STORY OF "STORRS"
MEMORY OF AN ARCHITECTURAL SPACE,
MEMORIALIZING HUMAN INTERACTIONS WITHIN THE SPACE

by

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ABSTRACT

LINA TAHERI Story of Storrs, Memory of an Architectural Space, Memorializing Human Interactions with Space (Under the direction of Prof. ERIC SAUDA)

In the contemporary age of social media and ubiquitous smart devices, what is the perception of people of spatial experience? How does this affect people's memories of space? Is the memory of space traceable? Would people want to follow other people's traces/memories? How would interactions add meaningful values/character to the space? Interactive environments are changing the way we interact with our static surroundings, also they are changing our perception of our environment. People record memories of spaces in their daily life, could the environment remember people's presence and memory?

This project explores how the environment can memorialize an event or people's presence and interaction in ways other than physical material. It proposes audience engagement in an interactive installation that memorialize life and events of a built environment, in this case Storrs, the building of the University of North Carolina at Charlotte's School of Architecture. It investigates how the intuitive human body interaction would affect their perception of their environment.

An extensive body of art has been produced in this realm but such works are static or frozen in space, on flat surfaces or in the case of performances, they are practiced, pre-recorded and non-interactive. Would it be possible for a place to convey a story to people or trigger their memory? In order to answer these questions an investigation on the sensory experience of space is necessary, in addition to exploring affordances that digital media, fabrication and sensors would add to the qualities of a static space to make it sensory and dynamic. This will be done through a taxonomy of projects that are conceptually related to memory in space and user interactions that are involved in creating a process of memorializing things.

This research is looking for an alternative to the normative forms of keeping memory architecturally such as a public memorial. The experiment that is presented at the end of this research is an interactive sound installation in the Daylighting Lab of School of Architecture at the university. The installation takes the presence of the audience, and plays different recorded sounds from the building to memorialize people's interactions, activities and events happening in Storrs. This is presented as only one example of how the interactions of people with the building could be translated into memories through sound.

DEDICATION

To my lovely parents, Parviz and Manijeh,
to my dearest Tina and Nima,
and to the love of my life, Iman
Whose love and support gave me courage
and strength for this path.

ACKNOWLEDGEMENTS

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1. Prelude

There are different conceptual frameworks relevant in this research: public memorial, audience engagement and interaction, and storytelling. In this research I explore existing architecture, artworks and installations that have a trace of memory and audience engagement as well as their architectural counterpart, memorials. I will investigate new storytelling methods and how I could use them meaningfully for this purpose.

In a *sensate* space, human presence and physical body interactions are the triggers for the interactive space, so the static space becomes dynamic.(Beilharz, 2004) It is interesting to explore how the space would be affected by these interactions. I investigate the concept of memorial and how it preserves memory in space. One architecture typology that addresses memory in space is memorial/monument.

Also there are elements of storytelling in this thesis. There has to be a narrative to the story behind the concept. By creating this interactive installation, the individual experience of the user is added to storytelling and a memorialized sensate space.

The questions that I am looking to answer are: How does an interactive art piece affect people's experience and memory of the space? Is the memory shared? How would interactions add meaningful shared experience to the space?

There are many examples of fixed public memorials, also other forms of artwork relating to memory, but most of them do not engage the audience interactively. Technology advancement

offers new opportunities for the artists to explore the spatial aspects of storytelling and shared experiences for the audience.

“The Third Space” describes where the physical interactions and digital interactions meet and their impact of these on the physical world. (Muller and Druin 2002)With today’s ubiquitous computing, every object and space can become sensory. With all types of sensors being available within today’s technology, designers can extract data from almost anything; from body gestures and facial expressions to air particles and material properties. In a hybrid space, in addition to having sensory perception, data sets can be drivers of interactive buildings or environments.

SECTION 2: CONCEPTS

2. 1. Memory in Place

In this project, a memorial is beyond fixed material and the conventional public memorial but rather a way of memorializing events. In order to understand the background of memorial/monument it is essential to know more about this typology and how artists and designers usually approach the issue.

In Architecture one typology that has represented memory in space is public memorials. Memorials are of importance in this project because they have the elements of storytelling in them. They engage people in an intellectual level and they trigger public memory in reimagining a story that everybody can see.

Memorials/monuments are usually static and frozen in space. Some of the forms are: gateways, obelisks, statues, plazas, walls or murals. On the other hand they could also be manifested spontaneously, such as by mourners after an event, or through narrative such as in documentary movies or collections of images or through other media.

There is another type called Counter Memorial which is used by many of the Holocaust artists. Holocaust artists have begun to turn to forms which they believe challenge the idea of monumentality, and have arrived at something James E. Young calls the "counter-monumental," or the "counter-memorial", as James young defines it in an interview with Yad Vashem*"the monument that disappears instead of standing for all time; that is built into the ground instead of above it; and that returns the burden of memory to those who come looking for it."* (Vashem 1998)

Memorials question what we choose to remember. It they are telling part of a story what part and whose story should it be. “Why should we remember?” Ian Buruma, sets a distinguished definition between a monument *“built to glorify a leader, an event, or the nation as a whole*”, and a *“monument of warning.”* Holocaust memorials, he says, are “monuments of warning.” (Facing History and Ourselves. 2017)

2. 2. Objects and Materials

Memorial installations sometime use physical objects or symbols from the event that is being memorialized. Different media have been used to manifest memories with collected physical objects, recorded stories of individual people relating to the specific event, and collected photos to video recording and documentaries.

When actual objects from an event are used in memorializing that event, the concept of preservation emerges. *“Historic preservation arose in conjunction with early nineteenth-century European nationalism. Old buildings in particular and physical relics in general for the first time became valued”* (David Lowenthal) and this was not only because they were valuable religiously but also because they carried a shared memory. On the other hand, there are types of memory (of space) that are reconstructed in a time after a major event. In this case the process and technique becomes important rather than the actual material being used for the purpose.

An architectural instance of this concept is the Ise Grand Shrine in Japan. The shrine includes two buildings with a pilgrimage road in between. The shrine buildings at Naikū and Gekū, as well as the Uji Bridge, are rebuilt every 20 years as a part of the Shinto belief of *“the death and renewal of nature and the impermanence of all things”*. It is also used as a way of inheriting building techniques between generations which is called *Sengu*.(Cartwright 2017)

2. 3. Constant Change:

Approaches to memorials and monuments respond to social and cultural conditions and advancement in technology. This changing nature can be used intentionally in designing a memorial space.

2. 4. Concept of "Third Space" in HCI

According to Bhabha (1994) the border or boundary region between two domains, two spaces, is often a region of overlap or hybridity, a "third space" that contains an unpredictable and changing combination of attributes of each of the two bordering spaces. He refers to the negotiations between the nations involved in colonization as a way to improve their knowledge of each other. This would create a new *"hybrid or third culture and even a third language."* In this case collective knowledge affects public perception. (Bhabha 1994)

This concept has been used in creating a collective learning space in HCI where everyone who is involved in the process is part of the collective experience. In this project I am looking for such a collective experience, where each individual's interaction would affect other people's perception of the space. (Muller and Druin 2002)

2. 5. Storytelling

Just like memories there are different medium and various methods of storytelling that have evolved throughout history. The storytelling history is quite ancient. It goes back to when families grouped with other families and formed clans. They had a role in their community, the storyteller, who would tell stories of heroism and major events of the tribe. Also it was manifested in paintings

on the walls of their cave dwellings. There are also other examples of storytelling in ancient tribes and civilization, such as North American tribal Totem Poles, which conveyed story of a family, or since the beginning of writing, in scrolls and in books. (Jonaitis 2010)

In this thesis, I engage storytelling in an unconventional way, different than the traditional linear and structured story. Non-linear and interactive storytelling can make the audience part of the story.

Fig 2. 1 Exquisite corpse, improvising drawing game Source: en.wikipedia.org

An example of this is the game “Madlibs” or “Exquisite Corpse” which is a method of collecting words or images and assembling them. The rules are simple, each player adds to a composition in sequence. (Figure 2. 1)

An architectural example of this is Dérive which is *“a mode of experimental behavior linked to the conditions of urban society: a technique of rapid passage through varied ambiances.”* in Debord’s words. (Debord 1958)

Storytelling has been an interactive form of communication and entertainment since the ancient history of humans. As social creatures, humans find physical interaction, touch and human to human presence essential for their life. With technology being a part of everyday life, some of these interactions are lost. Physical and social interactions have become limited and natural interactions like body gestures, gaze and physical awareness are lost. These limitations have been addressed by scientists and interaction designers by using tangible user interfaces and augmented reality.

With social media being involved in every aspect of everyday life, perception of memory, recording a memory and referring to it has also changed. People use Instagram stories to tell their daily life stories. (Figure 2.2) The stories disappear in 24 hours. Facebook and Google Photos remind their users of their past events and assist them in remembering something from the past.

Fig 2.2 Instagram stories, memories which disappear in 24 hours Source: Lina Taheri

SECTION 3: PREVIOUS WORK

3. 1. Previous Projects

These examples are dealing with collective memory, memory in space and audience engagement in different levels and each of them is telling a story. These examples are using different medium to convey their messages.

3. 2. Storytelling and Improvisation

In the category of storytelling and audience engagement, there is a group called Punchdrunk, who has multiple performances in collaboration with the MIT Media lab, Opera of the Future group. In this performance *"Sleep No More"* they engaged audiences in their performance by giving them freedom to move around the scenes in different levels of the stage. (Torpey et Al. 2012)

Fig 3. 1. Sleep No More, by Punchdrunk, 2011-12 Source: https://futureofstorytelling.org

Sleep No More is an immersive theatrical production created by Punchdrunk. It is a rendition of Shakespeare's Macbeth intertwined with Alfred Hitchcock's film adaptation of Rebecca. The set is warehouse in New York City, with over 100 rooms distributed over the seven story set. Audience members can wander around the theatrical set and discover actors who enact the story over the course of the three-hour performance, see figure 3.1. (Torpey et Al. 2012)

Once upon a place on the other hand, engages people in two different levels. First the artist collected stories from the immigrants in voice recordings, then engages the audience by presenting them phone booths in which they could pick up the phone and listen to those stories. (Figure 3.2) This installation examines the immigrant experience, touching on themes of "belonging and displacement." (Best, 2017)

Fig 3. 2. Once Upon a Place, Aman Mojadidi, 2017. Source: http://arts.timessquarenyc.org

3. 3. Symbolic use of material or object

The following projects are memorializing an event by using symbolic objects, and not only by preserving actual objects from the past event.

An installation that is *Remembering the Oklahoma City bombing* is using chairs as symbols of the victims of a bombing in a governmental building, representing empty seats of those who lost their lives in that governmental building.

Fig 3. 3. Remembering the Oklahoma City bombing. Source: https://oklahomacitynationalmemorial.org

"Shoes on the Danube" also uses shoes as symbols of victims of a mass killing in Budapest. Sixty pairs of shoes are installed on the shore of Danube in Budapest, Hungary. They symbolize the Jew victims of fascist Arrow Cross militiamen who shot them and threw their bodies into the river in 1944 and 1945. (Ochayon)

Fig 3. 4. Shoes on the Danube, 2005, Photo by: Phil Watkin

3. 4. Reimagining space

Some of the installation projects that are looked at are *Reimagining space* in a sense. *"The Future Was Then"* is an example in which the artist is trying to show presence of the human body in architectural settings and how humans interact with Architecture.

Fig 3. 5. The future was then, Daniel Arsham. Photo courtesy of the artist. Source: www.arch2o.com

In his latest exhibition, “The Future Was Then,” artist Daniel Arsham, installed a series of 300-feet-long carved faux concrete walls in SCAD Museum of Art. The series of walls start with an abstract shape hole in the first wall and continues to change the outline until it reaches the last wall with “fully formed outline of a life-size human.” (Malhotra)

The installation explores how mankind interacts with architecture, “continuously building and destroying the walls around them.” The visitors are invited to stand in between the walls, they would place themselves in the time line of building and destruction of the walls, see figure 3.5) (Malhotra)

Among the projects reimaging memory in space, Bloom stood out for me because it is manifesting the essence of a space. It is using the image of a mental hospital in which both hope and

disappointment was experienced in a way that people visiting the space would experience those feelings. The artist installed 28,000 potted flowers at the Massachusetts Mental Health Center to memorialize the unique experiences of the patients in this mental health center. (Figure 3.6) The artist is attempting to memorialize buildings history of both hope and sadness. The artist is doing it in a way that it reflects both past, being a hospital, and the future (destruction) of the building. (Jobson 2012)

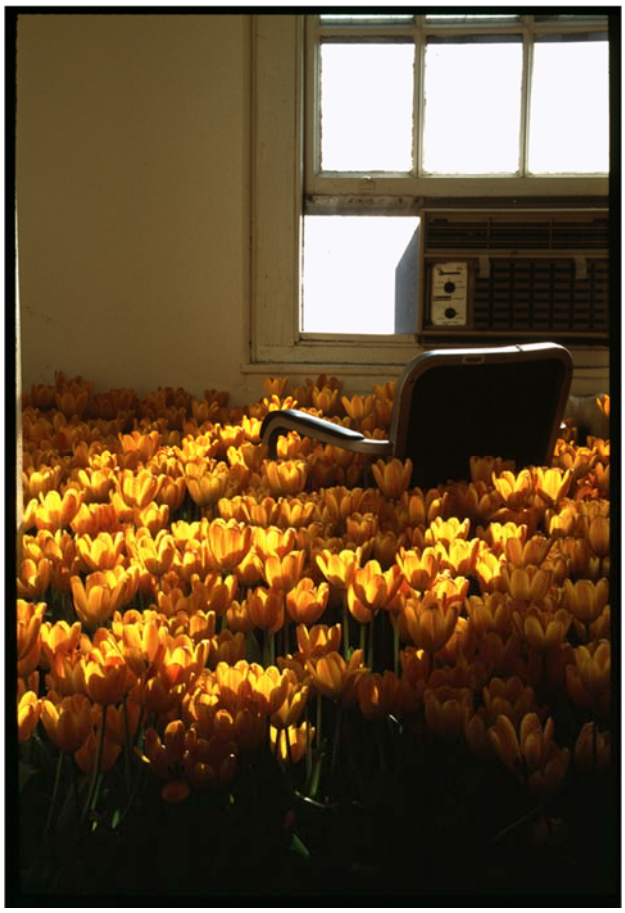

Fig 3. 6. Bloom, Anna Schuleit, 2012. Source: www.thisiscolossal.com

Fiber Optic Installations by Carlo Bernardini, are creating spaces within a space. The artist uses light and darkness here to create new spaces. (Figure3.7) These installations are created with the idea of light-dark, although it is not absolutely dark and the viewer is aware of the surrounding.

The surprise element is when you walk around the objects and you discover it is a geometrical form that could only be viewed from certain angles. (Mansour 2009)

Fig 3. 7. Fiber Optic Installation by Carlo Bernardini.2009 Photo courtesy of the artist. Source: www.arch2o.com

David Moreno also uses straw looking metal rods in his *Architectural Sculptures* to reimagine houses, the concept of home and memory of the home which is really faded in today's life.

Fig 3. 8. David Moreno's architectural sculptures, 2016- .Source: www.thisiscolossal.com

Spanish artist, David Moreno, uses steel rods and pieces of piano wire to build "unwieldy sculptures" that resemble 2D sketches of houses. (Figure 3. 8) The art pieces are designed to look like a "haphazard collection of sticks". The link between drawing and sculpting is very intentional as Moreno himself refers to his process as literally "trying to draw sculptures." (Jobson 2016)

3. 5. Responsive environment

Aurora is a physical sensory space with physically moving parts that interact with presence of people in the space. (Figure 3. 9) This is the kind of interaction that is the purpose of this thesis. *Aurora* is a materials and robotics study that also explores level of interaction between human and the space. (Farahi 2016)

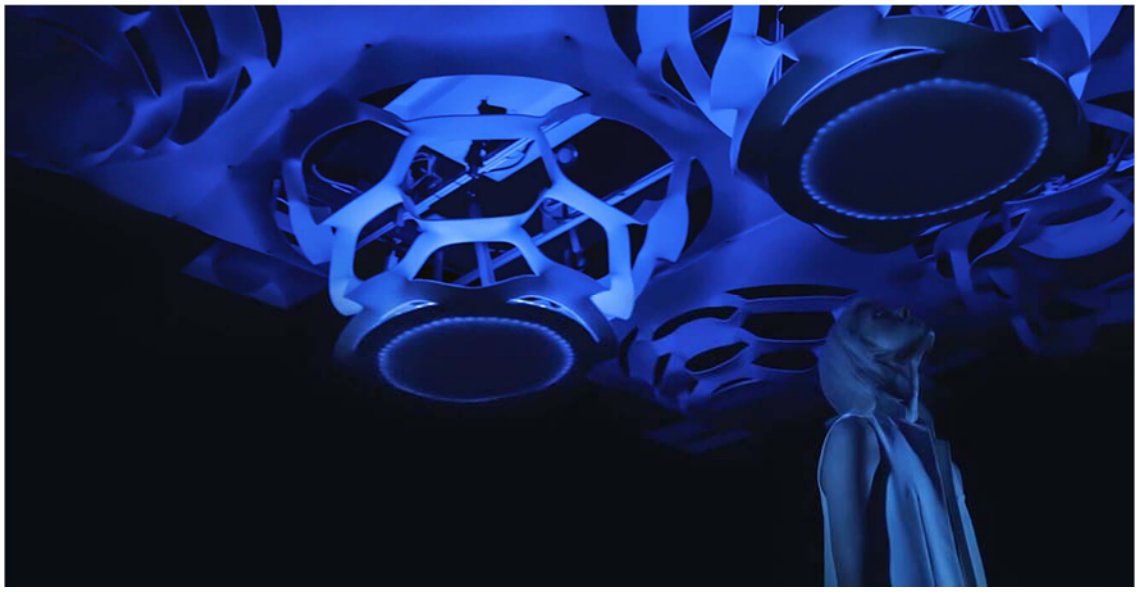

Fig 3. 9. Aurora, by Behnaz Farahi, 2016. Source: http://behnazfarahi.com

In the process of this experimental structure, the artist, Behnaz Farahi, was investigating dynamic shape changing structures, robotics, material behaviors, and interactive system of controls to find a connection between design, technology, engineering, and fabrication.(Farahi 2016)

Philip Beesley's Hylozoic Ground, (Figure 3.10) is an installation of a forest of acrylic fronds that move as if they were breathing was installed inside the Canada pavilion at the Venice Architecture Biennale, 2010. This structure moves in response to its environment, "drawing in and filtering moisture and organic particles from the air." (Beesley 2010)

Fig 3. 10. Philip Beesely's forest of acrylic, Hylozoic Ground, 2010. Source: www.dezeen.com

3. 6. Third Space and Audience experience

In the next example the idea of *Third Space* and *Audience engaging* is perfectly exhibited. *"Vocal Vibrations"* which is an expressive performance for Body-Mind Wellbeing, is an installation that uses spaces of a gallery that create individual experiences for the visitors. (Holbrow et. al. 2014) (Figure 3.11)

Fig 3. 11. Vocal Vibrations, MIT Media Lab Opera of the Future group, 2015. Source: http://opera.media.mit.edu

This project explores the relationship of vibration of the voice and the human body. The voice is used as an instrument here. “It is incredibly individual, infinitely expressive, and intimately linked to the physical form.” This MIT Media Lab group have developed a series of experiences that explore possible “emotional, cognitive, and physical transformations, all in an enveloping context of immersive music.” (Holbrow et. al. 2014)

3. 7. Unconventional memorials

Typically, existing memorials are permanent, requiring visitors to be physically present to experience a memorial. Future memorials could be temporary or mobile. By moving around a city, relocating to different cities, or existing for limited periods of time, a memorial has the potential to ignite enthusiasm. (

An example of this type of memorial is *The AIDS Memorial Quilt*, a living memorial to those who have died of AIDS, see figure 3.12.

Fig 3. 12. The AIDS Memorial Quilt, communal art. Source: www.aidsquilt.org/

As Jorge Pailos names it, there is also a category of *"Unintentional Monument"*. *"A farmhouse can be a monument* "as he states in his interview podcast "Never the same river twice". It can be a significant cultural element." So anything or any place with significance, even if it is personal, could become a memorial. (Architecture talk 2017) In one of his exhibitions "The Ethics of Dust"

(Figure 3.23) in Old United States Mint, San Francisco, Jorge Otero-Pailos is encouraging the visitors to give more thoughts and reflect on pollution which in his words is *"one of humanity's most neglected, and also most abundant, cultural products"*. (Taylor-Hochberg 2016)

Fig 3. 13. The Ethics of Dust by Jorge Otero-Pailos, Noting Stable Under Heaven, 2018. Source: http://www.oteropailos.com

SECTION 4: METHODS

Interactive space requires the use of tangible interaction methods. The space needs to be responsive to people's interactions. Using sensors I investigate how these medium can create and memorialize interactions and events.

4. 1. Human Perception of the world

As mentioned in SECTION 1, human's perception of the physical world has changed through merging of physical world and digital world, and the border around these worlds is blurring more and more every day. Humans understand the surrounding physical world through the five senses: taste, sight, touch, smell, and sound. These senses are involved in the process of preserving a memory as well. Emerging concepts in urban design that uses senses is urban soundscape and smellscape and tactilescape. Urban planners and designers have developed soundscape and smellscape maps to record these triggers around different borders, see figure 4.2. As an example, Urbica had a summer program that produced a noise map of Moscow in 2017. (Urbika 2017) (Figure 4.1)

Fig 4. 1. Noise map of Moscow, Urbica,summer internship group, 2017. Source: https://medium.com

Fig 4. 2. Smellscape and Sounscape in Urban design, unknown artist, Source: www.arcc-network.org.uk

So in this thesis, I recreate a process of memorializing, by including hearing and sight senses and interactions in a space. As an experiment I chose Storrs as a space to memorialize, as most Architecture students spend most of their time here, which will be described in SECTION 5.

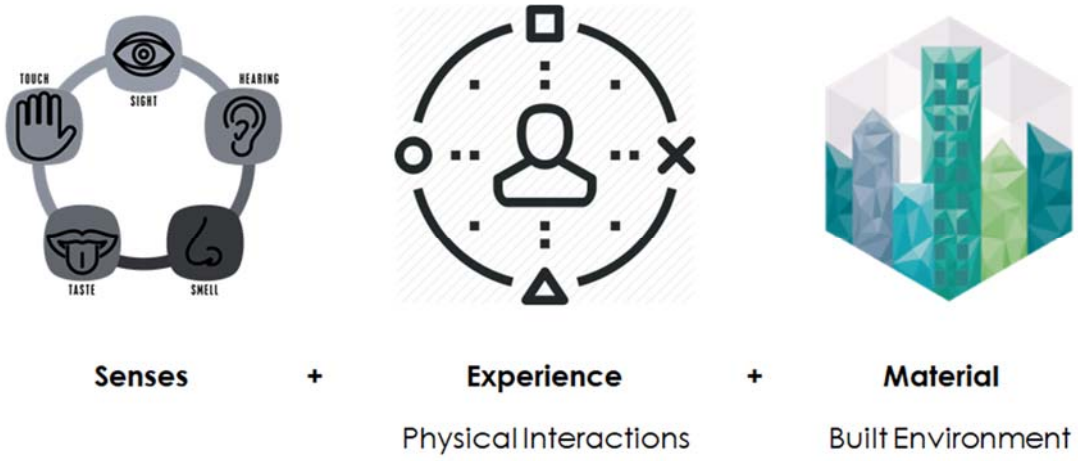

Fig 4. 3. Diagram of the concepts. Source: Lina Taheri

4. 2. Sensors

Active sensing requires conscious and deliberate interaction. Sensors that bend, motion sensors, gyroscopic and velocity sensors attached to limbs, pointing devices, 6-degree of freedom mice, etc. are the devices that could be used for this purpose.

On the other hand, passive sensing is inconspicuous, unobtrusive, embedded and captures data without the user needing to change behavior or consciously interact with the space. Some examples are: sensitive floor mats, video tracking, infrared sensors, temperature, proximity and ultrasonic sensors. Because I want the users/audience to experience the space “naturally” and without forced interaction with any devices, I use passive sound sensors in the design of this project.

4. 3. Using Sound as medium

There are different methods of generating sound scientifically, which are described here:

- *Audification*: a technique for listening to a large time series by mapping values directly to sound pressure levels

- *Sonification*: the use of non-speech audio to convey information or perceptualize data
- *Earcons / Auditory Icons*: brief, distinctive sounds used to represent a specific event or convey other information

Auditory perception includes temporal, spatial, amplitude, and frequency information, it is a contrast to our visual perception. Audification is an auditory display technique for representing a sequence of data values as sound, particularly applicable to large datasets with periodic components.(Beilharz 2004) Therefore in this project I use the concept of sonification, by sensing spacing of users and mapping that for a meaningful manipulation of the sound.

SECTION 5: EXPERIMENTS, SOUND INSTALLATIONS

5. 1. Whispers

"Whispers", was a collaboration with my colleague Alex Nelson as part of an interactive design studio. I started this project with the concept and some sketch codes with Arduino and was joined by Alex Nelson for the implementation of the idea. It is an interactive musical installation that engages the audience in creating a body of music within a built environment. In this project ultrasonic sensors were used to take the distance of users from a series of sculptural modules, attached to the columns of a salon. The distance was mapped through programming Arduino microcontrollers, to play different notes off of a MIDI setup. The MIDI setup was connected to the microcontrollers through *Ableton Live*, which is a music editing software. Sensors were embedded inside the module protruding from cylindrical columns of the salon. An instrument was assigned to each column, total of 4, and the audience could hear the low tone of each instrument. As they got closer to the columns they would hear their impact on the sound. They would hear the pitch, velocity and chord changing by their approach towards the modules.

The goal in this project was to engage the audience directly with the modules that would react to their distance, to create a body of music based on their movement. This installation was setup in two different locations. Based on the observation during the interaction and interviews with the audience after their interaction, most of the audience found the lights inside the modules intriguing to get close to the columns. Also they could clearly recognize their impact on the sound and were encouraged to continue the interaction with the piece.

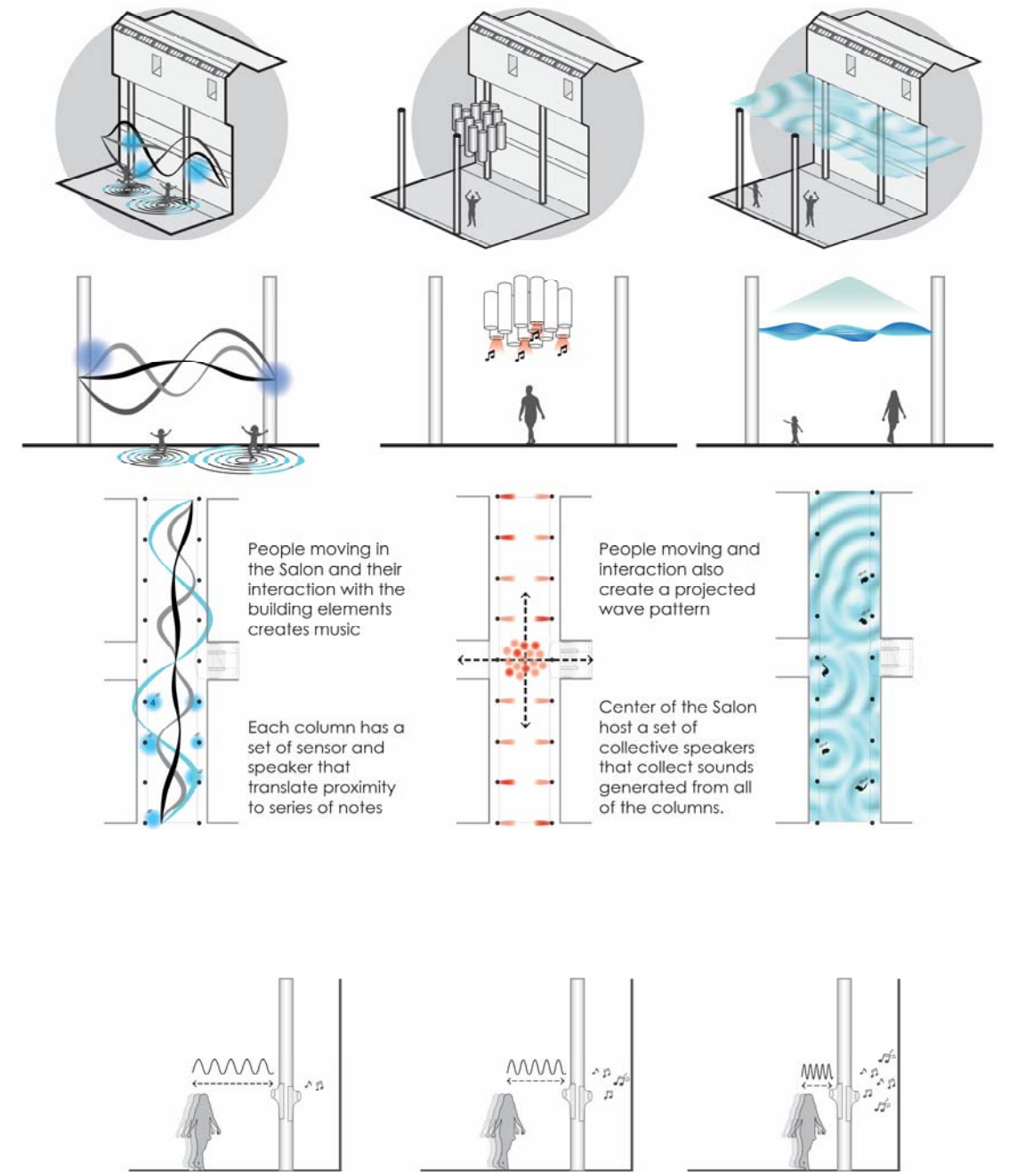

Fig 5. 1. Diagrams showing concepts of Whispers. Courtesy: Lina Taheri

Whispers explored how to transform a static building into a dynamic space, by integrating music and architecture. People's presence in space and their movements and interactions with the space can lead to the creation of both individualized experiences with the sound as well as a collected representation of the sounds.

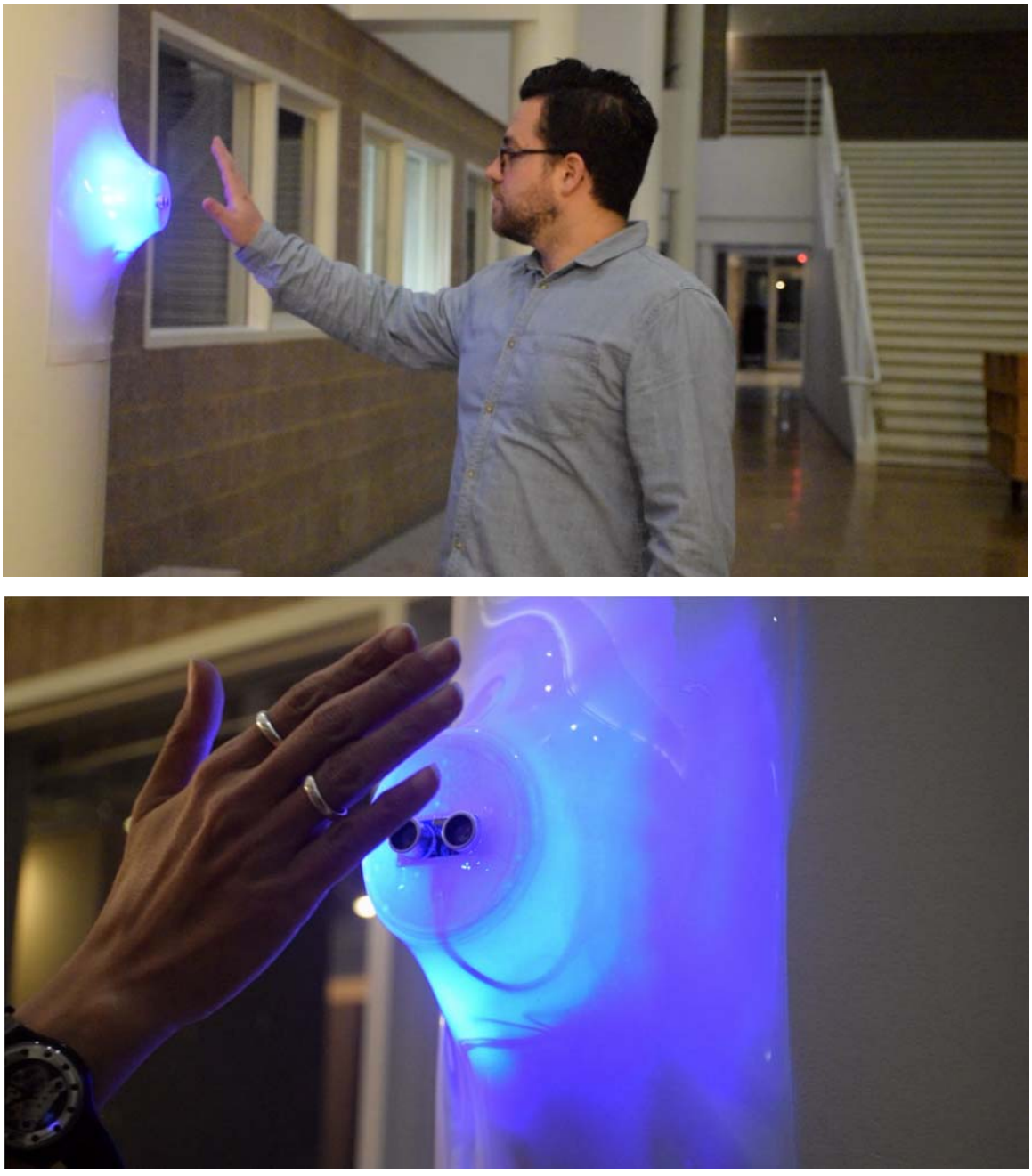

Fig 5. 2. Whispers: Interactive Sound Installation by Lina Taheri and Alex Nelson, 2017. Courtesy: Lina Taheri

5. 2. Infinite Story of Storrs, a sound installation

The infinite story of Storrs is my final experiment I chose the building of school of Architecture in UNC Charlotte, to explore and experiment with sound and its impact on memory. This building has a life of its own, it has a lively character that changes throughout the day and different days of the week. Because of the design culture of the School of Architecture, students spend a lot of their time here and basically live here. Interactions and activities throughout the building make up its character, impacts how people interact with each other and with the building, and all of these would build memories.

Although specific to students of Architecture, this building is typical of how people feel and experience space; through their senses. Since I decided to work within the building of the School of Architecture, I started to observe activities, and listen to the sounds of the building. I challenged myself to hear sounds that I don't normally pay attention to and feel the textures of different materials. The challenge for me was how to capture these feelings. And the question was how to represent these captured moments in a meaningful way that tells the story of life in this building.

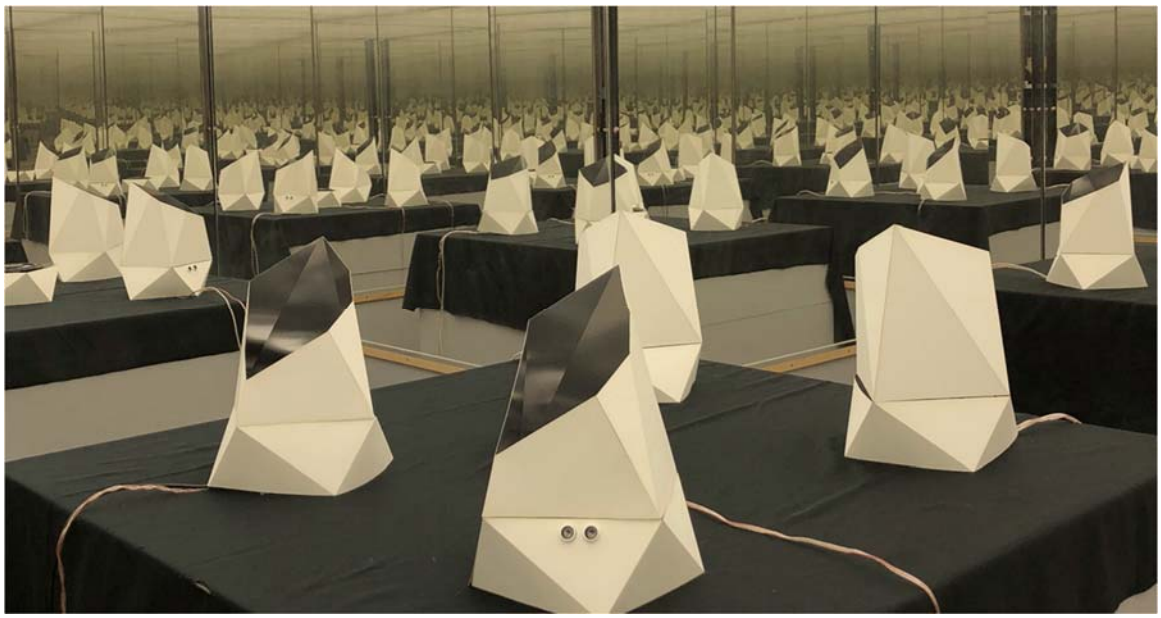

Fig 5. 3. Infinite story of Storrs, sound installation, 2018. Courtesy: Lina Taheri

In order to frame a specific sense, I decided to use sound as the medium. Unlike the previous sound installation, Whispers, the main feature of this installation was the recorded sound itself, and not the sound as a product of people's interaction with the sensors.

When we talk about a building representing memories from the past, it often connotes historical monuments. This project is beyond material, an extra non-material layer is added to the physical layer of materiality. I have recorded sounds from different corners and spaces of this building. The following section is a narrative of my observations during the time I was listening to the building and its activities and collecting samples.

5. 2. 1. Methods

In a course of three weeks, sound samples were recorded from different activities from different corners of the building through different times of the day. There is always something happening in here: reviews, desk crits, speeches, gatherings (figures 5.5 and 5.6). The fabrication lab is always working, the most prominent sound of the east corridor. Most students confirm that the sounds from Fab Lab are the boldest sounds that could also be heard from the salon (see figure 5.4). There are always people walking along the corridors and doors get opened and closed. These samples were then composed into a set of sounds that overlay in a sound installation.

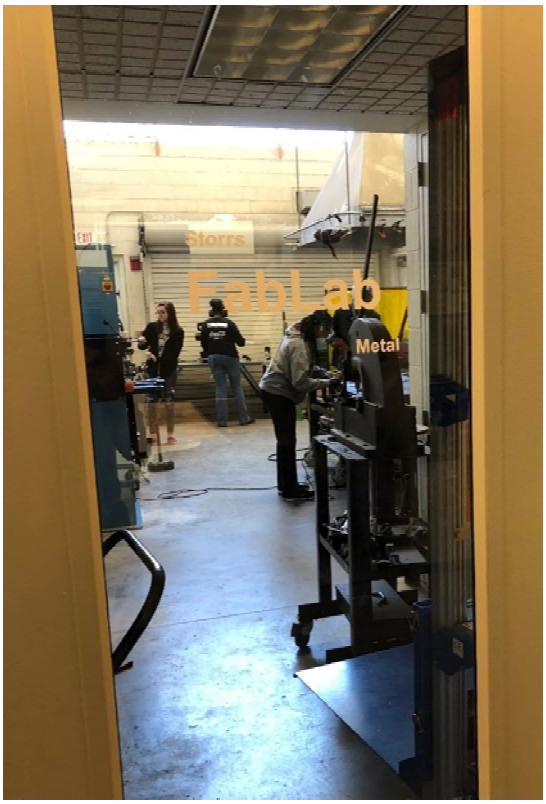

Fig 5. 4. FabLab, has a prominent sound, 2018. Courtesy: Lina Taheri

We cannot forget the acoustic characteristics of different spaces, in the sonic experience of a place. For example, in Storrs Salon, where major reviews happen and different sounds find their way through the corridors to it, sounds echo, overlay and merge into each other. When there is silence in the salon, you would know there is not much going on in the whole school. For instance, non-studio days, are much quieter than studio days (3 days a week).

In the corridors on the other hand, sound is directed and more concentrated. You would hear a door being slammed, footsteps, or people's chatter when they walk along them.

Studios are totally different spaces on the west corridor with large bays divided by student desks. Students claim desks and somehow create a personal boundary or territory, meanwhile keeping communal space for the whole studio. (Figure 5.7)

Fig 5. 5. Events in Storrs salon, 2018. Courtesy: Lina Taheri

Fig 5. 6. Events in Storrs salon, 2018. Courtesy: Lina Taheri

On a studio day one would hear the mesmerizing sound of chatter between students, discussions and desk crits, model making, papers flapping, computer keyboard and mouse clicking, music bleeding from headphones, all together. Studios have a subtle and muted character without these sounds. First level studios, dedicated to undergrad students, are more active and noisier than the second level studios for grad students.

Fig 5. 7. Storrs, first year studio, 2018. Courtesy: Lina Taheri

The sound that you hear also depends on where you are hearing it from. The sound of a metal cutting saw is much more muted if you hear it from adjacent labs than when it is heard from the corridor or from the rooms outside the lab.

5. 2. 2. Observations

Collecting sound samples from around the building made me more aware of my surroundings. It was like deactivating all senses but hearing. Sometimes it would attract my attention to diminished and individual sounds like a water fountain and the vending machines, sometimes it would isolate annoying sounds like the beep of a lift machine backing up, and other times it would give me a holistic idea of what is going on in the salon, reviews or events, see figure 5. 8. The more isolated

spaces, like the student lounge, where usually no activities happen, become just a space for echoing other sounds, rather than being a source of sound.

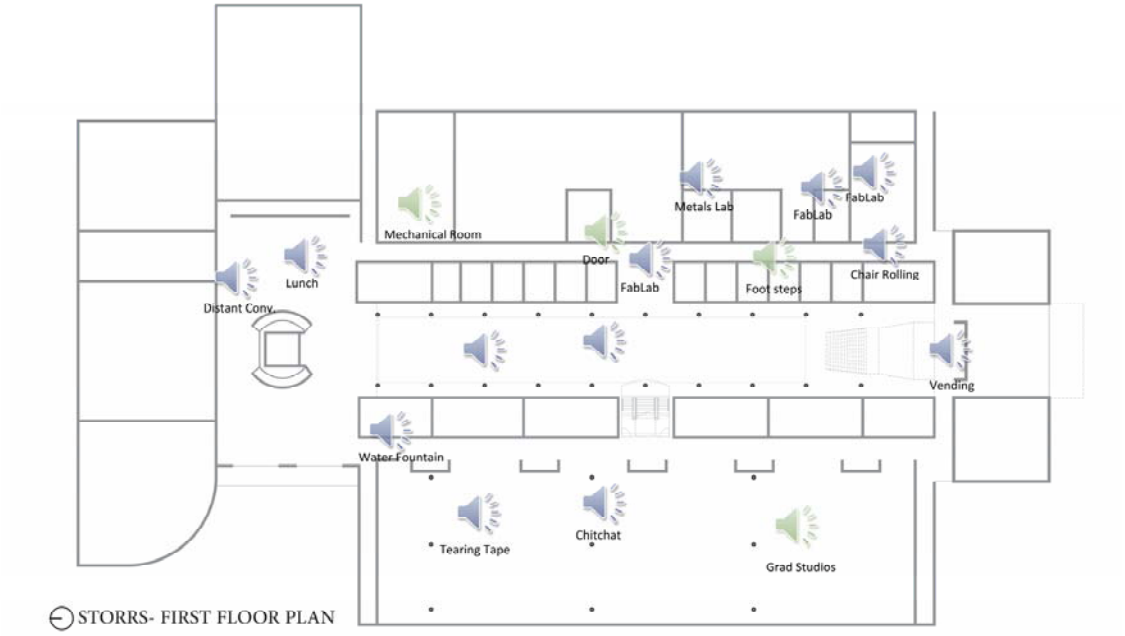

Fig 5. 8. Schematic plan of Storrs and locations of recorded sounds. Courtesy: Lina Taheri

5. 3. Installation

5. 3. 1. Location

The location of the installation was important. Several options were considered for setting up the installation. Some had the potential to have overlay of live sound to the recorded, some were more enclosed spaces that would isolate the audience and focus more on the sonified essence of the building.

Fig 5. 9. Storrs salon, 2018. Courtesy: Lina Taheri

For example, one potential location was the end of one of the busy corridors, in which one would always hear footsteps, doors slamming, and maybe someone whistling or singing.

By contrast, the daylighting simulation room, presents opportunities for a controlled and isolated experience. This space is an open lab with high ceilings in which the sound would echo. The daylighting test room is a 10ftx10ft fabricated room inside the lab, with mirror walls (Figure 5.10) The ceiling of this room has a translucent material that lets the daylight penetrate the room.

Fig 5. 10. Daylighting simulation room, 2018. Courtesy: Lina Taheri

This room used to be utilized for physical material testing and simulation, a process that has been replaced with computer simulations for a while now. So this was an isolated room within a lab. As mentioned in earlier sections, one of the features of isolating sounds is to bring attention to isolated places and corners of the building. The mirrors on the walls, would add neutral visual field to the experience. So both hearing and sight would be triggered in experiencing this space.

5. 3. 2. Concept

The goal of this installation was to create a sound based spatial experience for the audience, a sound installation that would represent the ambience of Storrs in an isolated space. Ideally, this experiment would cause the audience to reimagine Storrs by triggering their memory of space through sound.

5. 3. 3. Implementation

The whole system is composed of a series of sensors, Arduino microcontrollers, speakers, a MIDI interface, an amplifier, music editing software *Ableton Live,* and a digital MIDI bridge.

There are 4 speakers in the room, and each is activated when a sensors detect a person's presence. The number of active speakers would increase as more people get inside the room and interact with speakers. So, two audience members would activate two speakers and so on. As more people enter the room, more sounds are overlaid in the whole composition. LED lights inside each speaker horn would turn on once the person is detected by the sensor. Then they index the loudness of each sound. So the physical interactions cause sensors to replay digital recordings, (physical meets the digital) and these are possible by a technical process as shown in Figure 5. 11.

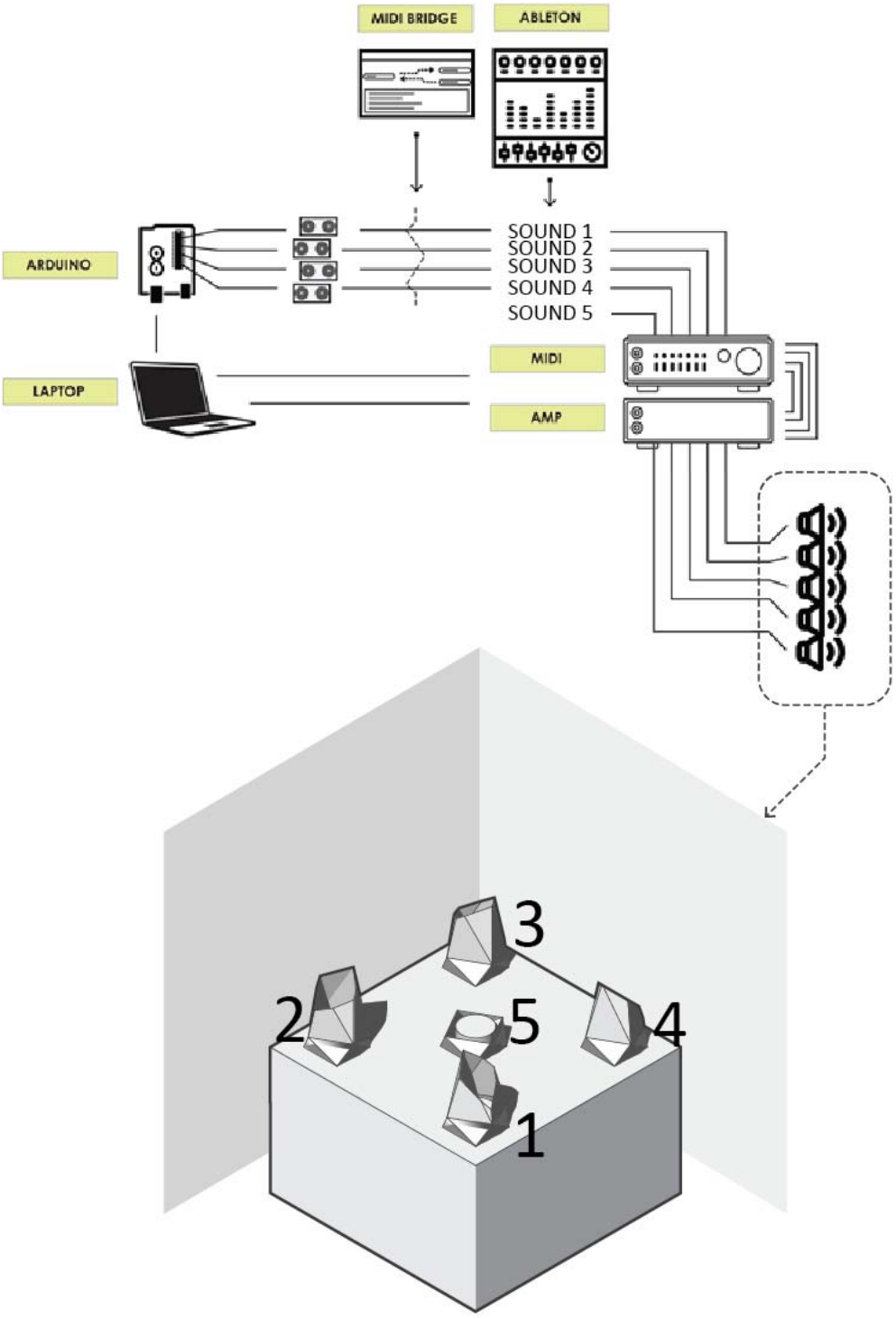

Fig 5. 11. Diagram of components of the system and the installation room. Courtesy: Lina Taheri

In this installation, ultrasonic sensors (Figure 5.12) embedded inside the speaker modules that are aligned to the corners of the room (Figure 5.13) sense the presence of the audience and map it to replay of the sounds and index of LEDs.

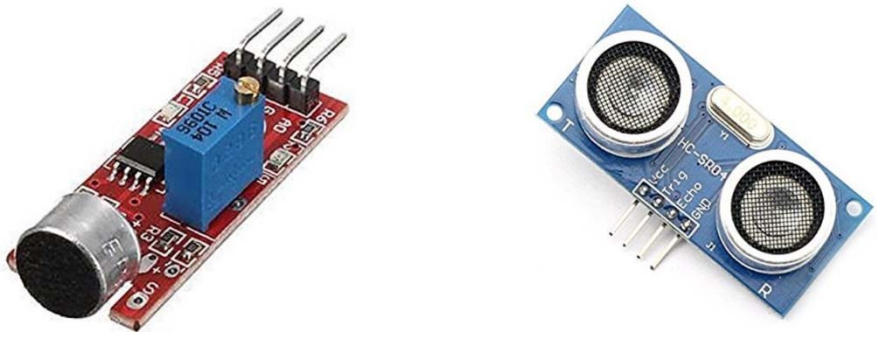

Fig 5. 12. Sound detector module and Ultrasonic sensors used in this installation. Source: Amazon.com

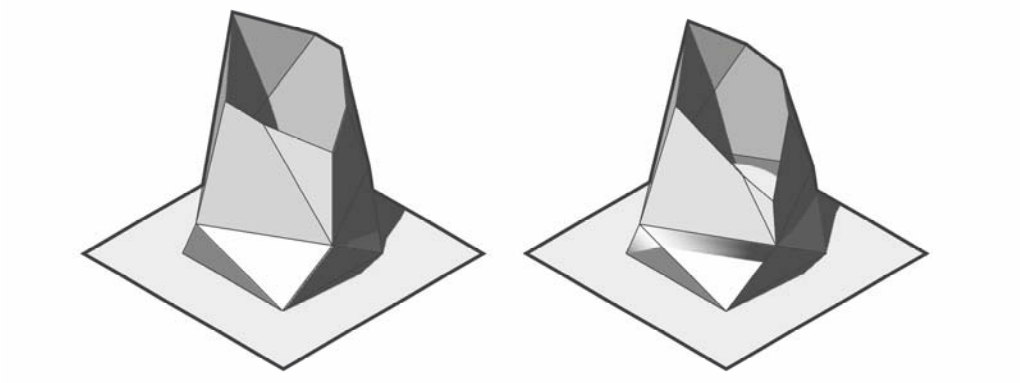

Fig 5. 13. Design of speakers inspired by the mirror room. Courtesy: Lina Taheri

Other option for detecting presence of the people was IR sensors, but since the distance was a potential controller of the sound I opted for ultrasonic sensors. The sensors take the presence of the audience, the distance is translated into MIDI notes that are generated through Ableton. Ableton has the ability to convert audio tracks to MIDI tracks. In this way the software user can play the sounds using MIDI keys just like an instrument.

MIDI (Musical Instrument Digital Interface) is a protocol designed for recording and playing back music on digital synthesizers that are supported by personal computer sound cards. It was originally intended to control one keyboard from another, then it was quickly adopted for the personal computers. After converting the audio to MIDI track, microcontrollers were programmed to play the generated notes off of each track.

Fig 5. 14. Snapshot of Ableton software, converting audio track to MIDI track, here showing the actual keys for the converted track to a chimes instrument. Source: Screenshot from Ableton Live

Fig 5. 15 . Snapshot of Ableton software, converting audio track to MIDI track, here showing a harmony MIDI track from directly extracted from a sound. Source: Screenshot from Ableton Live

In order to program the Arduinos, a MIDI library was used that lets the programmer translate almost any readings from sensors to MIDI commands.

For example with this line:

```
MIDI.sendNoteOn(note, velocity, channel);
```

You can send a note with specific velocity to a specific output channel in your speaker set up. Here, once the presence of a user is detected, the sensor sends the generated MIDI notes of a track to the assigned channel and speaker.

Assigning channels to speakers was possible through use of MIDI interface which is a *Presonus Audiobox* with multiple inputs and output channels. (Figure 5.16)

Fig 5. 16. Presonus MIDI Audiobox. Source: Amazon.com

In total, five speakers playing five different sounds are installed. Four of them were from the building:

1. from metal grinding inside metals lab
2. sound of footsteps along the corridor
3. opening and closing a door
4. chatter of reviews inside the Storrs Salon.

In the selection process of the sounds, I was determining the particularity of the sound to Storrs. In other words, I wanted the sounds to be specific to Storrs. For example the sound from metals lab is to iconic in this building. Such sound would not likely be heard in another academic building. These sounds are purposefully unique to Storrs. I also wanted to add an essence of individual experience of the building. That is the reason I chose the sound of footstep and the sound of a card accessed door.

These sounds would tell the unique story of a person who would wander around the Storrs building, going through spaces, getting in and out of spaces and fade into the chatter of people in the salon. As an experiment I have tried adding more sounds to make other combinations and layers as well. More speakers were added to the setup as the equipment allowed for up to 16 output channels. But

I chose to work with four speakers that would create good sound results and quality inside the 10x10 light room. This way each channel would be heard individually and the collective sound was not too chaotic.

A fifth speaker was added later, playing subtle underlay musical chord from a piano instrument to fill the ambience before any interaction starts. It also established that this is a sound installation before the audience enters the room and start to interact with the pieces.

5. 3. 4. Audience experience

This installation was an experiment based on the concepts of this research, storytelling, audience engagement and memory of a built environment. When the audience triggered the sounds with their presence in the room, a collection of sounds from the building were played, audience would feel the vibrancy of the sound and the lights responding to the sound level. As the installation is inside a room with walls of mirror, the user will find him/herself in an infinity of the mirrored images of themselves and the speakers. The enclosure of the space helps isolate the sounds, while the mirrors make the audience aware of their presence and their impact on the sounds. See figures 5.17-21.

Fig 5. 17 Audience being self-aware because of the mirrors. Courtesy: Lina Taheri

Fig 5. 18 Installation idle mode, before user interaction only the speaker in the middle is playing musical cords.

Courtesy: Lina Taheri

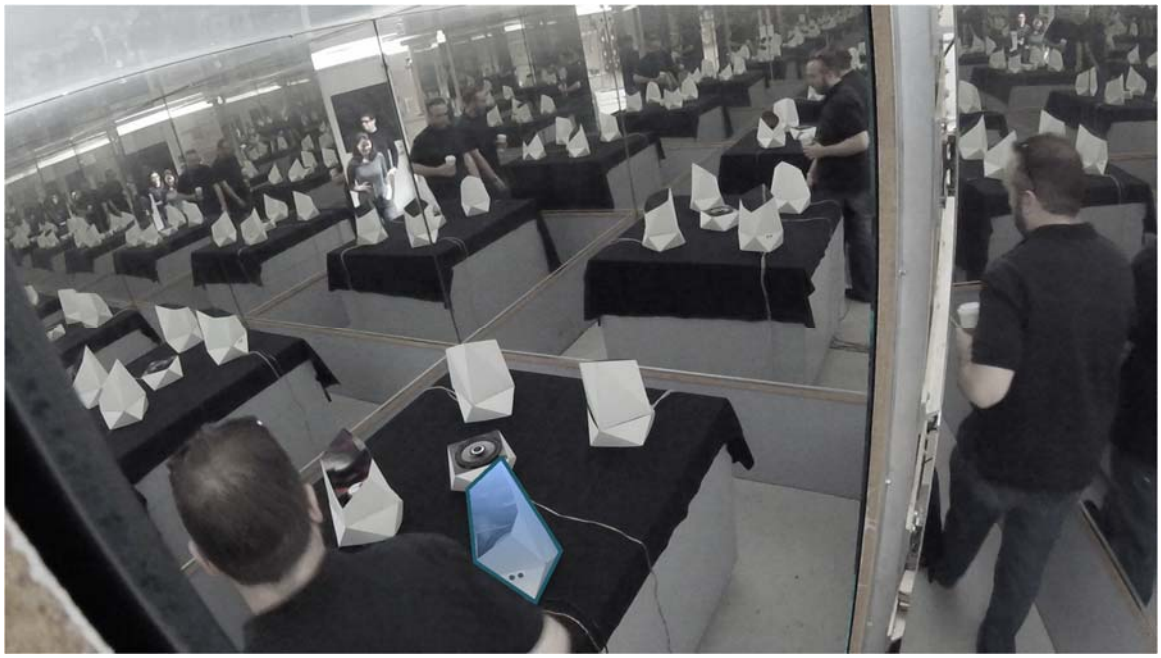

Fig 5. 19 System in use, first user activates first speaker, sound of foot step. Courtesy: Lina Taheri

Fig 5. 20 System in use, two users activate two speakers, overlay sound of footsteps and door opening and closing

Courtesy: Lina Taheri

Fig 5. 21 System in use, all speakers activated, overlaying sounds of footsteps, door, fablab metal grinding, and chatter in the salon. Courtesy: Lina Taheri

This installation was designed for people who are familiar with Storrs and have spent time there. When observing people going into the room and coming out of the room, it was obvious that they were able to identify that the sounds were unique to the building. They could also recognize their impact on playing and replaying the sounds. The lights were also a clue to the users that their presence is detected and showed which speakers were activated to play sounds.

In unstructured interviews after their experience:

- Majority of the visitors claimed that the sounds reminded them of their activities in the building.
- Some suggested that other sounds might have been more intriguing for them.
- They all agreed that the sound from the metals lab is something that they have all noticed in the building all the time.
- Most users could understand that it was their presence in the room that activated the speakers.
- For some the footsteps and door opening and closing was meaningful individually
- The majority agreed that the combination of sounds were harmonious and chaotic at the same time
- Some users mentioned that they felt emerged in the installation with reflected images of the mirrors
- They felt self-aware because of seeing themselves in the mirrors
- Some of them did not recognize the change in intensity of LED lights but noticed that the lights flashing were related to the change in sounds
- Most of them were triggered to see inside of speaker modules because of the flashing light

Because the only interaction was people's proximity to the modules, there was no training necessary for the audience beforehand.

SECTION 6: CONCLUSION AND FUTURE WORK

There is always potential in exploring where the physical interactions meet the digital interactions and how they affect the physical world. Most designed projects using the concept of memory, refer to an event in the past, a hero, a heroic act or a cause that has happened before. Built environment remembers events and passage of time through erosion and rustiness of the material.

The Infinite Story of Storrs is a sound installation that researches concepts of sound, storytelling and memory, and uses sound as a medium of storytelling and in combination with its location it creates a memorable shared experience between audience members. In the process of developing this project I investigated the current trends and typology of public memorials.

Because of my interest in finding an alternative to normative methods of architectural memorials, this project investigates how sound might be used as a medium for remembrance.
Some of the advantages of this method include:

- Sound can be less explicit and more ambient
- It is beyond material and thus does not have limitations that come with materiality
- It is not physical, which makes it more flexible and malleable
- It is open to locations used for other activities, it is flexible for being used in other locations
- Potentially programmable and changing or adaptive
- Could have both qualities of individual/personal and collaborative/public
- Sound is dynamic, it can be generated constantly and potentially be added as new layers, so it is not frozen in the past

My work so far has shown that people understand the sound installation and capture what it is about. Each user can feel the impact of other people present in the room. They can sense multiple layers of sound, identify iconic sounds and accept it as ambient.

Location of the installation can have significant effect on the audience experience. For example, I examined a corridor vs an isolated place in this building. Because the corridors are not enclosed and they are always somehow occupied, they have the potential of adding a layer of live sound generation to the whole system. The isolated location gave me more control over ambient sound and it gave a sense of uniqueness to the sounds being played. It isolated the sense of hearing from visual clutter and makes the sounds more prominent. This specific room with mirror walls had an additional advantage of making the audience aware of their presence and that it is their presence that activates the sounds.

Having each speaker respond to each user adds elements of shared experience to the work. When each user understands other peoples impact on the system it makes it a collaborative and shared experience. One user can only activate one speaker, other speakers activate only when there are other users in the room. And that is when they create a shared memory and experience the piece collaboratively.

This sound installation is by no means an absolute answer to the questions of this thesis, but it is one example of many more possibilities, experimenting with how isolating one sense, hearing, would memorialize events and characteristics of a place.

For the future work I would like to add more interactions to the system. I would like the system to also record users' interaction with the system and add their impact to the sounds being played with a delay, so that people could leave their real time trace for future visitors. The impact could fade

away through time and be replaced by new sound layers. So I believe this has real potential as a storytelling medium. I would also like to explore how the shape of the speaker horns would affect user's interaction. One of the challenges of the current location was that there was a fixed table in the middle of the room that limited the height of the fabricated speakers. When observing visitors' reaction to the installation, I noticed that people were curious to see what is inside, so I believe the shape and material of the speakers also could be a matter of more investigation for future work.

REFERENCES

Antle, Alissa, Paul Marshall, and Elise van den Hoven. 2011. "Workshop on embodied interaction: Theory and practice in HCI. Mathematics of Computation." *Workshop on embodied interaction.*

Anwandter, Patricia Marcella. "Frames of mind: Photography, memory and identity." (2006).

Architecture talk, Rethinking Historic Preservation with Jorge Otero-Pailos, podcast audio, October, 2017 Available: https://player.fm/series/architecturetalk/3-rethinking-historic-preservation-with-jorge-oteropailos

Mansour, M. 2009."Fiber Optic Installations, Bernirdini" *Arch20.* https://www.arch2o.com/fiber-optic-installations-carlo-bernardini/.

Beilharz, Kirsty. "Criteria & Aesthetics for Mapping Social Behaviour to Real Time Generative Structures for Ambient Auditory Display (Interactive Sonification.)" In *INTERACTION-Systems, Practice and Theory: A Creativity & Cognition Symposium, Creativity and Cognition Press, The Dynamic Design Research Group*. 2004.

Best, T. 2017. *New York Times.* 5 July. www.nytimes.com/2017/07/05/arts/design/times-square-phone-booths-art-installation.html.

Bhabha, Homi K. 1994. *The Location of Culture.* New York: Routledge.

CAO, JERRY. 2015. "6 storytelling techniques for great interaction design." *DESIGN & DEV*, 09.

Cartwright, Mark April 2017,"Ise Grand Shrine" Available: https://www.ancient.eu/Ise_Grand_Shrine/

Debord, Guy 1958, Internationale Situationniste #2 Available: https://www.cddc.vt.edu/sionline/si/theory.html

Dubus, Gaël, and Roberto Bresin. "A systematic review of mapping strategies for the sonification of physical quantities." *PloS one* 8, no. 12 (2013): e82491.

Farahi, Behnaz. 2016. "Living Breathing Buildings." In *Interactive Architecture: Adaptive world*. New York: Princeton Architectural Press.

Facing History and Ourselves. 2017 "Chapter 11: Visual Essay: Holocaust Memorials and

Monuments" in *"Holocaust and Human Behaviour"* available: www.facinghistory.org

Gardiner, Hazel, and Charlie Gere. 2010. *Art Practice in a Digital Culture (Digital Research in the Arts and Humanities.* Ashgate Publishing Group.

Holbrow, C.J., E Jessop, and R Kleinberger. 2014. "Vocal Vibrations: A multisensory experience of the voice." *NIME.*

Jacko, Julie A. 2012. *Human computer interaction handbook, Fundamentals, evolving technologies and emerging applications.* CRC Press.

Jonaitis, Aldona, and Aaron Glass. The totem pole: An intercultural history. Seattle: University of Washington Press, 2010.

Jobson, C. 2016. *Architectural Sculpture by David Moreno.* http://www.thisiscolossal.com/2016/10/drawing-sculptures-david-moreno/.

Lane, Cathy, and Nye Parry. "The Memory Machine: sound and memory at the British Museum." *Organised Sound* 10, no. 2 (2005): 141.

Osorio, Julian Andres. "20-20 Listening: A sound documentary dedicated to the study of listening experiences in acoustic environments." PhD diss., Iowa State University, 2016.

2012. *Bloom.* http://www.thisiscolossal.com/2012/03/bloom-28000-potted-flowers-installed-at-the-massachusetts-mental-health-center/.

2017. *Musuem of Arts and Design.* September. https://madmuseum.org/sonic-arcade-shaping-space-with-sound.

2017. *Urban Noise Mapping.* Sep. https://medium.com/@Urbica.co/urban-noise-mapping-5dfb5a49eb1c.

Lowenthal, David. n.d. "Material Preservation and Its Alternatives." *Perspecta* 67-77.

Malhotra, Sanjana, The Future Was Then, Daniel Arsham", available: https://www.arch2o.com/future-daniel-arsham/

Marguardt, Nicolai, Robert Diaz-Marino, Sebastian Boring, and Saul Greenberg. 2011. "The proximity toolkit: prototyping proxemic interactions in ubiquitous computing ecologies."

n.d. *National Capital Planning Commission* . https://future.ncpc.gov/.

Muller, Michael & Druin, Allison. (2002). Participatory Design: The Third Space in HCI. Handbook of HCI.

Ochayon, Sheryl, "The Shoes on the Danube Promenade – Commemoration of the Tragedy"

Available: http://www.yadvashem.org

Paul, Christine. 2015. *Digital Art.* London: Thames and Hudson.

Searle, Adrian. 2016. *The Ethics of Dust: a latex requiem for a dying Westminster*. https://www.theguardian.com/artanddesign/2016/jun/29/the-ethics-of-dust-jorge-otero-pailos-westminster-hall-artangel

Schwartsman, Madeline. 2011. *See yourself sensing.* London: Black Dog Publishing.

Taylor-Hochberg, Amelia. 2016. *Archinect.* January. https://archinect.com/news/article/145189824/never-the-same-river-twice-experimental-preservation-and-architectural-authorship-with-jorge-otero-pailos-on-archinect-sessions-47.

Torpey, Peter, Bloomberg, Ben et Al. 2012, *"Remote Theatrical Immersion Extending Sleep No More"*
Available: http://opera.media.mit.edu/projects/sleep_no_more/

Vashem, Yad , May 1998 *An interview with Prof. James E. Yaoung.* Personal Interview

Watkins, Phil. 2012. One of Budapest's Most Moving Memorials: Shoes on The Danube http://visitbudapest.travel/articles/one-of-budapests-most-moving-memorials-shoes-on-the-danube/