The Fall Beyond Tomorrow's Life

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Abstract

The Fall Beyond Tomorrow's Life is an interactive environment that unites water and sound. The primary components of the piece are a volume of water, a hexagonal multichannel speaker array and a computer vision apparatus. The computer vision component is positioned above the volume of water and captures the motion of the surface of the water. This interaction and the resultant waves are captured by the camera and translated into spatialized sound via custom software. The volume of water is an analog of the room in which it is placed—interaction in specific areas of the volume cause sounds in a corresponding area of the room.

The impetus of this project was the investigation of water as an interface for the creation of sonic events. Water is inextricably tied to human existence and therefore holds the potential of a unique membrane of interaction. It has alternately symbolized life, love, death, rebirth and renewal in myriad cultures and is never far from anyone's conscious mind in this era of mass environmental concern. I seek to create an environment that has at its core a volume of water, which the viewer encounters with little or no added artifice. When the viewer touches the surface of the water, sounds resonate accordingly.

Description

In the midst of a rectangular void beneath a thin beam of light, one encounters a small form filled with water on the ground. The surface of the water is smooth and undisturbed, and it is shallow enough to permit one to see the terrain of its bottom. A dark cube too wide to easily step across, the form is matte black that reflects little light. The texture of the concave surface of the form ranges from flowing grooves, undulating into eddies and half-spheres of varying sizes to harsh fields of rectilinear transitions. The form is elevated slightly from the ground, atop a recessed surface, giving it the feeling of floating. Kneeling beside the form, one reaches a tentative hand out and touches the surface of the water with a finger. From behind, one hears abstract ringing; effervescent tones appear and then decay as the ripples in the surface of the water subside. Another touch confirms the relationship between the water's surface and the sounds.

As one makes their way around the form, it seems that the touch-triggered sounds and the terrain of the form are of a piece. Where the water is broken up by jagged or immediate transitions of steep slopes or sharp cornered pockets, the sounds issuing from the dark ring surrounding the form are harsh, metallic, clipped or dissonant. Yet, when the water is disturbed near gently sloping, bowl-shaped impressions or above loose spirals of ribbed grooves that almost reach the surface, the emanating sounds are soft—reminiscent of ringing bells, major chord members held in partial suspension or strings stretched above a resonant body, stimulated by an unseen hand.

Introduction

The touch surface, in its various forms, has become the popular and accepted paradigm for a multiplicity of devices, from cell phones to tablets to ATM machines. Although many of the technologies that make touch possible, such as capacitive touch or infrared, are neither new nor cutting edge, the acceptance and ubiquity of the interaction touch surfaces provide is an important aspect of several investigations of *The Fall Beyond Tomorrow's Life.*

Perhaps more than any other medium, water contains numerous metaphors, symbols and myths with which it is associated. It is an agent of metamorphosis and transformation, a potent elixir of purification and the legendary membrane over which one may pass from one fantastical realm to the next. The piece seeks to quietly acknowledge any or all of these associations, and any others one may bring, as inherent associations to the piece. The piece explores water as a medium with which to cause, shape and sculpt another highly intuitive medium, sound.

Sound is likely the simultaneous other primal and early interface one encounters in the womb, and engages humankind in unique ways. Unlike most art media, musical components, such as rhythm, require both the left and right hemispheres of the brain for complete perception. In *The Fall Beyond Tomorrow's Life,* the viewer must touch the volume of water to create music. This initial interaction becomes an attack, and the sound events and objects created by this first series of events resonate as the waves slowly decay. In this way, the interaction with the water and sculptural form serves the same purpose as in traditional acoustic compositions. While *The Fall Beyond*

Tomorrow's Life can be defined as a musical instrument, that is not the primary goal of this project—though that is one logical and welcome outcome. The primary goal is to present the viewer with a volume of water that beckons them to its edge, entices them to touch it, and then encourages them to remain an extended time to both interact and watch others interact. As multiple viewers disturb the water, the consequent waves are added to each other, causing new sounds that are distinct from the original disturbance. (fig. 11)

Sonically, *The Fall Beyond Tomorrow's Life* creates a rich harmony between the pressure waves traveling through the atmosphere of the room and the surface waves on the volume of water. The relationship between water and music is not merely metaphorical. Although the former is the medium for a wide variety of periodic motion and the latter is the result of sound waves being intercepted and decoded by our auditory system, there are many physical similarities in the manner in which the surface waves on water sound waves are reflected, decay or propagate. The volume of water and the volume of gas that completely fill the environment of the piece are therefore two parts of the same membrane. The water may be the beginning of a causal chain, but it is also the effect in the sense that viewers encountering the music made by their initial gestures will interact with the water again to modify the original cause.

Conceptually, *The Fall Beyond Tomorrow's Life* is related to previous works of visual art and of computer music, and to works that have similarly combined the two. Olafur Eliasson's *Notion motion* (2005) calls to foreground the interplay of surface waves

on a body of water, using them as a medium with which to bend projected light. In *Ondulation* (2002), Thomas McIntosh uses sound to create surface waves, which are reflected onto a wall in order to visually reveal the relationship between the invisible sound waves and the resultant visible motion of the water. *Earth's Magnetic Field* (1970), by Charles Dodge, converts the physical properties of the Earth's magnetic field over the course of a year into a sound composition with the duration of eight minutes. In the area of frequency modulation and spatialized sound composition, *Stria* (1977) and *Turenas* (1972) by John Chowning, are works that have most influenced the sonic framework of *The Fall Beyond Tomorrow's Life.*

Unlike traditional acoustic composition, music composed using software offers many advantages that are only possible using a computer. I see this piece as an opportunity to explore varied aspects of performance and duration. Through the dynamic potential of computation, the piece will change throughout each day that it is exhibited. Aspects such as frequency, phase, duration and amplitude will be altered every hour. As a musical composition, the piece becomes a dynamic and ever-changing experience that is deepened by changes in the timing of interaction and sensitive to the position and qualities of that interaction.

In 1992, Monika Fleischmann & Wolfgang Strauss investigated touch married with vision in their piece, *Liquid Views—Narcissus' Mirror.* The viewer encounters a plinth with a touch sensitive screen fixed to the top. A camera captures the viewer's reflection, which is reproduced on the touch screen. The reflection is warped and

disturbed as the viewer touches the screen, made possible by water simulation. [1] Although the most common (and first) read of Ovid's poem Echo and Narcissus is that it is a parable about the ills of self-love or self-possession, the spring in which Narcissus becomes mortally consumed by his own likeness reflected in the surface of the water is a primitive mirror. A mirror, in whatever form, may be considered a prototypical interactive surface. As such, Narcissus is beguiled by not only the image of himself reflected in the spring, but also the phenomenon caused by the recognition of the cause of the likeness. The mirror excellently and quickly provides the initial didactic moment that is widely regarded as essential to successful interface design.

A project of a similar milieu and era is *A-Volve* (1994-1997), by Christa Sommerer & Laurent Mignonneau. *A-Volve* gave viewers the opportunity to create and interact with creatures projected in a pool of water, in which the creatures "swam." Custom algorithms designed by Sommerer and Mignonneau controlled aspects of the creatures' form and movement. Thus, the creatures could flee from viewers or be caught, and could spawn offspring from interactions with other creatures. *A-Volve* relied on the very same notions of water as interface as is currently being investigated in *The Fall Beyond Tomorrow's Life*; conceptually Sommerer and Mignonneau see water thusly: "the metaphor for birth and basic evolution is the medium for this artificial life 'pool', that is open to its real environment."[2]

Unification of
Aural And Sculptural Media

One of the primary goals of this piece is the unification of the aural and sculptural components. There is an obvious physical kinship between the surface waves on the water and the sound waves moving in the air, however, uniting them in a way that is aesthetically pleasing is a non-trivial task. As was mentioned in the previous section, it is dire that there is the didactic moment in which the viewer is aware that their action has caused sonic events that are a result of their interaction with the surface of the water, but that is a rather one-dimensional experience. There must be secondary realizations, as the viewer connects the movement of the waves on the water and how the sounds they initiated are changed. [3] Additionally, separating the sounds of previous eras in the life of the piece and those sounds that are being created in real-time, and causing the two to interplay with each, is an important aspect of the composition of the piece.

Another key component of the work is the well-accomplished kinship between the topology of the sculptural form that holds the volume of water and the sounds generated through the interaction with the water that occurs in those regions. As described in the abstract, there are thematic and compositional similarities between the sculpture and sound. The zones that are more rectilinear, and therefore non-organic in form, cause sounds that evoke metallic, mechanized, dissonant and disordered structures of sound. In contrast, the areas that feature smooth, rounded or curvilinear shapes are related to sonic events that are harmonic, warm, organic and analog. Zones of transition between these states share aspects of both that overlap and blend into

hybrid sounds. Conceptually, the body of water housed in the interface is akin to what one might stumble upon in a forest—it is an oasis, a mirror or a fountain.

The fabrication of the sculptural form was accomplished through a process that began with a gray scale drawing and ended with a Computer Numerical Control (CNC) system, an apparatus that provides automated fabrication of forms through a computer controlled tool (in this case a router and mechanized mount that moves in X, Y and Z directions). Using Photoshop, a gray scale drawing is made. This drawing is a depth map for generating a 3d model, interpreted by computational processes as physical distance between a set viewpoint and the most distant component of the model. The software used will interpret black as zero depth and white as maximum depth, with every permutation in between corresponding to either extreme, depending on the ratio of the two. After the depth map is created, it is applied to a polygonal plane in Autodesk Maya, a 3d modeling, texturing and rendering environment. (fig. 1 and 2) The resultant model, formed by the applied depth map, is exported as a Stereo Lithography (STL) file and imported into Rhino, another 3d modeling, texturing and rendering environment. From Rhino, a 3dm file, which is compatible with the computer that controls the mill, is created and exported to another software environment, which calculates the tool paths. The tool paths are calculated by the software by generating G-code, which is a list of X, Y, and Z coordinates for individual horizontal slices of the model, for the final routing. (fig. 5 and 6)

Although it is possible to achieve very detailed sunken or high relief, machine complex parts and minute, intricate form with a CNC mill, the overall aesthetic desired for this piece is one that retains evidence of the machine that carved it. By limiting the level of finishing that occurs, nuanced artifacts of the machining process leave beautiful cross hatched, scalloped and truncated forms, some of which are the product of the manner in which the mill moves the router. (fig. 7) The relationship between the artist and the sculptural form is made possible through the interface of numerous machines and computational processes. Through the initial act of designing and drawing the black and white image that will serve as a depth map, already it is necessary to extend one's mind to the final milled form. It is as if seeing through a series of veils or screens; at each point in the process between thought and physical milling, a layer is removed and a glimpse of the final form become clearer and clearer.

While drawing the depth map and applying the map in a 3d modeling environment, considerations for the relationship between the topology and the sound events related to them are paramount. Simultaneously, all aspects of the form must be designed with the effects of the topology on the movement of the water contained therein. Although the movement of water is highly complex and hard to predict, basic principles of hydrodynamics inform predictions about the way water will interact with the viewer's touch and the form itself. For example, the friction generated between the viewer's hand or finger and the water, or between the water and the boundaries of the form create turbulent swirling and reflection. Due to the high resolution of the camera

and computer vision system, these subtle movements are translated into equally minute and subtle sonic events.

Sound in Space

The auditory system, consisting of the binaural systems that include outer, middle and inner ear, enables sound localization through the recognition of both direction and intensity. Cues such as time and level differences between ears provide the brain with the necessary information to interpolate accurate localization information.[4]

From an acoustical engineering point of view, the term sound localization refers to the accurate simulation of sound in a virtual 3D space. When generating multichannel sound, timbre is a key component of creating rich, locatable sound. Whereas acoustic instruments tend to have complex timbre that is easy to locate, typical computer synthesized sounds, such as simple oscillators, tend to lack the timbre necessary to be located by a listener. One strategy in multichannel computer music synthesis is the use of granular synthesis. Granular synthesis is the use of small slices of sounds, called grains, which are typically measured in milliseconds. Clouds of these grains are layered together—changes in pitch, phase, volume and duration producing highly varied sounds. Another strategy employed in the piece to improve sound localization was to increase the overall harmonic complexity of each sound object.

Sound localization is a key aspect of *The Fall Beyond Tomorrow's Life* —the user interacts with specific areas of the water interface that correlate with zones created by the speaker array. The aural component of the piece is created with Supercollider, an object-oriented language for sound synthesis and digital signal processing (DSP). (fig. 4) Sound is generated in real-time in Supercollider through separate server and language processes, allowing a broad range of scheduling and control to sonic events. Each

instrument was built using the basic building blocks of digital sound, e.g. shaping waves generated by oscillators and frequency modulation.

The geography and topography of the sculptural interface is analogous to the sonic space of *The Fall Beyond Tomorrow's Life*—moreover, they are two aspects of one unified space. Inversion, in the form of convex and concave forms that either emerge from the water or create deeper zones are inverted versions of one form, and are directly related to the inversion of chords or scales in traditional Western music. Although the sound is realized through a hexagonal speaker array, the sonic topology of the piece occurs cubically in a space that changes, based on the viewer's position. Details about the sculptural interface will be covered in the next section of the text, but key aspects of the topology of the interface, as it relates to both music composition, and the way this topology affects the movement of surface waves therein are directly related to how the sounds are generated and propagate in space.

The Fall Beyond Tomorrow's Life is an instrument: its physical dimensions, depth and topology impose physical limitations in the same way a traditional acoustic instrument does. Although the mechanisms of *The Fall Beyond Tomorrow's Life* do not rely on the passage of air over a reed or the excitation of taut strings near a resonant body, the topology of the vessel has a specific effect on the movement of the water when it is interacted with, and this varies from area to area.

Conclusion

The Fall Beyond Tomorrow's Life provides the viewer with a 1:1 relationship with the amalgam of water and sculptural form and the resultant sounds generated by the viewer's interaction and the consequent waves that linger after that interaction. Since the viewer encounters the water and sculptural form at a height of a few inches above the floor, it is necessary to lower oneself to touch the water, or peer into the water to see the submerged form. This posture makes possible a more elemental reaction to the piece, and places the viewer in a non-traditional pose from which to interact with art. (fig. 11)

Sonically, the spatialized sound events and objects create an immersive zone, enveloping the viewer as they stop to interact with the water and sculpture. The abstract nature of the sound events and objects, for example those that are minor, dissonant or abrasive, directly relate to the structure of the sculptural form and the movement of the water.

Sculpturally, the process of the creating virtually and realizing physically the final form through a digital design-to-numerical control methodology made possible detailed relief and patterned tool marks that are a key component of the overall aesthetic of the piece. While possible using traditional tools, 3d modeling and CNC milling ensures quick production of the final form, allowing a greater amount of time to be spent in the sketching and prototyping phase.

From the viewpoint of embedded computing, a portion of the success of *The Fall Beyond Tomorrow's Life* comes from the obfuscation of the equipment necessary for the realization of the piece. The lack of a multitude of direct, visual evidence of the

machinations or processes that enable the interplay between water and sound waves prevents a great deal of distraction that would occur if the piece was presented otherwise. The element of wonder that results from the aforementioned structure is a desired outcome of the piece. Through dynamic changes in the sonic qualities of the piece occurring throughout the day, *The Fall Beyond Tomorrow's Life* evolves and provides opportunities for varied performance to viewers. *The Fall Beyond Tomorrow's Life* unites elemental and alchemical materials with contemporary technology to form a compelling zone of intersections.

Appendix

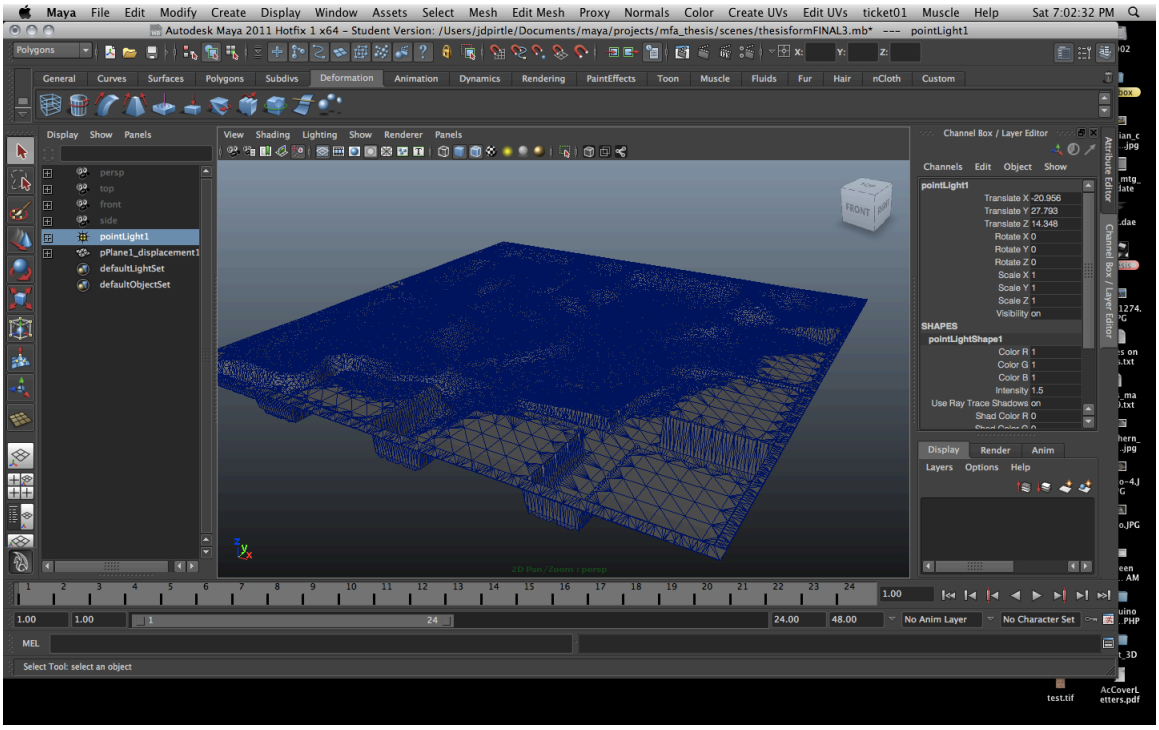
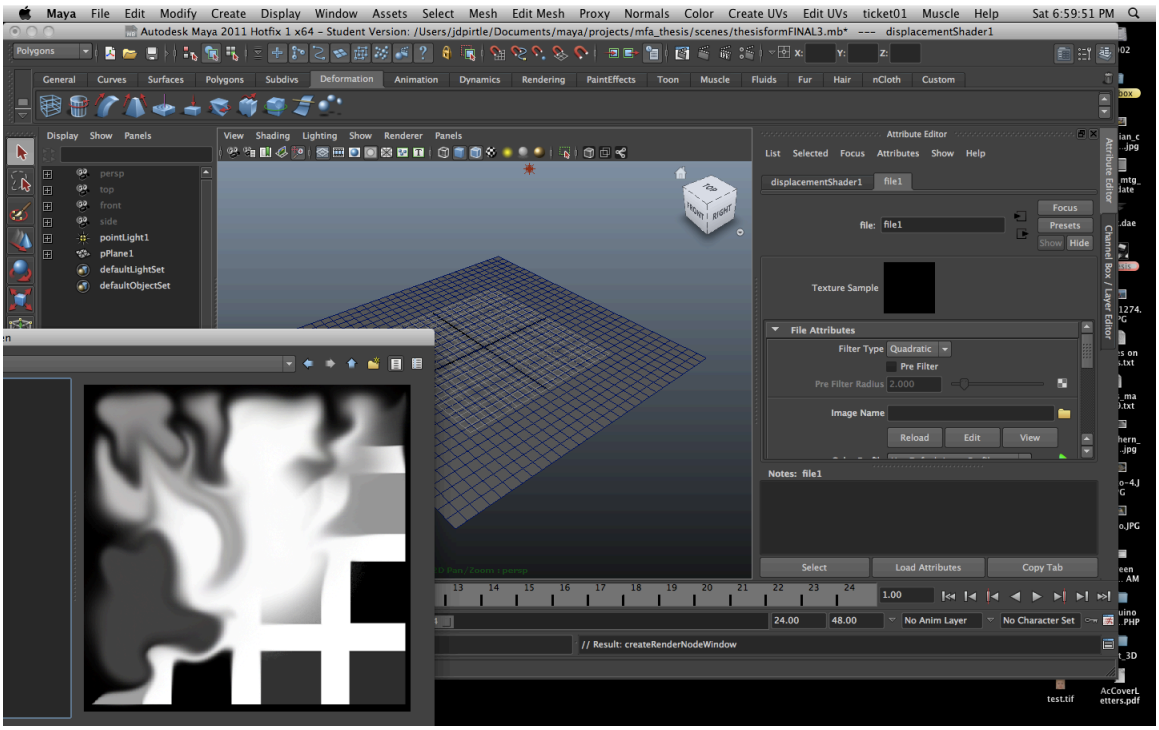


figure 1.



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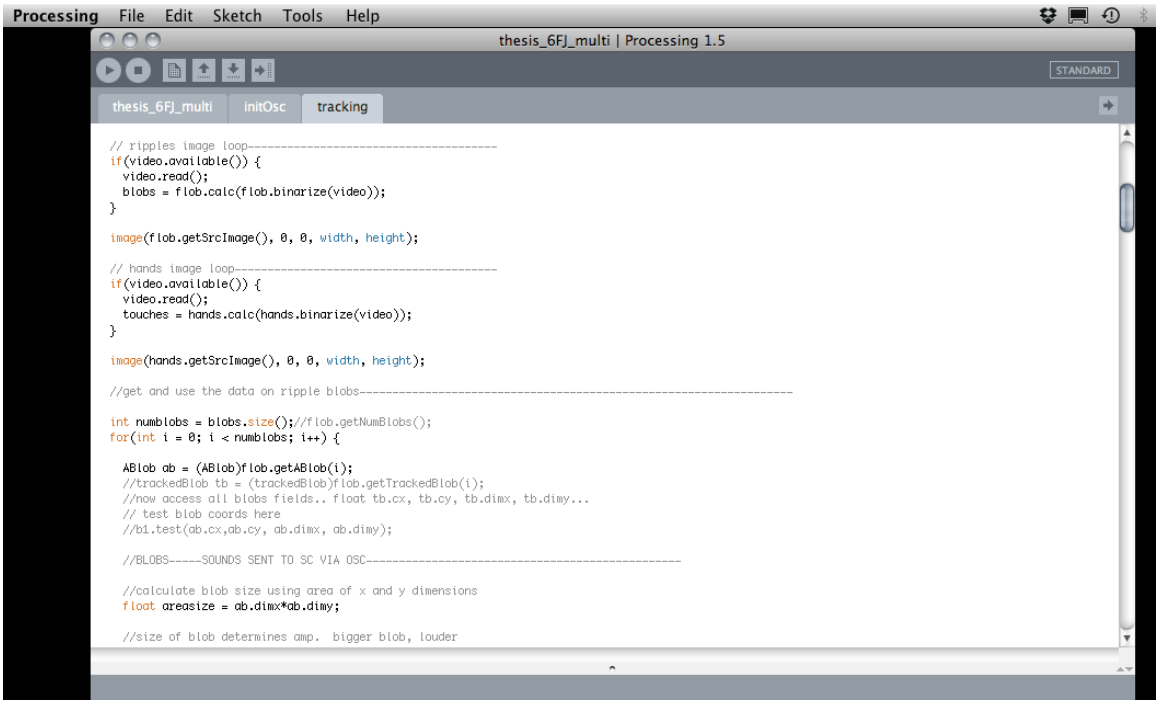

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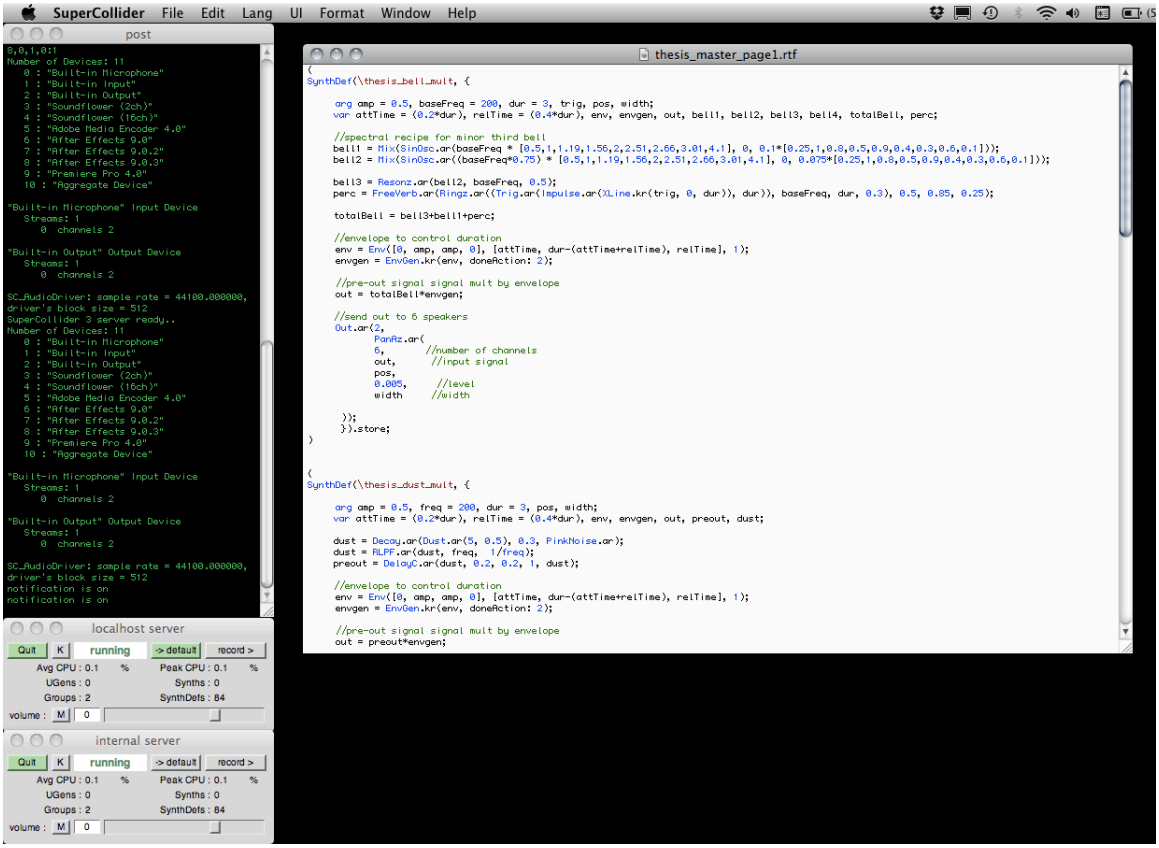


figure 4.

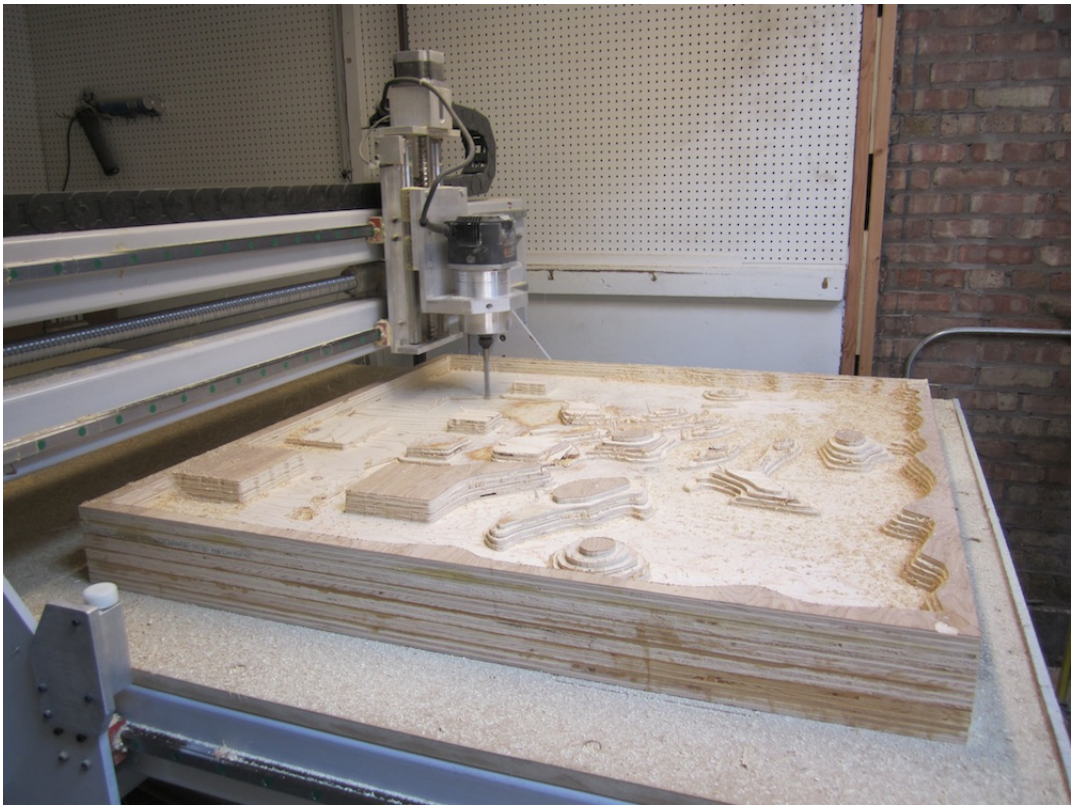
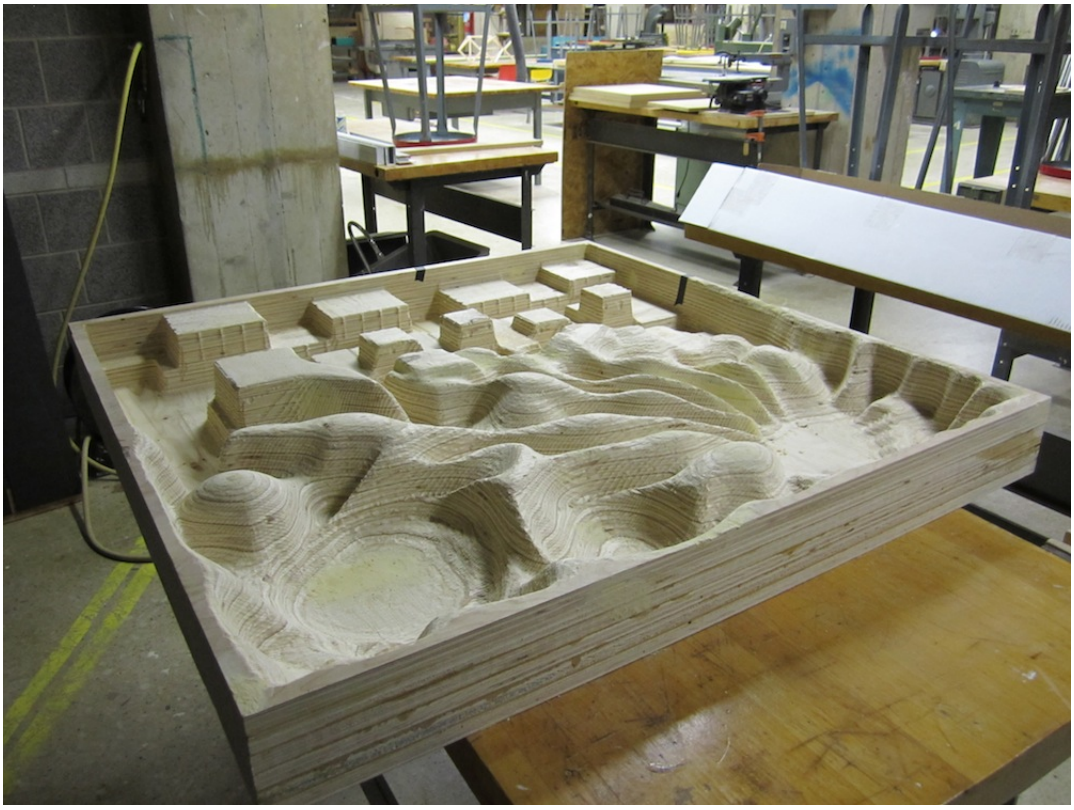


figure 5.

figure 6.



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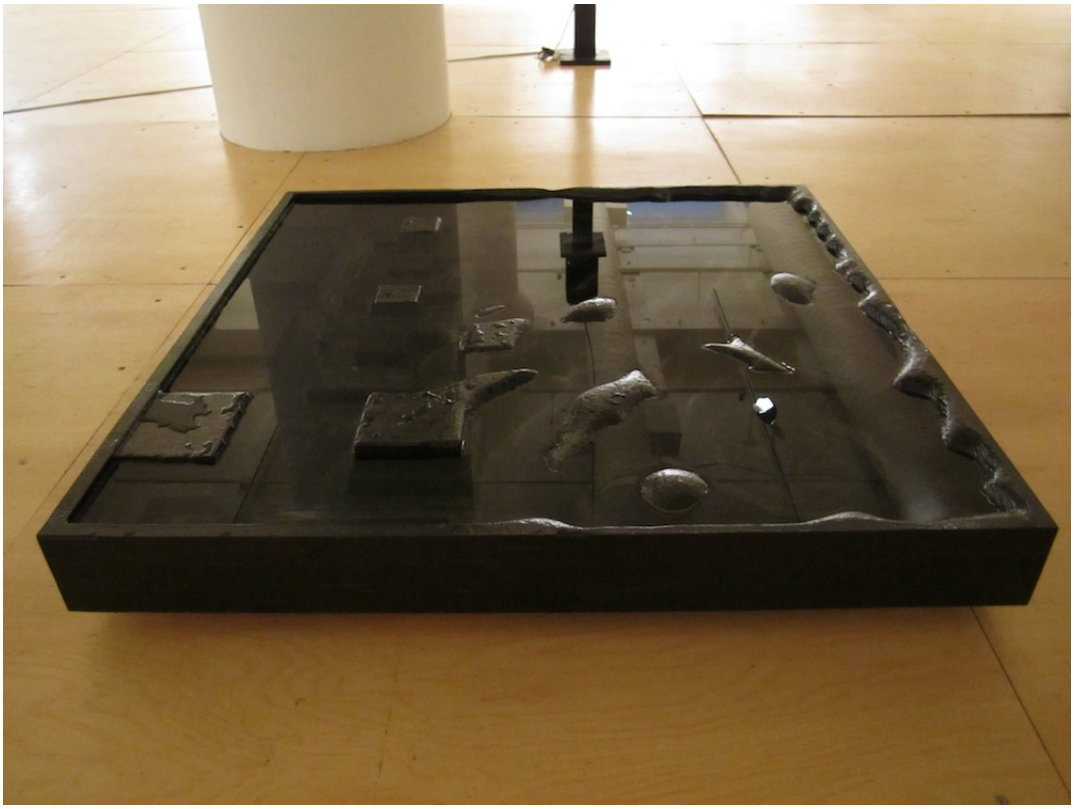

figure 8.

figure 9.

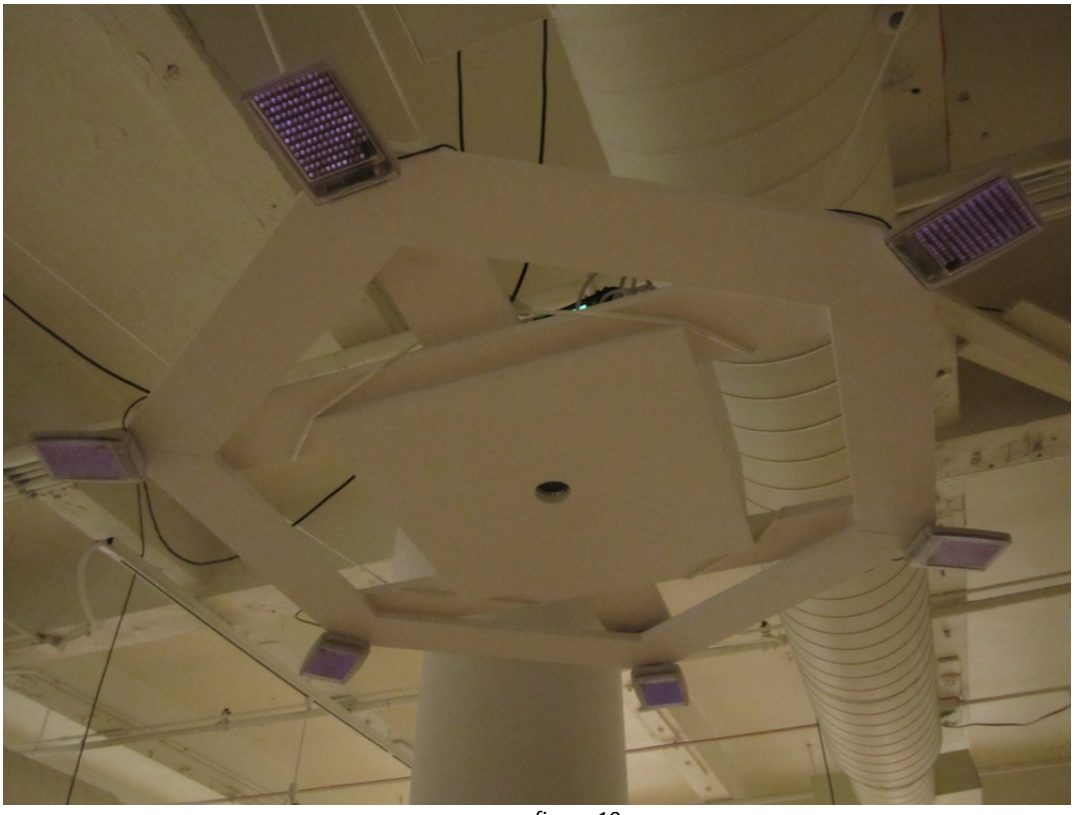

figure 10.

figure 11.

figure 12.

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