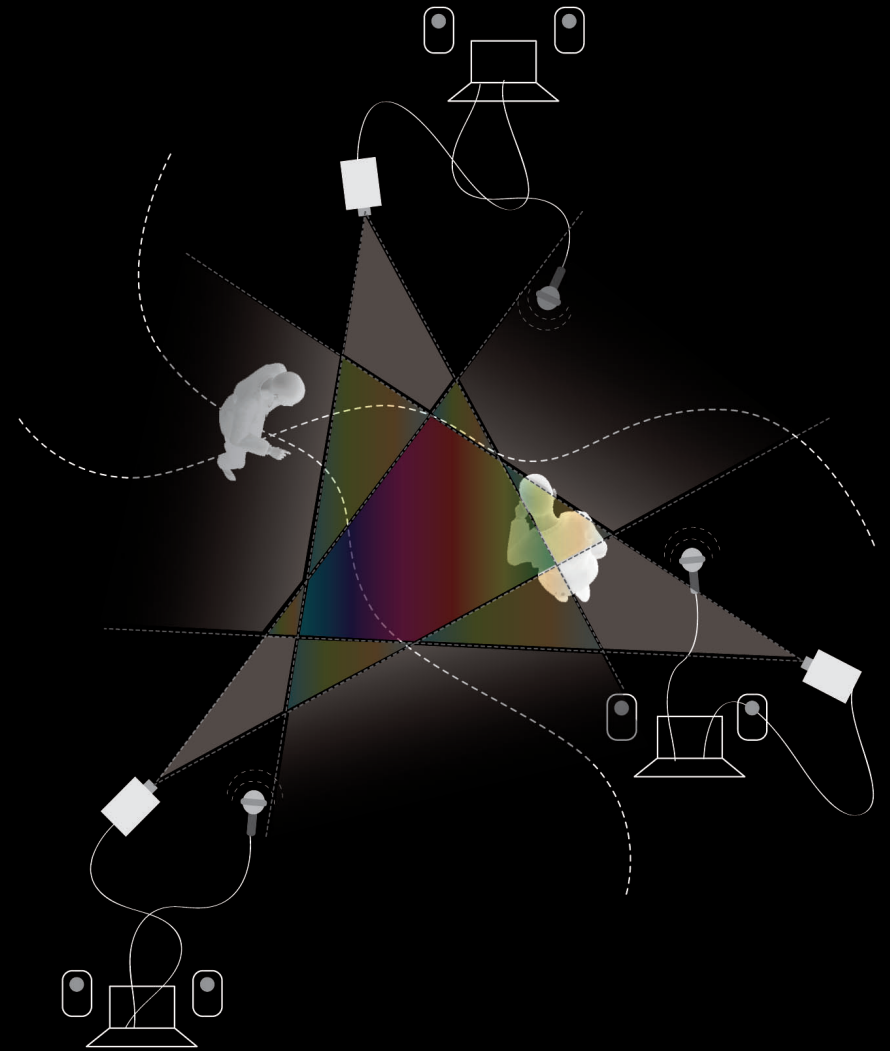
Periphery:
section with one projection light



> Three-layer projection system with three projectors



> Gather human interaction with three projecton light system



> Three-layer projection system with three projectors

I walked into the space and stood in the center. A few classmates joined my experiment. They said that they saw the light around my body. I didn't know and I didn't see it at the moment. After they stepped into the center, I saw their bodies were "lighting" with lighting onto.

The light patterns were projected over the original patterns of their clothes. It was so illusory and interesting looking. Light would be projected on some positions in the space but not on others. Some corners had less light; some had more it depended on the angle of the projectors.

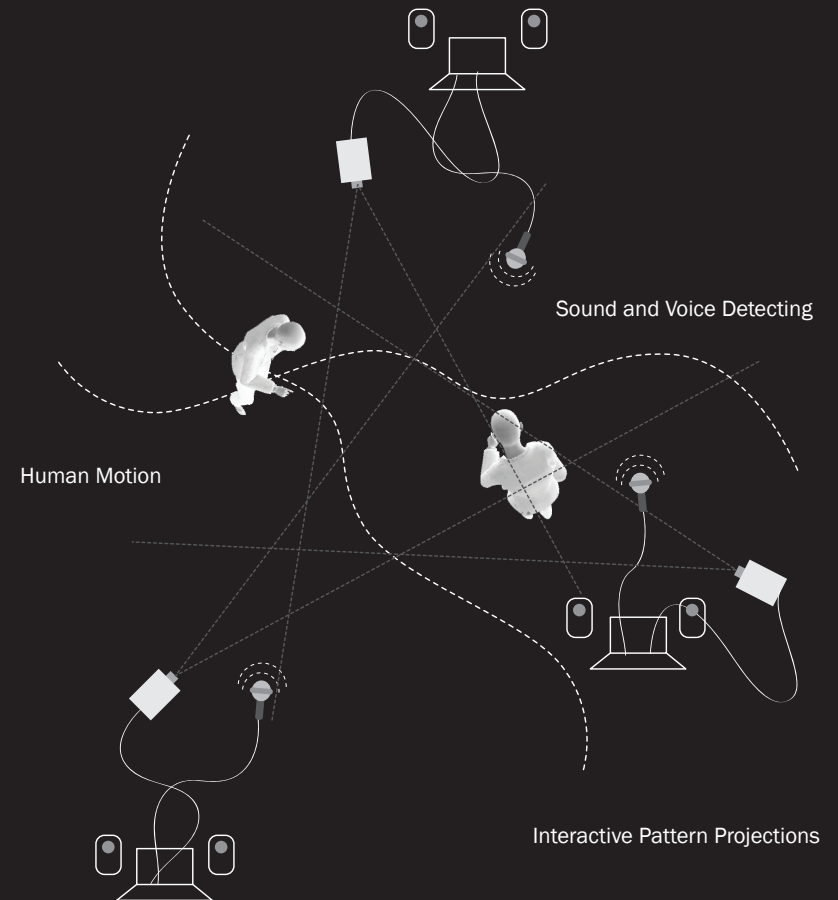
In the projected spot, I could not see the light on my body, but my classmates walked closer because they saw the light. The person who was inside in the space did not know what was happening and felt confused. The observers enjoyed seeing the patterns I put on the person in the middle. Then, I tried to add large papers to wave and catch the light patterns. The papers looked flexible because of the light. I made some gestures such as flapping, folding, waving the papers, to interact with the light.

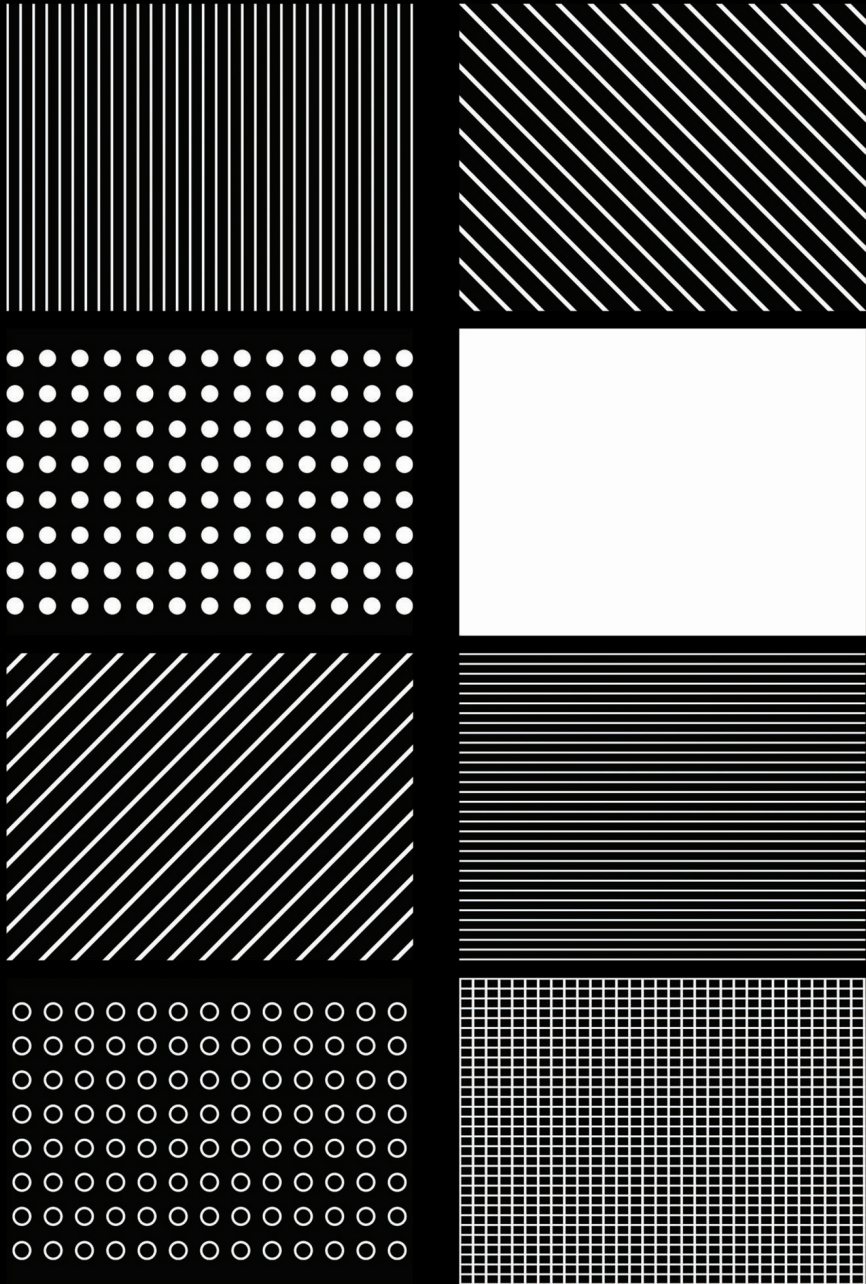
Jan Kubasiewicz and I discussed that the playful part in this test could be developed as a performance language. Otherwise, we were concerned about the contents of the projection.

Interactive Light

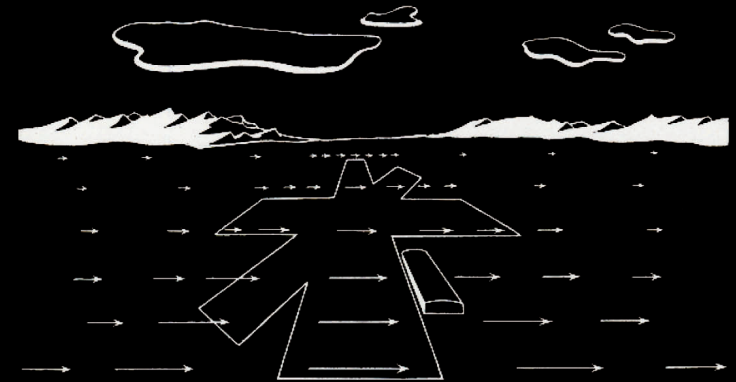
I worked in a dark and private room for my second test. Here I created an interactive sound program with Processing for manipulating the interaction of light patterns and surrounding sounds.

Experimentation:



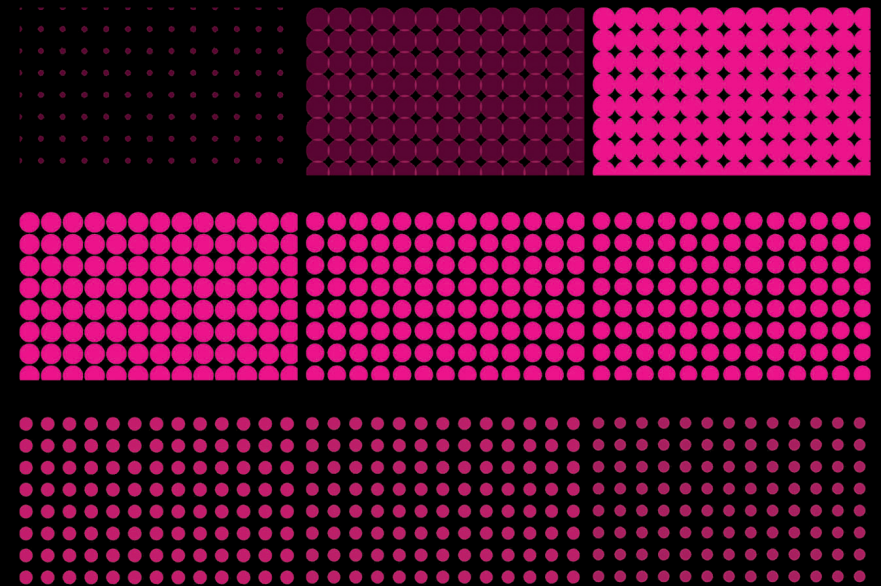
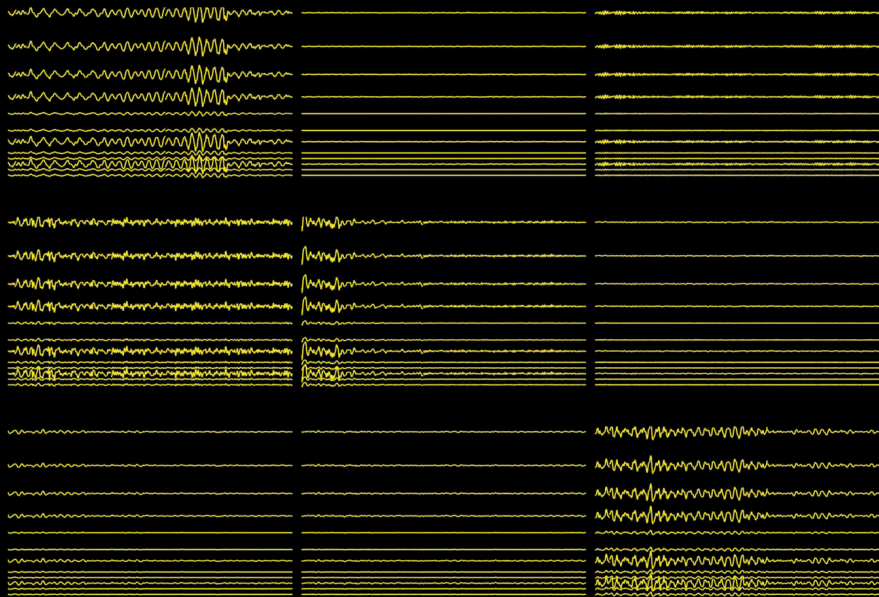
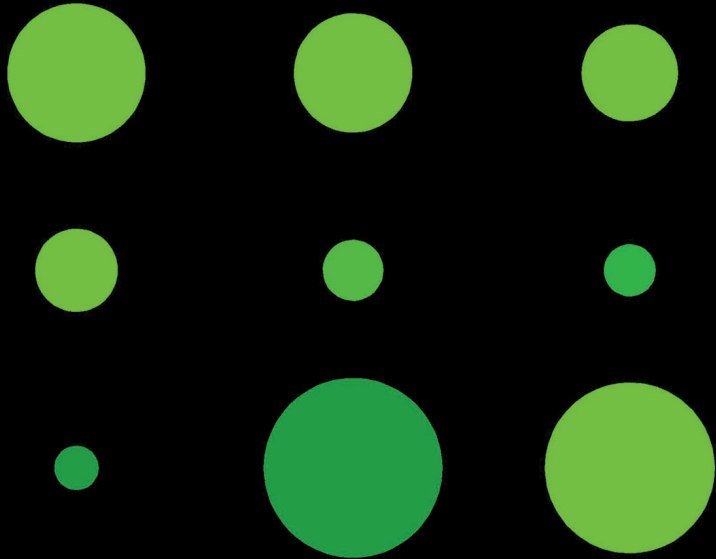


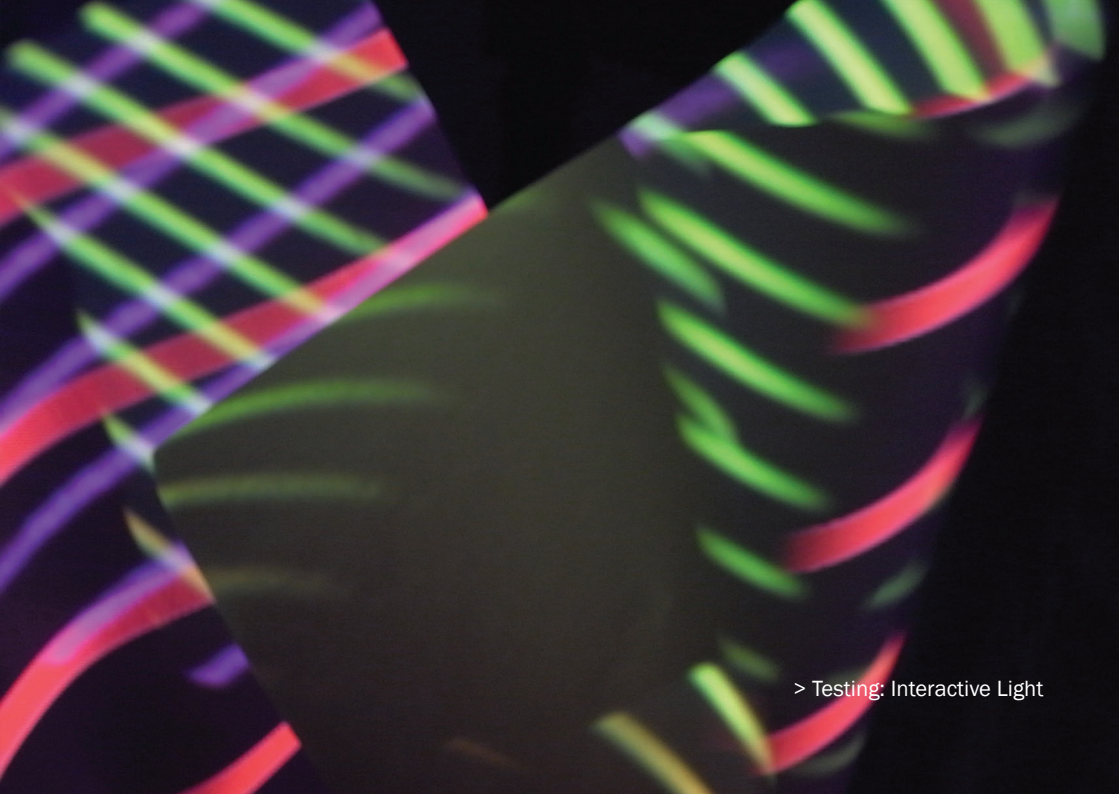
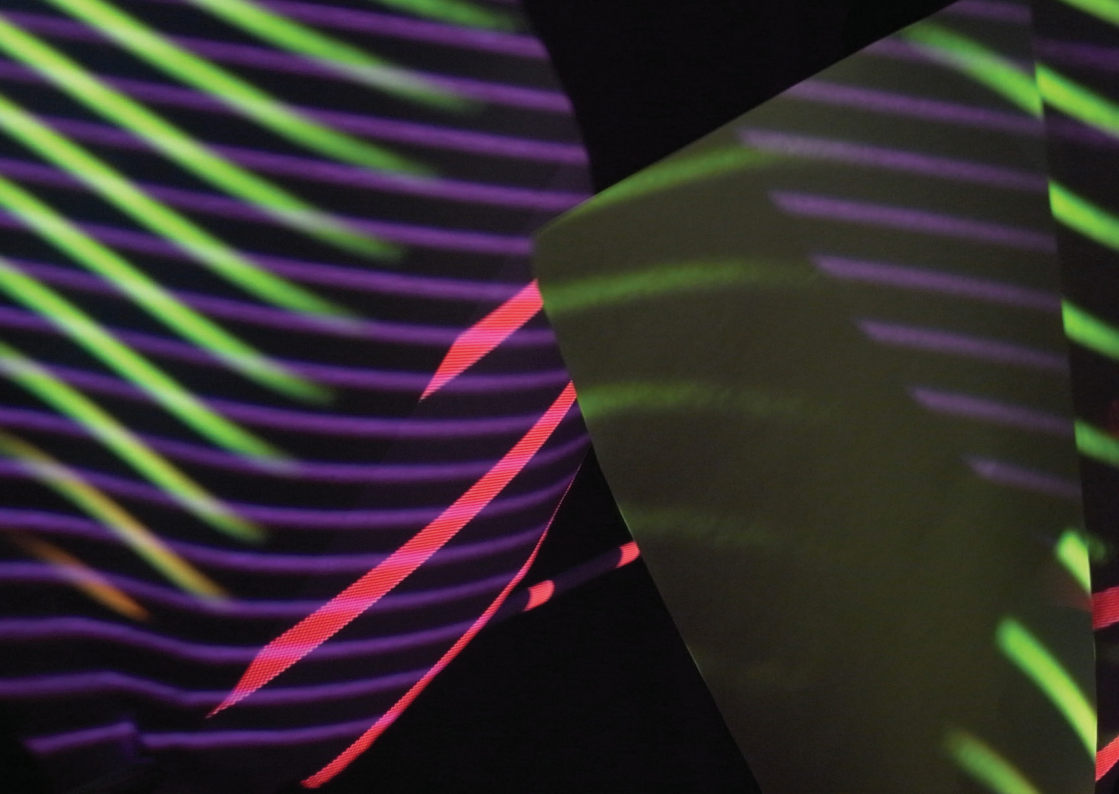
Gradient and depth create three dimension illusion



Depth and Space
Margaret S. Livingstone, "Vision and Art: The Biology of Seeing."

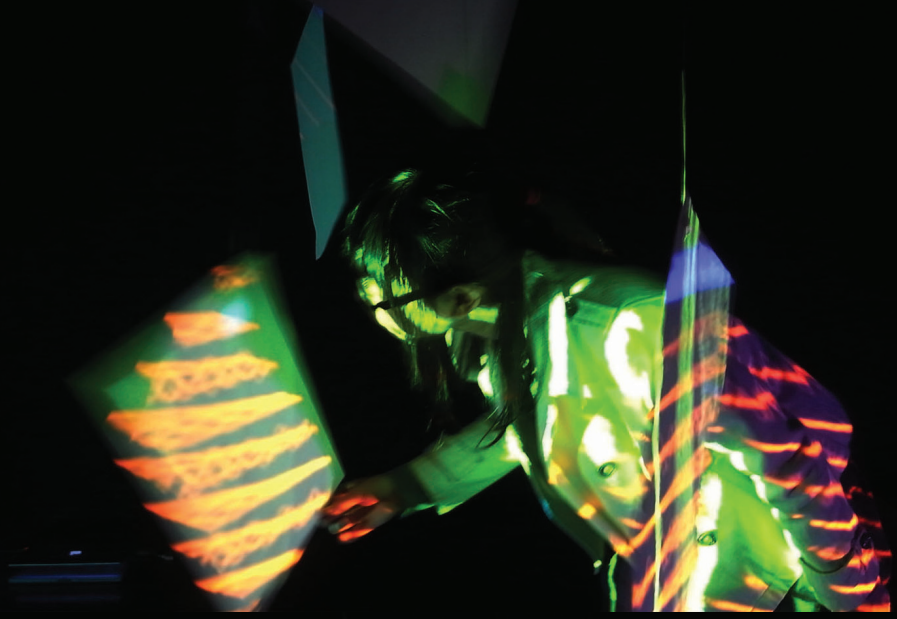
> Testing: patterns with lines, circular forms, grids







> Testing: Light as Dream



Testing: Moving Light

> Testing: Lighting Bodies



If I made sound in the room, the microphone would detect and transmit it to Processing to change the light pattern.

Light as Dream

Instead of the private room, this test was set in a public space, a hallway surrounded by windows on the first floor. I chose a spot near a large sculpture of a man. The projectors were directed onto the sculpture. The sculpture resembled Rodin's "The Thinker."

When I worked on my projection, many people passed and expressed interest in it. They said the light first attracted them.

The sound filled the hallway and interacted with the light projections. Several people walked by again and again, they finally told me they wanted to experience the light on their own. An old gentleman stopped by and talked to me. He thought the light projections were like a sculptor's dreams. I realized it was a nice point.

Moving Light

I went back to the dark room to work. It was my last testing in fall 2009. Among the conclusions from my previous tests:

- Develop more interaction of sound with light.
- Make microphone detected more sensitively.
- Design the new pattern with a different pitch to create depth of field.
- Use hanging papers as a medium to catch and expand the light a little bit to invite people to walk in.

The large hanging papers were attracting me. I saw the light pattern projected on them and tried to make gestures with them. The sound was made by my action when I flapped and blew the papers. My motion changed the light dynamically.

A new perception of space was created with light patterns and bodies' motions.

Light re-arranged the space adopting the body as a filter. Light attracted people to walk into the room, and gathered people to recreate a new arrangement in the space. Then, a new space was made.

Fall 2009
 Project Advisor: Jan Kubasiewicz
 Equipment Support:
 Brian Lucid, Dennis Ludvino



> Gesture drawing: Day Dream by students

Primary Thesis Projects: Day Dream _Group Users Experiences

Overview

Objectives

Based on the three-layer projection system with light source, physical filters and spatial surface, I used three projectors as the light source and bodies as both physical filters and spatial surfaces to recreate the perception of the space.

In this project, I was exploring what is the imagined daydream, an experience everyone has had and bringing group audiences into the space that I created with three projections.

In order to perceive the interaction between light and group audiences, the interactive visual sound lines from "Sound Wave" project and huge papers were the medium to make the illusive perception of the space.

Preparation

At first, I wondered, "What do people see when they close their eyes? What is the space there?" I turned to ask many friends. Some of

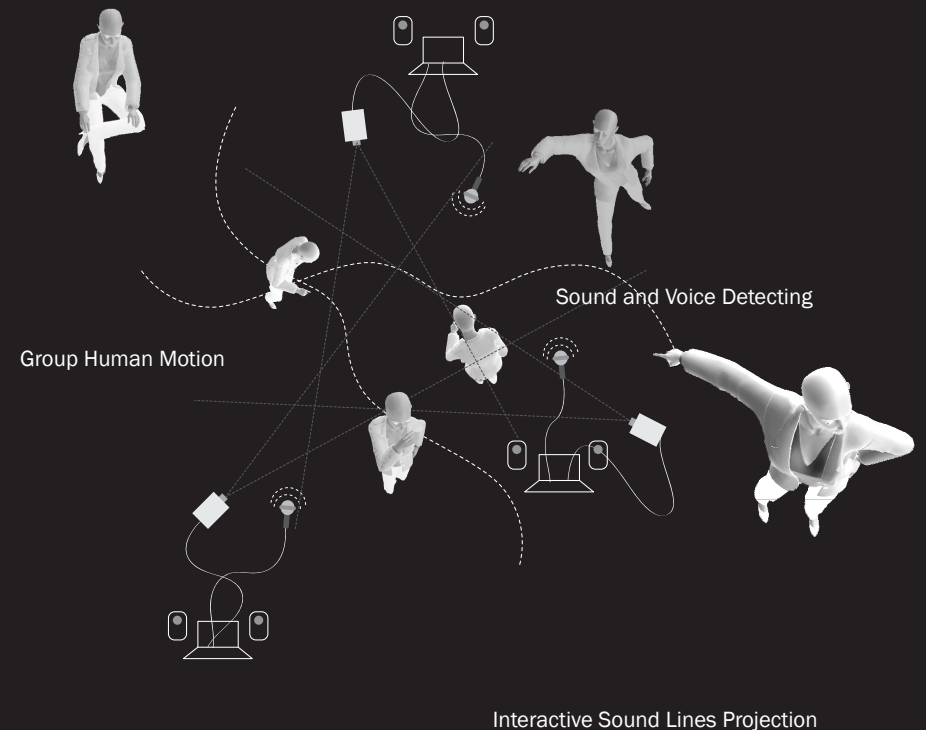
them told me that they saw a bright square, which was like a screen, some said that they saw dark spots and white lines, a few of them saw the last image they saw before they closed their eyes, which is a kind of “retentivity of vision.” So the question was: Why could people see when their eyes were closed? What were the space people see? I’d like to imagine.

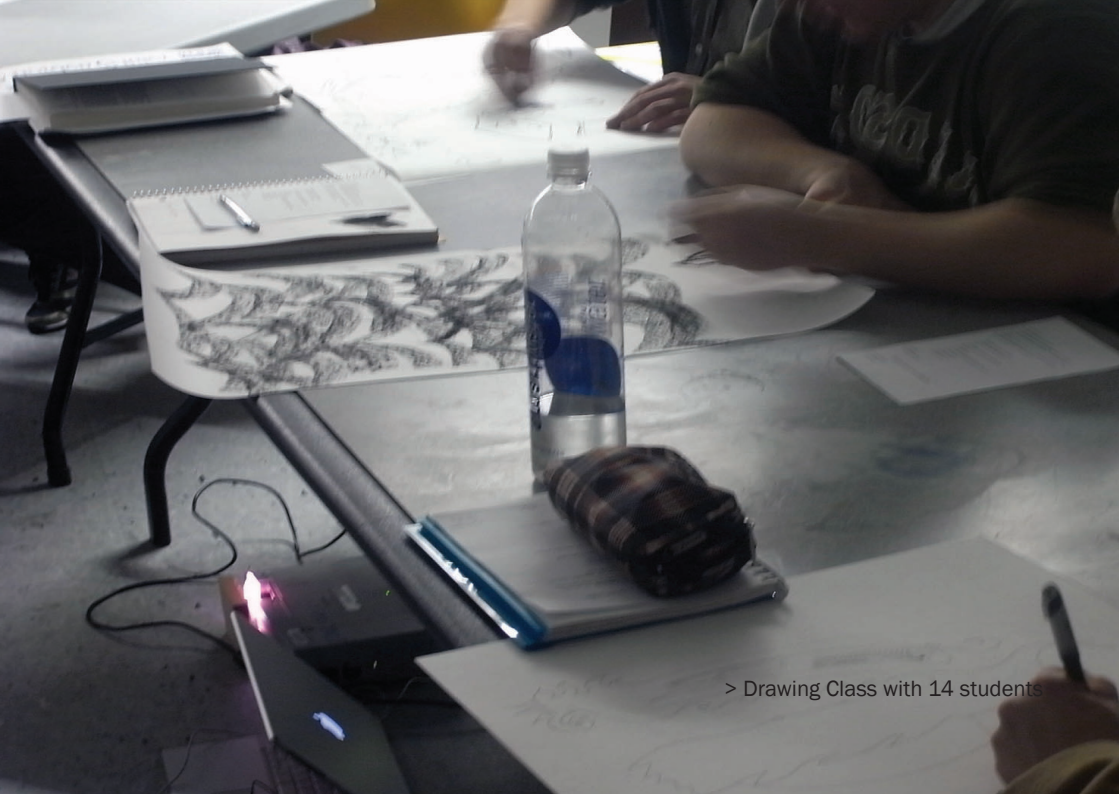
I focused on the understanding of interaction between group experiencers and observers, which I have not tested before. Using the opportunity of the teaching assistant work with Gunta Kaza, who was the main instructor of the “Drawing” class, I set up an installation for students to experience. For the drawing, I required the students to draw what they saw both when they closed their eyes to dream and after they saw my project. Their drawings, which visualized light, were different from the textbook definition of light.

Following the experimentation with three projectors in a three layer projection system, three projection light sources in the large triangular shape projected and interlocked in the classroom, students function as both physical filters and spatial surfaces. Then I made two areas, which were the center with multiple projection overlapped and the periphery without light. In addition, I added the huge papers as the medium, some were hanging, and some were folded on the floor.

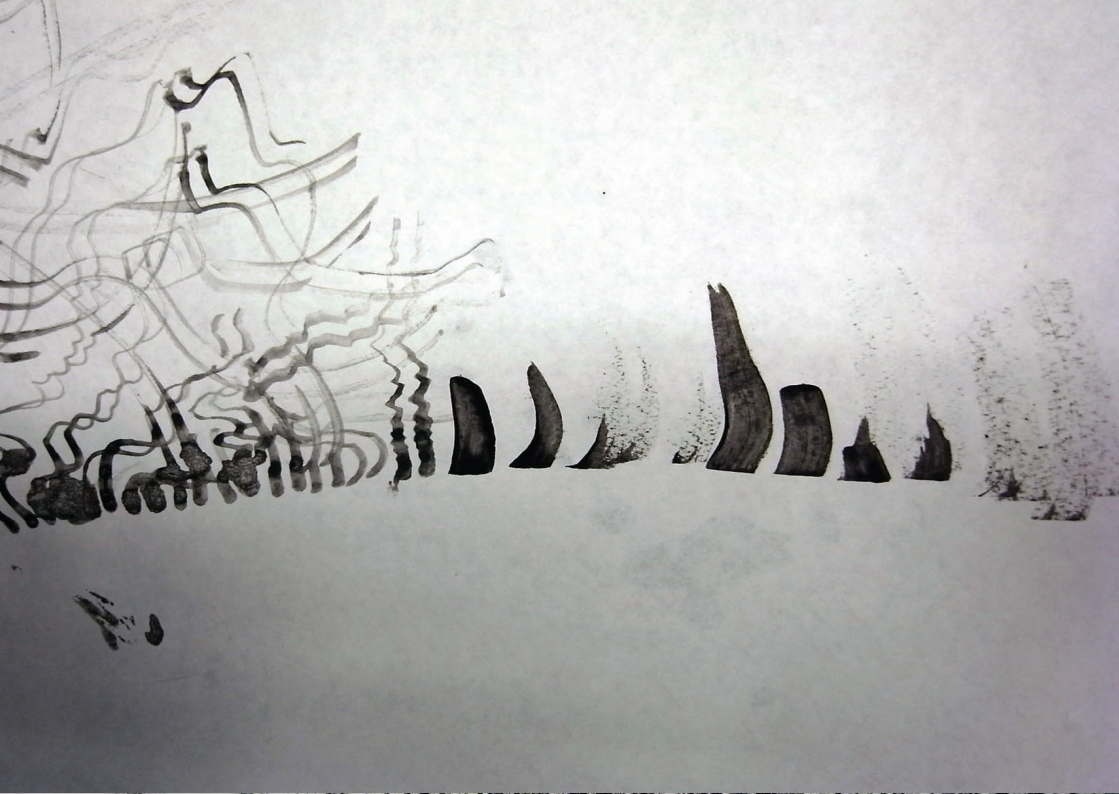
There were fourteen students in the classroom. I separated them into groups of seven and to take turns as experiencers and observers. The experiencers would move around the center, the observers stayed on the periphery.

Experimentation:





> Drawing Class with 14 students



> Gesture drawing: Day Dream by students

For the major light sources, I continued working on Processing for interactive sound detection. There were visual sound waves as lines with different colors and pitches in between being projected. Adding a different pitch between lines could create gradients, which gave further depth of field. The light lines projected from three positions in the classroom, moreover made three-dimensional illusions in space.

The medium was the hanging papers and a huge paper that was about four inches in height and thirty inches wide for catching and extending the light lines. Papers were available for students to draw on and play with.

Process

I gave a note with a thought as a warm up for students to inspire their creativity and imagination.

Most students came from solemn backgrounds like engineering and accounting. Ordinarily, their carefulness in their drawing and presentation were apparent. I wouldn't like that the students felt confused in this process when I suddenly asked them to join. The short sentences were to engage them in thinking and bring out their thoughts.

"Close your eyes. What do you see? What do you hear? Do you see flurry light floating, brightness, and darkness? Keep your eyes closed. Keep them closed a long time. Do you feel the blood flowing and feel alive? Then, open your eyes open your thoughts. What was that space you sensed?"

Afterwards, I made four steps of instructions:

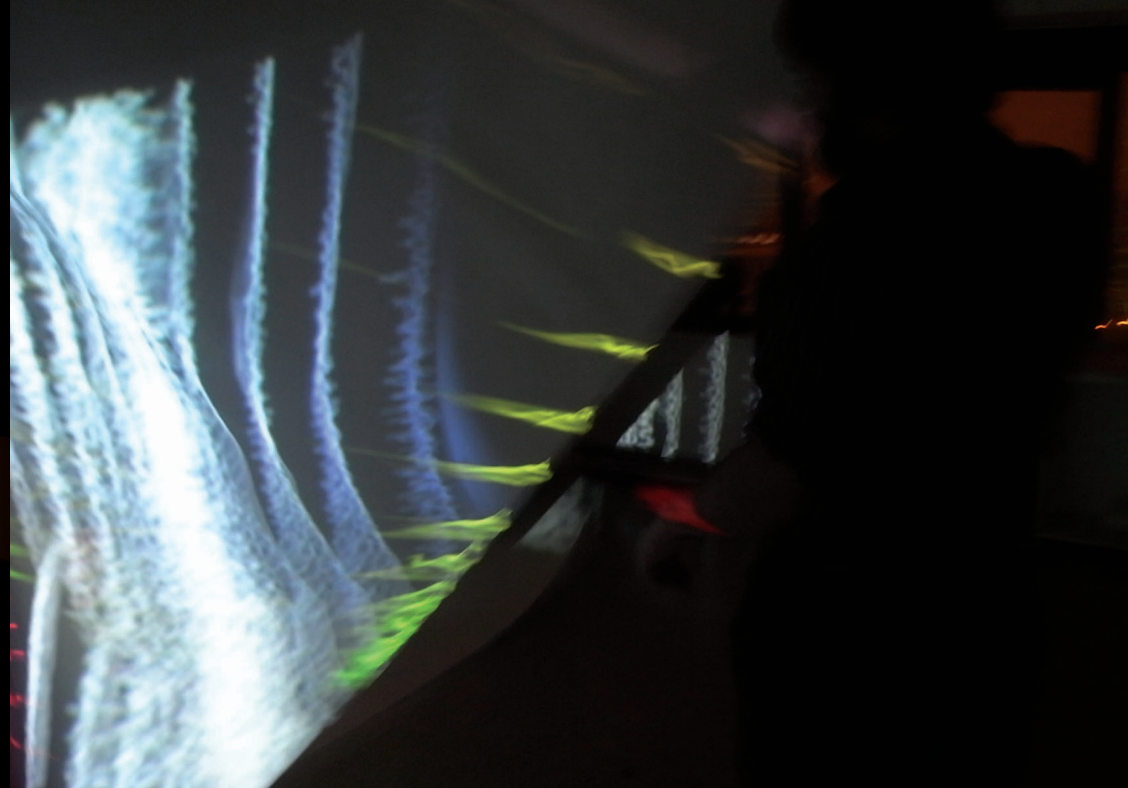
- Have a day dream with your eyes closed for one minute.
- Draw what you imagined for five minutes (with any tool, white paper).
- Each group takes a turn to interact with light and draw (you would like to make sound to interact with sensors).
- Take turns, and I stayed on the side to direct.

In this process, students tried to draw their daydream after the first step. Part of them worked on their mark immediately, part of them still wondered what I wanted them to do. They wanted to figure it out. I told them: just experience, play and have fun.

Then I turned on the music, turned on the projectors. The light lines beautifully sprayed in the room, gracefully waved on the hanging papers and clearly represented and interacted with the music. Everyone was quiet at that moment.

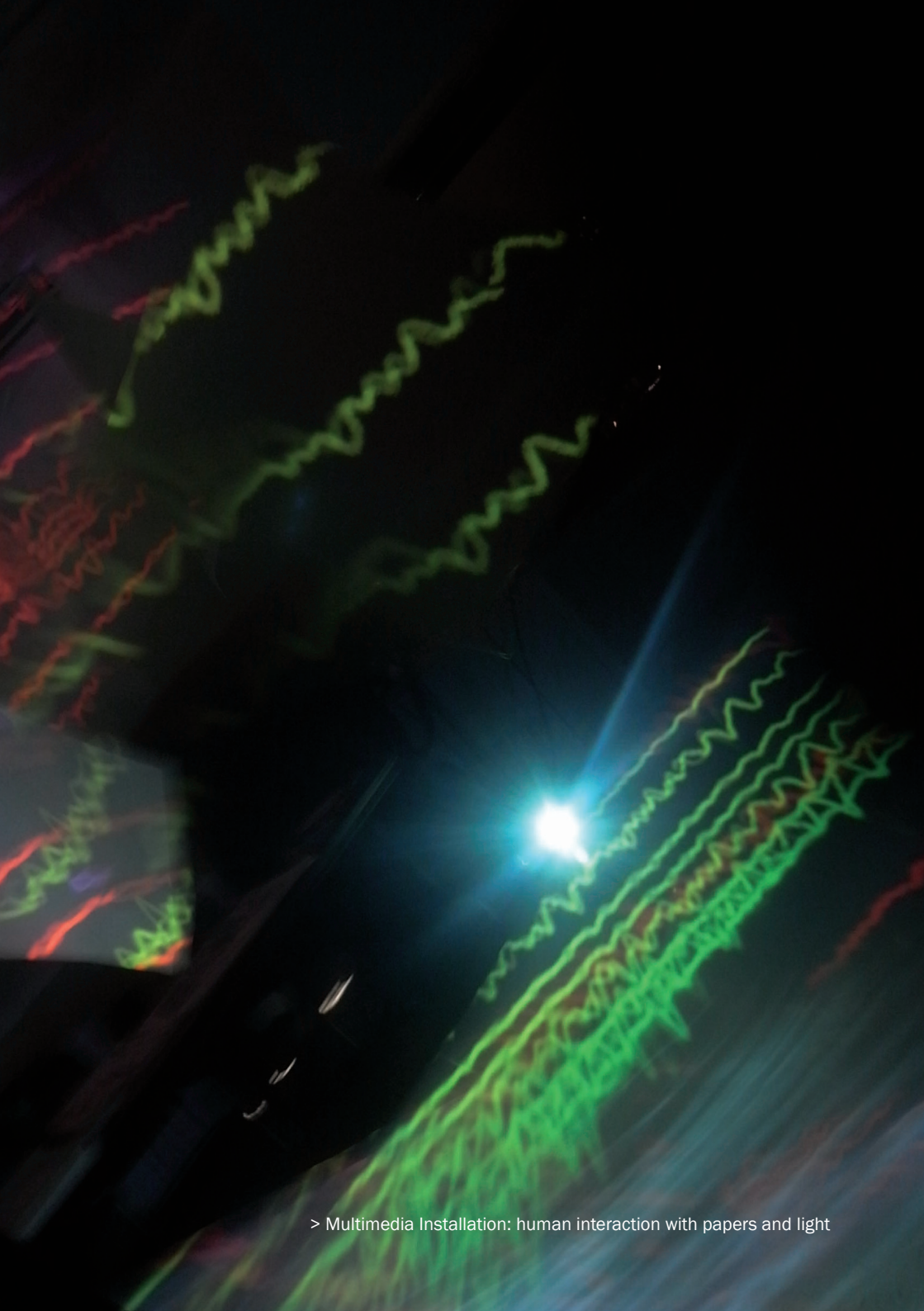
Most students enjoyed playing with the huge paper I put in the center of the classroom. They joined forces to spread the paper and create multiple angles to shape different forms of light sculpture. They gave orders to each other and negotiated their action. Furthermore, they understood how the system worked and how the projection lights created the illusion. Some students stayed, drawing what they observed on their paper and on the hanging papers.

I reminded them the sound could be detected and the projection light lines could be interacted with. Two girls made sounds with the drawing tools and by clapping their hands. Students started to use the paper to make sound in order to interact with the light. The group in the center played with the huge papers, had the idea to flip



> Multimedia Installation: large papers, human motions, gestures, shadows





> Multimedia Installation: human interaction with papers and light

the paper as a wave and made loud sounds in the room. The microphones detected the noise and the light lines were crazy wild to see. The bodies in the light interlocked and covered each other creating the shadows on the paper. Everyone worked hard for about ninety minutes in many ways to interact. I videotaped to document the group interaction.

I went back to review the drawings the students did. The drawings of daydreams before I showed the projection light were abstract geometrical pattern such as lines, circles and spots with strong, bright and dark textures. Some people drew recognizable houses, faces and plants. After I turned on my projectors, the drawings emphasized the thick and thin lines, movement and blurred bodies as well. The strong bright and dark marks were similar to what they drew before. I collected the drawings as visual references for my thesis documentation.

Project Reflection

It was a big challenge for me to describe and deliver my thoughts to communicate with students in the class. Thankfully Gunta Kaza was there and helped me a lot. Everyone in the classroom made this project successful. The interaction between people and my projection lighted space was the most valuable observation I gained in this experience.

“Day Dream” guided people to bring out their creativity and imagination. Further, I brought them into my lighted space to sense and feel this illusive perception. The students gathered themselves in

the center spot of the classroom instead of separating in the periphery to play with the light. The students on the periphery tried to become the experiencers instead of just observers. They converged in the center, the space quality became tight and closer; and the center became dense from the middle of the triangle projection area toward the periphery.

Some students specially liked to made sound with their voice and clacking noise. They used the interaction ability of the visual sound waves here to activate the light lines. Some enjoyed observing the whole scene of people acting in the space with papers and light. One guy used his camera to take picture all the time and shared them with classmates after the class.

In all parts of this experience, I considered the audience's interaction would be an important in my projection lighted space. Students gave me feedback that they'd like to have this installation in an opened area outside or in a huge room. I thought it would be a nice suggestion for a further step and I'd like to make it.

As a creator in this project, I learned to think about the human interaction more. I designed a way for people to interact, but people also interacted on their own. They drew, moved and observed. Then, I watched their motions and learned another gauge of interactive perspective.

Spring 2010
Project Advisor: Jan Kubasiewicz
Additional Advisor: Gunta Kaza
Additional Participation: Drawing Class
Equipment Support:
Brian Lucid, Dennis Ludvino

Primary Thesis Projects: Heart Beat _Language of Performance

Overview

Objectives

The objective in this project was to explore the possibility of bringing a projected, lighted space into the language of performance. I invited a dancer to work with me. Ching-I Chang performs professionally for multiple dance groups in both New York and Washington D.C.

From the design of the stage, to selecting the music, we thought, created, performed together. We tried to bring her performance into my system of three projectors as the light source and bodies as both physical filters and spatial surfaces to recreate the perception of the space.

The project name was “Heart Beat.” Ching-I performed the idea: heartbeat, the projection projected the metaphor of the heartbeat as the blood pumping. Not only did I want to create a new generation of stage design for a dancer, but also I’d like the performer’s body to move and pull audiences into this experience.

Preparation

The first project in the DMI program for every incoming student is “I am Now Here.” It was a two weeks warm up project. I took the meaning of “I am Now Here” as the concept of my culminating “Heart Beat” project.

I approached the concept from two points:

- I am now here; I exist. I am aware of myself mentally through my thoughts.
- I am now here; I am alive. I feel life flowing through my blood and the stroke of the pulse. I am aware of myself physically through my sensations.

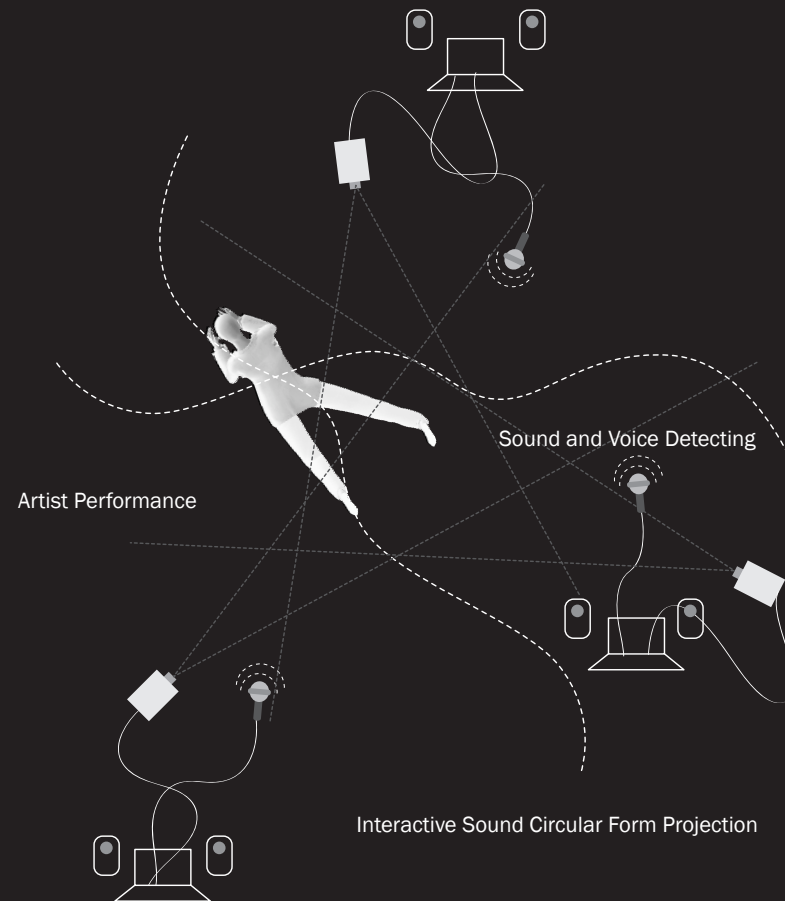
Both of the two points conveyed a sense of “I am now here.”

This project focused on testing the language of performance by using my three-layer projection system with three projectors into a real stage space.

Two directions were planned for the audiences to observe this performance. First, the audience observed only, they could merely watch the artist perform with light and space. Later on, I directed the artists to invite the audience to get involved by their acting and interacting with the light and the other audience members.

Based on the experimentation with three projectors in a three-layer projection system, the artists’ motion was both the physical filter and the spatial surface. Then I made two areas, which were the center where the multiple projections overlapped and the periphery without light. In addition, I added lots of balloons as the medium, some were hanging, and some were floating on the floor.

Experimentation:



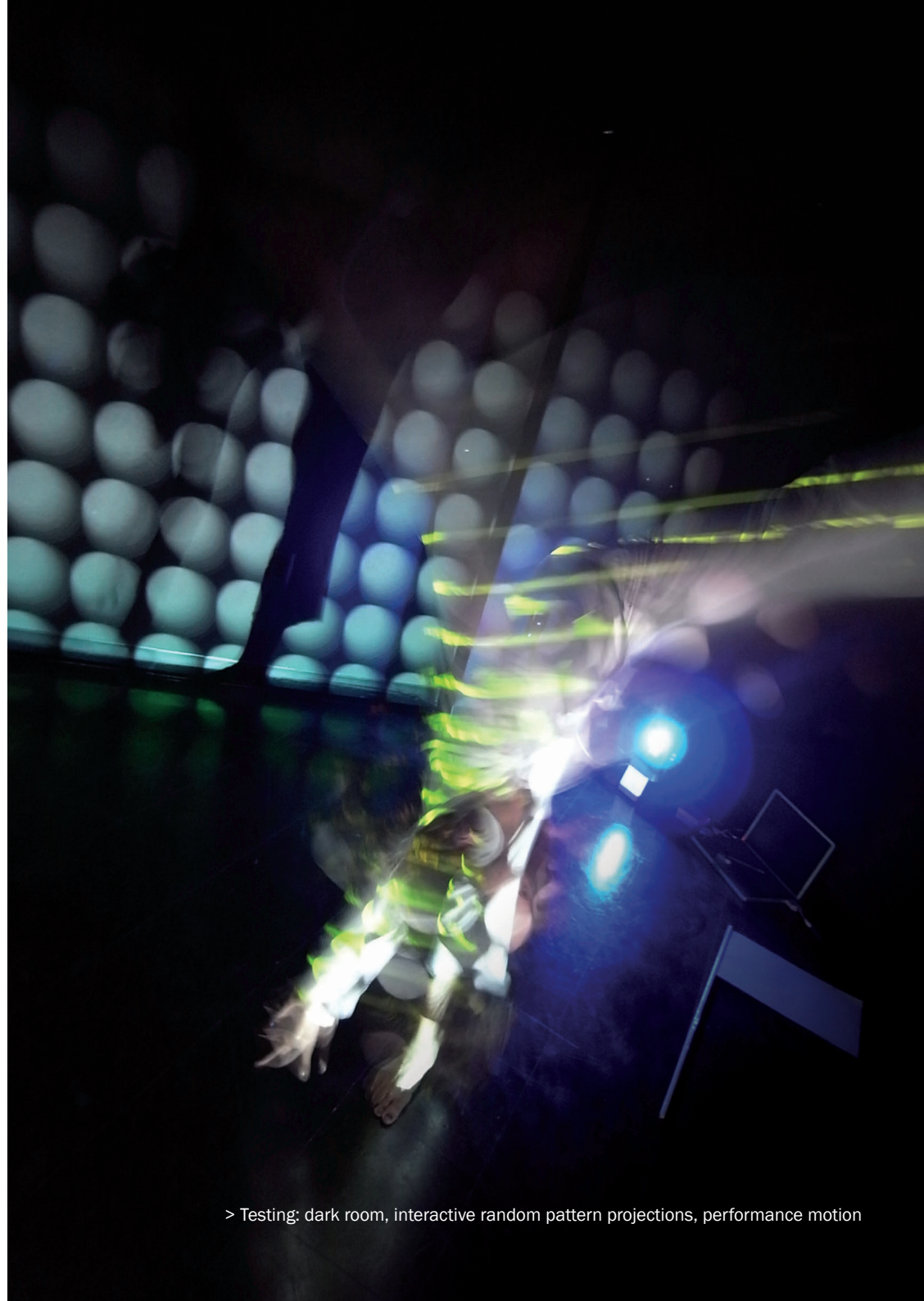
For the three light sources, I continued working on Processing for interactive sound detection. There were visual sound patterns as solid circular forms with different colors. Each circular form represented a heartbeat; each sound created the meaning of “alive.” When the sound was detected, the solid circular forms grew and interacted to each other.

Ching-I and I considered the white large papers, a simple shaped chair and objects with unlike forms when we picked and selected the medium to place between the projections. We finally adopted the balloons to be the main medium to create a dialogue with the solid circular forms projection as the visual language. The balloons were everywhere.

We selected a classroom, which was about 20x20 feet with curtains as background, as the site. Before this decision was made, we tried an empty dark room that was about 10x10 feet and a public stair transition site at school.

Process

The first time Ching-I experienced the light projections, I turned on the projectors and she tried to feel the whole light and space with her body and without too much thinking. She stayed still and moved slightly, she sensed. Although I told her how it would look on the phone several times, she thought that was too difficult to imagine by my description and the photos I sent her. She was shocked and surprised.

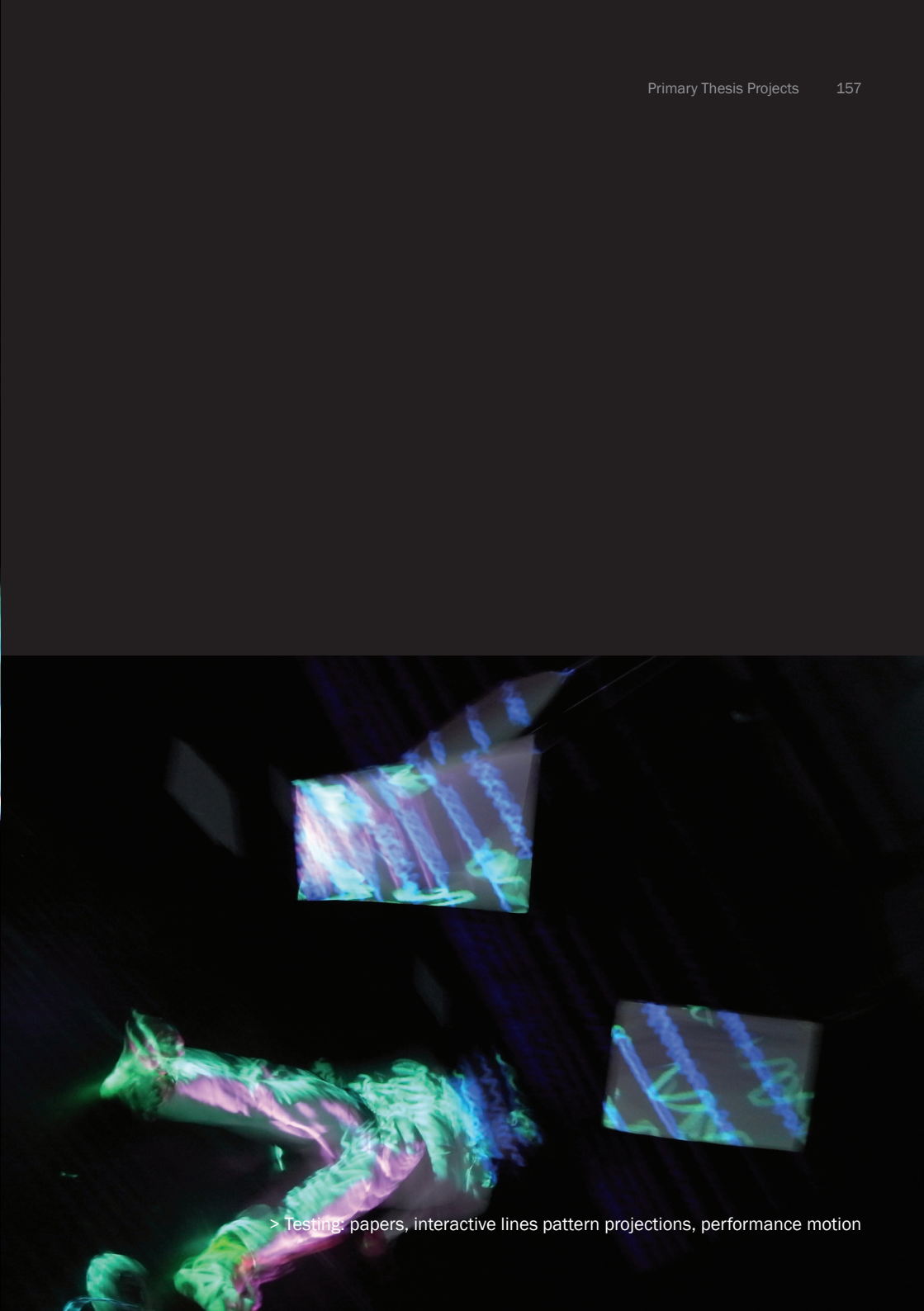




> Testing: interactive random pattern projections, performance motion



> Testing: objects, interactive random pattern projections, performance motion



> Testing: papers, interactive lines pattern projections, performance motion



> Testing: balloons, interactive circular forms pattern projections, performance motion



> Testing: balloons, interactive circular forms pattern projections, performance motion

Extending her body naturally in the empty dark room to sense and catch the light was the first practice she made. She asked me to take pictures and shoot video for our discussion because she could not really see how the light changed and moved on her body. She moved every part of her body; she stood upside down, jumped, lay down on the floor and stepped on tiptoes.

For another practice, we choose a transition site in a public stairway at school. It was a busy area, people walked around. The place was giant and light projections were projected onto the far and near walls, glass windows and ceiling. The perception had been made boundless and limitless. She gradually gained more understanding of my experimentation and the effects of the light.

On the second day, we moved the equipments to the classroom. I built the stage with curtains as a background to the performance. She first asked for more objects with different forms such as white box, cylinder bar among others, on the stage to catch the projections. In my opinion, there were too many interruptions. So I suggested using one simple chair in the scene. She made a scenario to slide it onto the stage slowly with music and light. Then, we both thought about the papers I tested before. We practiced all the different possibilities.

Between our conversations, we negotiated and tried our ideas until we focused on the heartbeat and determined that the balloons were our main medium to interact with the sound circular forms. The influence of the balloons and light was dramatic to see. Between light projection and illusory perception of space, she danced.

Ching-I and I cooperated again in Dynamic Media Institute “inter-akt” exhibition, April 15th, 2010. I set up the installation with her performance and my lighting space. She first danced a short section and then invited the audience to walk onto the stage and interact with her, the light and space.

Project Reflection

The most important thing I gained in this project was the support of a performing artist. Ching-I contributed a lot of her thoughts and dance. We had a tacit understanding and unspoken agreement during the process. She helped me in brainstorming ideas and helped generate new ones. It was a new start for testing the language of performance. The discussion about the possibilities on the stage inspired me with enthusiasm. She and I would like to push this idea more in the future.

On the other hand, the action for the performance was changing. Instead of a show, which was only for watching, the artist invited the audience to walk onto the stage successfully. The balloons were a nice and playful medium I used to function in the installation, the light and illusory space was attractive. The motion of the performance was the main part that introduced the concept of the projection light and space for people to interact with it.

Because of the interaction and the invitation from the dancer, the audience easily crossed the edge of the “stage.” They became part of the installation and recreated the performance.

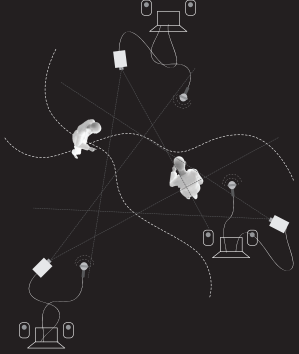
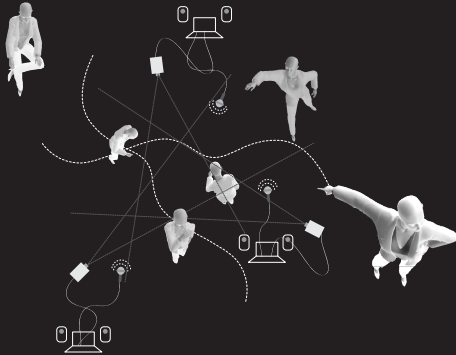

Some people stayed in the periphery and kept observing. They saw the effects between the human motion and lighting space. It was

a joyful observation. Then, they maintained the spirit of performance by continuing to watch the show. Some people generously moved their bodies and gathered on the stage, they blew the balloons I gave them and played. I have investigated and explored this topic for two years; suddenly the scenes pleasantly surprised me. This result was marvelous. I had never used this kind of huge scale of light, space and human motion to gather the interaction.

The next step for this project is using group performances to perform. I wondered if it will give performances impulse to inspire their work. Moreover, how will my projection light and illusory space interact with them.

Spring 2010
Project Advisor: Jan Kubasiewicz
Artist: Ching-I Chang
Technical Support:
Scott Murray, Andrew Ellis
Equipment Support:
Brian Lucid, Dennis Ludvino

Thesis Projects Matrix:

	Experimentation	Light Sources	Physical Filters	Spatial Surfaces
<p>Four Explorations: Lighting Bodies Interactive Light Light as Dream Moving Light</p> 		<p>Interactive Three Projections With Circular Form and Lines Patterns Processing</p>	<p>Human Motion Gestures Shadows Papers Curtain Mirror Chair Objects</p>	<p>Human Motion Gestures Shadows</p>
<p>Day Dream: Group Users Experiences</p> 		<p>Interactive Three Projections With Lines Patterns Processing</p>	<p>Human Motion Gestures Shadows Large Papers</p>	<p>Human Motion Gestures Shadows Large Papers</p>
<p>Heart Beat: Language of Performance</p> 		<p>Interactive Three Projections With Circular Form Patterns Processing</p>	<p>Human Motion Gestures Shadows Artist Performance Floating White and Translucent Balloons</p>	<p>Human Motion Gestures Shadows Artist Performance Floating White and Translucent Balloons</p>

Conclusion

Experience and Thought

“The most beautiful experience we can have is the mysterious—the fundamental emotion which stands at the cradle of true art and true science.” Albert Einstein, Living Philosophies, 1931.

I was inspired by the responses between projection light and illusory perception of space, and further perceived the human interaction during my exploration process. On the way to approach the goal of my thesis, I made multiple tests and brought in many different thoughts with my experimentation. Through the use of various physical filters, such as the human body and other objects on which the light is projected, the perception of space can be altered.

After all of my work, I realized that an interactive performance guided by a lighting system would be a potential prospect to present my thesis reflection and thought. On the other hand, I went back to consider the practical help of my real world architecture background. The light could be brought into the interior design to create an atmosphere and change the original perception of the space.

Dynamic media is a creative medium to make a communication between human and environment, further, between projection light, space and human motion. The interaction is engaging. Light is a great tool to change the perception of the space. In the process of perceiving space, light plays a crucial role, especially projection light which can modify the physiology of our visual system. Furthermore, the interaction of users, primarily humans in motion, either choreographed or random, creates the action by altering the light. These aspects can only be discovered in the process of exploration. The roles of humans in motion and in observation are explored by people interacting with my project. My space becomes a laboratory.

On my thesis' path, I kept questioning myself: "what knowledge and experience did I gain in the past two years?" I realized the most outstanding aspect was the experimentation in my creative process. The beautiful thing about the projects I presented and designed was that the process of exploration took me across the design gap to thoughtful and meaningful thinking.

For the design experience, I emphasized the working process. To document my process was an important part for me, for rethinking and figuring out my creative system. I experimented and tested every possibility, although the result sometimes was not as good as what I expected. I always had to take a risk. When I failed, it was painful and I felt like I wasted time. Then I understood, if I knew I was wrong, I was able to turn to the right direction. Further, I kept working, worked hard, and had fun.

In the end, what I learned, when I explored light, space and human interaction, was that creating questions satisfies my wonder.

Bibliography

Books, Article

- Antonio Zamora, *Anatomy and Structure of Human Sense Organs*.
- Bachelard, Gaston, *The Poetics of Space*.
- Cecil Balmond, *Pamphlet Architecture 27: Tooling, Informal, Element*.
- Colin Ware, *Information Visualization: Perception for Design*.
- Craig Adcock, *James Turrell: The Art of Light and Space*.
- Diane Ackerman, *A Natural History of the Senses*.
- Gui Bonsiepe, *Some Virtues of Design*.
- Italo Calvino, *Six Memos for the Next Millennium*.
- Helen H. Hu, Amy A. Gooch, William B. Thompson, Brian E. Smits, John J. Rieser, Peter Shirley, *Visual Space Perception and Visually Directed Action*
- Janet Abrams, Peter Hall, *Else/Where: Mapping - New Cartographies of Networks and Territories*
- Jimmy, *Turn Left, Turn Right*.
- Joanne Northrup, *Jennifer Steinkamp*.
- John Dewey, *Art as Experience*.
- Kaku, Michio, *Hyperspace*.

- Krzysztof Wodiczko, *Critical Vehicles: Writings, Projects, Interviews*.
- Les Manovich, *The Language of New Media*.
- Madeleine Grynsztejn, *Take Your Time: Olafur Eliasson*
- Margaret Livingstone, *Vision and Art, The Biology of Seeing*.
- Marshall McLuhan, Quentin Fiore, *The Medium is the Massage, An inventory of Effects*.
- Meredith Davis, *Massaging Media Two Conference Keynote Presentation*.
- Michael Hohl, *This is not here: Connectedness, remote experience and immersive telematic art*.
- Nathan Shedroff, *Experience Design, Design Is the Problem: The Future of Design Must be Sustainable*.
- Neil Postman, *Technopoly, The Surrender of Culture to Technology*.
- Richard L Gregory, Priscilla Heard, *Knowledge in Perception and Illusion, Eye and Brain, The Psychology of seeing, illusion in Nature and Art*
- Rudolf Arnheim, *Art and Visual Perception, A Psychology of the Creative Eye*.
- Semir Zeki, *Vision of the Brain*.
- Steven Johnson, *Interface Culture: How New Technology*
- *The New Media Reader*.

- Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*.

Artists, Websites

- Anthony McCall, <http://www.anthonymccall.com/>
- Bill Viola, <http://www.billviola.com/>
- [Indianchild.com](http://www.Indianchild.com)
- James Turrell
- Jennifer Steinkamp, <http://jsteinkamp.com/>
- John Stell, <http://www.leeds.ac.uk/sid/>
- Merriam-Webster, <http://www.merriam-webster.com/>
- Michael Hohl, <http://www.hohlwelt.com/en/>
- Nathan Shedroff, <http://www.nathan.com/>
- Olafur Eliasson, <http://www.olafureliasson.net/>
- Polygon-Playground, <http://www.polygon-playground.com/>
- United Visual Artists, <http://www.uva.co.uk/>
- *UN Climate Change Conference 2009*
- [sciencebob.com](http://www.sciencebob.com)

