RHYTHMSYNTHESIS

by

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September 2012

A thesis submitted to the

Faculty of the Graduate School of

the University at Buffalo, State University of New York

in partial fulfillment of the requirements for the

degree of

Master of Architecture

Master of Fine Arts

School of Architecture and Planning

Department of Media Study

I would like to dedicate this work to my family, for always supporting and encouraging me to continue to do whatever it is I may be interested in at the time. I would also like to thank my thesis committee, Erik Conrad, Jordan Geiger, and Teri Rueb for their endless support through this stimulating, stressful, and satisfying process.

Contents

Abstract

In a time so distracted and involved with the latest computing technologies, the relevance of designed space as having a significant role in the ways in which we conduct our day to day lives is diminishing. Architecture is losing its power to ground us in a particular place, at a particular time, surrounded by specific materials. *Rhythmsynthesis* attempts to engage the body, stimulate interaction, and encourage new ways of touching, listening to, and looking at space. *Rhythmsynthesis* responds to Henri Lefebvre's *Rhythmanalysis*. Where Lefebvre coined his term for an act, a means for learning and discovering spatial, social, and political rhythms through analysis and writing, *Rhythmsynthesis* has an approach of exposing, synthesizing, and playing with similar rhythms through an interactive intervention looking towards practices of the Situationists and sound artists such as Max Neuhaus and David Byrne. In earlier stages of the thesis, a question was often posed: "How do shared auditory and tactile experiences affect new forms of participation and embodied interaction?" Throughout research, auditory and tactile experiences were defined by sounds, materials, and types of spaces which we encounter in our daily lives and the ways in which these two sensory systems can be fused.

Introduction

As the interaction between bodies and the physical world becomes ever more mediated by new technologies, we find ourselves in a state of distraction. The virtual world inside of a screen demands our attention, causing a detachment from the physical world surrounding us. This is a particular concern for architecture because of the shifts in social interaction caused by technology: expansion of the social sphere from local, personal interactions, to global. It has become commonplace to see people with their heads down staring at a computer or mobile device, even in highly populated areas. Our immediate environment is becoming secondary to a global communicative reach, meaning a pocket-sized device may have more influence on our interactions with people and space than the space itself. There is an increasing invasion of computing technologies in our everyday lives which are desensitizing our relationship to the things which affect our physical bodies.

Stemming from phenomenological thought, the question arises: how can interaction and interface design relate closer to the body? More importantly, how does this interaction relate to everyday space? These issues correspond directly to concepts like Henri Lefebvre's *Rythmanalysis* and the *everyday*, Paul Dourish's writings on embodied interaction, and Juhani Pallasmaas' exploration of phenomenological architecture.

Embodied interaction grounds the thesis by understanding Human-Computer Interaction (HCI) in terms of the body and the context in which the computer is set. While embodied interaction relates to the embodiment of information within a computing system and how meaning is revealed inside and outside of the system, more importantly it is concerned with how interfaces for HCI can address the body more explicitly and intuitively. Architecture is the epitome of embodied interaction. Buildings, and elements, are under investigation as *the* interface for interacting with a computer system.

Lefebvre's theories on rhythms and everydayness are critical to the thesis' understandings of space and how people conduct their daily lives. Rhythm as seen by Lefebvre imposes a political and capitalistic structure upon everyday life; it "appears as regulated time, governed by rational laws" (*Rhythmanalysis*, pg. 9). This can be related to the ways in which new mobile technologies pervade

contemporary society. Mobile phones impose a rhythm by syncing to the network every five minutes for example, periodically distracting us from our immediate surroundings. Consequently, everyday space becomes uninteresting, if even noticed at all, as the glass screen consumes our attention. Thus, a study of rhythms opens the potential for social intervention, breaking the routinized divisions of time and reducing the banality of the everyday while increasing its potentials for creativity, chance, pleasure, and fun.

With a specific focus on sound, this thesis attempts to disrupt rhythms which emerge through movement within a building such as walking up stairs, waiting for an elevator, and opening and closing doors. To disrupt these rhythms involves both amplifying existing sounds as well as introducing new generative sounds based on these existing sounds. This process relies on the notions that sound produces a feeling of social and spatial connectedness as we can decipher many aspects of space just by listening. By singling out moments in sound through a technological interface, mundane sounds can gain significance and cause a user to pause and contemplate their interactions with space. The work has the effect of re-tuning the ear to the everyday sounds of acoustic environments as alternative forms of what one might call "organized sound."

The following chapters will go through the thesis explaining various phases and concerns leading up to the *Rhythmsynthesis* event at the main lobby of Buffalo's Liberty Building, a transitional space. I began looking at spaces of transition, which are overwhelmed with distraction. These transitional spaces have qualities of temporary inhabitation, often spent distracted by advertising or media devices, overarching schedules determining a global rhythm, and spaces which are visited by more or less the same people day to day: *habitually encountered spaces*. These spaces became interesting to the thesis since they are for the most part ignored by their inhabitants, the rhythms imposed on the space govern both social and political life, and sonically they are rich in soundmarks and ambient soundscapes.

There are three main issues which the thesis regards with equal importance: sound, interface, and everydayness. These will be addressed separately, but are all interrelated, coming together in the final event. Sound is continuously looked at as revealing qualities of space and materiality often in a context of everyday space. Differences between hearing and listening are a topic of study in referenced work as well

as iterations throughout the thesis. Interface is explored methodologically for testing concepts of networked objects, audio/tactile materials and methods, and the ways in which bodies and daily interactions can inform the design of an interface system. The *everyday* is the catalyst which binds these ideas regarding sound and interface, as well as the ways in which people move through and interact with technology in mundane spaces. These ideas are fused into an understanding of space and sound through rhythms of everyday spatial use.

Sound

"When I hear the sound of traffic, for instance, I have the feeling that sound is acting. And I love the activity of sound"

John Cage, *about Silence*

Hearing is an inherently social sense. We feel included and connected to our surroundings through sensing sound. If the sounds around you are removed, a feeling of isolation emerges[1]. Therefore, sound animates the exterior world; it penetrates our senses, transcending mental interiority to bodily exteriority. Composers including Pierre Schaeffer, Edgar Varese, and John Cage spanning to sound artists such as Max Neuhaus and select David Byrne pieces have worked with sound in this context of *spatiality* and *materiality,* often embracing the existing sounds of a given space. The *soundscape* is a term often used to describe the vast array of sounds which exist within our environment, surrounding us every day. In the introduction of R. Murray Schafer's *The Soundscape* he writes, "The final question will be: is the soundscape of the world and indeterminate composition over which we have no control, or are *we* its composers and performers, responsible for giving it form and beauty" (Schafer, pg. 5). Responding to this question requires two separate tasks, as elaborated by Schafer. The first is to analyze the soundscape; learn it; understand what makes it unique. The second is to synthesize soundscape; make sense of it; accompany it and create with it.

Analysis

Not surprisingly, part three of *The Soundscape* is titled *Analysis,* which Schafer breaks into six chapters: *Notation, Classification, Perception, Morphology, Symbolism,* and *Noise.* This entire section discusses how the "soundscape historian" should approach sounds in context, as "sound events;" how to

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[1] "Personal-stereo use reorients and re-spatializes experience which users often describe in solipsistic and aesthetic terms" (Bull, pg. 22).

listen to these sounds, how to document them, how to approach them psychoacoustically, and how soundscapes and their inhabiting "sound objects" may take on different semantics. In the *Classification* chapter, Schafer describes how he instructed students to describe five sounds they liked most and five sounds they liked least, after which he instructed them to take a soundwalk around their immediate environment. Through this experiment, the students *listened* to their environment and began to classify sounds according to their aesthetic qualities. Schafer takes this further in order to understand how people experience and react to different sounds in different contexts, further pushing a very scientific and calculated (although denouncing any form of computer-aided calculations) form of soundscape analysis. What is important for this thesis is the emphasis Schafer placed on the students to *listen*, carefully, to their immediate sonic environment which he later goes on to describe as "ear cleaning exercises in order to improve the sonological competence of entire societies" (Schafer pg. 181). While *The Soundscape* provides an unrivaled understanding of soundscapes for the purpose of analyzing, cataloguing, historicizing, and designing sensitively for the future, I do not wish to dwell on the subject as such. Rather, I wish to approach *analysis* not as a soundscape historian or acoustician, but as a producer of physical works which directly addresses and engages the body and its surrounding acoustic, material, and social environment.

A sound artist or composer may be considered to "analyze a soundscape" through design or artistic creation. For Schafer, analysis focuses specifically on *listening* rather than *hearing*. Max Neuhaus defines the word *listen*, "to pay attention aurally" ("LISTEN", pg. 1). Whereas *hearing* refers literally to the detection of sound, *listening* is more of an active reception to the sounds one may be hearing; responding emotionally to them and acknowledging their presence, or "sonological competence." They are quite distinct yet quickly interchangeable in mental state. One can go from *hearing* to *listening* to particular sounds and vice versa. Schafer describes how soundscapes can be understood in visual terms: figure versus ground. Just as the eye focuses on the figure and sees the ground as background blur, the ear focuses – or *listens* – to the figure, and in a full ambiance *hears* the ground (Schafer, pg. 152).

John Cage's landmark *4'33"* is a clear example of the simple yet powerful shift from *hearing* to *listening*. This musical performance, consisting of three "silent" movements, brings the existing

soundscape of the performance space to the foreground: wind blowing, people shuffling feet, coughing. All of these sounds which are normally subjected to the human ear as something to be *heard* suddenly become something to be *listened to*. For Cage the purpose of the piece was to reveal an intrinsic lack of silence in the world; he points out, "There's no such thing as silence" (Kostelanetz, pg. 70). "You soon become aware of a huge amount of sound, ranging from the mundane to the profound, from the expected to the surprising, from the intimate to the cosmic" (Gutmann). *4'33"* invites the listener into a state of heightened *listening*. In removing the proper performance, the sonic roles of the performance space becomes reversed: figure and ground are effectively switched. Suddenly, the venue is no longer occupied by a musician(s) playing a piece of music, but by an entire audience producing the most mundane of sounds. The listener becomes an aural analyst of their environment, if they make the transformation from anger to appreciation. As Cage recalls,

> "They missed the point... What they thought was silence [in *4'33"*], because they didn't know how to listen, was full of accidental sounds. You could hear the wind stirring outside during the first movement [in the premiere]. During the second, raindrops began patterning the roof, and during the third the people themselves made all kinds of interesting sounds as they talked or walked out." (Kostelanetz, pg. 70)

Just as Schafer instructed students to go on soundwalks, Max Neuhaus' first works as an independent artist in 1966 consisted of soundwalks which he titled *LISTEN*. Citing Russolo, Varese, and Cage, Neuhaus describes his interest in the insertion of everyday sounds into the concert hall (as seen in Cage's *4'33"*). Although, Neuhaus writes, "I became interested in going a step further. Why limit listening to the concert hall? Instead of bringing these sounds into the hall, why not simply take the audience outside – a demonstration in situ?" ("LISTEN", pg. 1) Thus, he began *LISTEN*. This work consisted of a series of soundwalks which began with a group of people in a concert hall brought immediately outside for a walk around particular areas of different cities around the US. As straight-forward as the title, *LISTEN* was about exposing an audience to a particular style of hearing their everyday environment. In the context of a performance, audiences presupposed a mental state of aural awareness (e.g. listening to a concert). Therefore, sounds of their everyday environment came into focus during these walks, ultimately invoking "a new way to listen" for the audience themselves. Just as in

Cage's *4'33"*, audience members are exposed to an aural awareness focusing on background sounds rather than foreground, such as a musical performance.

A contemporary example that addresses issues of soundscape analysis via artistic intervention is Claudio Midolo's *soundFishing* (2007). This project is an audio interface design which records sounds surrounding the user throughout the day. These sounds are recorded based on sets of rules given as input by the user, allowing the interface to analyze a given soundscape and capture moments as desired by the user. Potentially problematic, the interface does not require a specific focusing of attention by the user, for it works autonomously – only revealing its findings at the end of the day. Therefore its effectiveness in aiding towards a closer *listening*, rather than *hearing*, of ambient soundscapes is unknown. Although, according to Midolo, "This sound collection would stimulate curiosity as it captures and shows the richness of variety of possibilities that live within the sonic layer usually taken for granted" (Midolo, pg. 20).

soundFishing stands as a personal experience, generating a collection of sounds for the user, revealing a sonic richness inhabiting the everyday environment. An earlier study of the thesis dealt with these ideas, yet expands them further by relying on a more socially-oriented gathering of sounds. *Crowd-Sourcing-Sound* was a study which asked users through social networks to record and upload moments of their day, chosen through a categorization system. The categories were specifically sounds of action: brushing teeth, starting a car, taking a train to work, drinking water, etc. This focused the sources as the production of sounds through common actions: sounds of
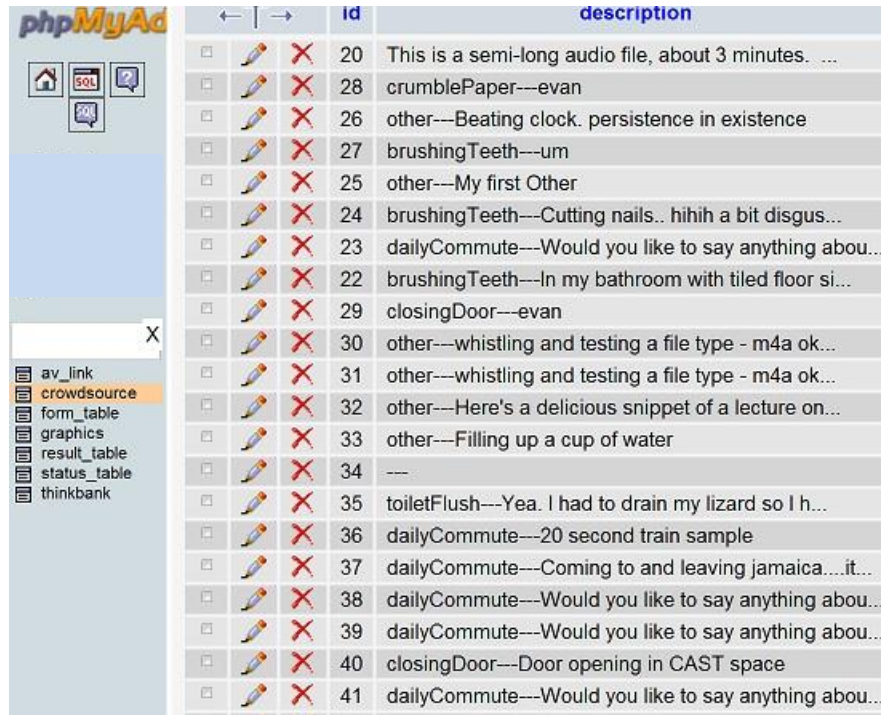
Figure 1 Screen-shot of web interface for submitting sounds for *Crowd-Sourcing-Sound*

everyday interactions with space and objects, bringing to light the corporeality of space. Therefore, every sound became similar within their category in that they were produced by bodies moving, interacting with, and touching space; although they became interestingly differentiated by things

Figure 2 Screen-shot of *Crowd-Sourcing-Sound* database of submitted sounds

like time of day, geographic location, and geometric and material qualities of space. Place becomes significant as common sounds begin to bring out sonic qualities which make one space different than another.

Analyses of qualities of materiality and spatiality can be seen quite clearly in many of Alvin Lucier's works. *I am sitting in a room* (1970), while tending towards aspects of synthesis, is ineffably rooted in sonic analysis. Here, the composer speaks into a microphone inside of a concert hall and records himself speaking. The recording is then played back and recorded again during playback. This process is repeated over and over again until the played back recording sounds nothing like the speech he initially made, and sounds more like random drone-like sounds. The sounds of human speech are transformed into the speech of a building's acoustics – its harmonic resonances. With each successive

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recording of the initial speech, the spatial and material resonances influence the recording of that current playback. This becomes amplified over a 40 minute timespan where the speech is re-recorded hundreds of times, such that the only thing that can eventually be heard are the resonant frequencies of that specific room. This piece is particularly important – to both this section on Analysis as well as the previously discussed exploration *Crowd-Sourcing-Sound* – because it addresses sound on three levels: the body, the technologies employed, and the space (geometry and materiality). In regards to the body *I am sitting in a room* focuses on speech produced by the subject; its rhythms, amplitudes, and frequencies. The technologies employed – microphone, recording device, amplifier, and speakers – unavoidably influence the effect to which this piece stays true to its intentions (something Lucier does mention). Then, undoubtedly, the space and all of its characteristics within which the piece is performed naturally manipulates, modulates, and reproduces (in reverberation) the speech performed by both body – speech – and technology – sonic reproduction. Although it will be discussed in greater detail, it is important to highlight the importance of these three elements within the thesis: body, space, and technologies. Methodologically, iterations of this thesis have developed new ways of combining these aspects into a unified experience, stemming from phenomenology, embodied interaction, and Lefebvre's *rhythmanalysis*.

Synthesis

In order to synthesize, one must analyze. Contexts learned, sounds studied, and particular goal(s) must be in order. I discussed *Analysis* through the lens of sound artists and composers; let's use a term from Schafer though instead in reference to *synthesis*: acoustic designer. This term brings with it notions of space, context, materiality, and obviously design; it places sound into an architectural context.

> "The acoustic designer may incline society to listen again to models of beautifully modulated and balanced soundscapes such as we have in great musical compositions. From these, clues may be obtained as to how the soundscape may be altered, sped up, slowed down, thinned or thickened, weighted in favor of or against specific effects." (Schafer, pgs. 237 – 238)

Therefore, the acoustic designer, sound artist, composer, even architect, synthesizes soundscapes: modulates and balances, manipulates and co-creates, adds and potentially subtracts. Rhythm becomes a important indicator then of how an acoustic designer should, in fact, design. After all, rhythms both influence and indicate the pace - the *feel* – of an aural space.

Many examples of rhythmic *synthesis*[2] can be provided by looking at the work of John Cage. For example, the *Water Walk* (1959) performance where Cage notated specifically timed and spaced interactions with water-based objects, *Reunion* (1968) which amplifies and synthesizes sounds based on a chess game with Marcel and Teeny Duchamp, and *27 Sounds Manufactured in A Kitchen* which quickly cuts between clips of Cage preparing a diet-based meal. I am referring to these works as synthesized audio pieces because of the ways which they either take a given soundscape and create within it, or create an entirely new soundscape.

These examples from Cage all exist within a framework of staged performance: television show, concert hall, and film. They are performed out of context, even *27 Sounds Manufactured in A Kitchen* is only made available as a film segment rather than a performance viewed within a kitchen. David Byrne's

Figure 3 David Byrne's *Playing the Building* at the Battery Maritime Building

Playing the Building (2005 and 2008) demonstrates a contextual synthesis of a soundscape. I want to focus on the 2008 installation of this piece, located at the Battery Maritime Building in New York City rather than the 2005 piece in Stockholm, Sweden because of the specific focus on context.

In 2005 the installation was performed in an art gallery, the project becomes much more inspirational and

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[2] I am referring to this work as *synthetic* so to speak because it is a constructed sound work. The produced sounds are performed and as a whole, synthesized from many different types of sounds. Similarly, the rhythms produced in the work are synthesized movements following a score and producing a specific tempo of bodily movements.

beautiful in the context of the emptied Maritime Building where one can imagine the sounds produced by the piece actually existing when the building was in use. *Playing the Building* sees the deconstruction of a piano with hundreds of wires and strings crawling off of it being drawn all over different structural and mechanical elements of the Maritime Building. At the end of each wire is an array of actuators, from motors to air pumps. Each device causes elements of the building to resonate and vibrate consequently producing sounds; the entire building is turned into a musical instrument. Whether intended by Byrne or not, *Playing the Building* invokes a metaphorical mimicry of a living building (as opposed to an under-inhabited building) through sound – one can imagine heat running through the building causing pipes to clatter. The building comes alive through sound; a soundscape is reproduced through an artistic synthesis.

To push the boundaries of synthesis further we can take note that *Playing the Building* synthesizes already existing sounds into a new soundscape; new sounds, inhabiting and accompanying the soundscape are not present. One of the most important sound artists relevant to this idea is Max Neuhaus. Three works which we can look at in relation to sound synthesis within a specific spatial and sonic context include, *Drive-in Music* (1967), *Walkthrough* (1973-1977), and *Times Square* (1977, 2002-present).

Drive-in Music embraces the linearity of a roadway as well as the soundscape of a car's interior; noting that, "most people spend a great deal of time in their automobiles… Most of them listened to sound in their cars over the radio" ("Modus Operandi"). He attached numerous FM transmitters located on trees following the perimeter of Lincoln Parkway, Buffalo, NY which would transmit different tones into a car as a person drove through the street. While Schafer would probably denounce this project on the grounds of sound choice (he speaks very poorly about similar sound techniques in the *Acoustic Designer* chapter), it is especially significant to my work because of the technical methods utilized for synthesizing the sounds. For example, the *Music Table* developed during the thesis (discussed in the *Embodied Interaction* section) utilized ideas of Bluetooth communications for transmitting audio recorded by users off-site, as well as download compositions being created on the table. Also *Audio Bugs* (discussed in the *Everyday Architecture as Interface* section) relied on the communication via wireless

network between each of the audio bugs to provide a holistic approach to sound synthesis. At the same time this work transcends previously discussed sound works because of its interactive nature, the driver controls to some extent how the sounds are heard; the driver controls their soundscape.

Drive-in Music did not address already existing sounds within the soundscape – rather it exploited existing methods of sound transmission – as *Walkthrough* and *Times Square* do. Both of these works look at a particular site, Jay St. subway station in Brooklyn and Time Square in Manhattan, and produce soundscape additions based on a careful analysis of the existing sounds, rhythms, and main uses of these spaces. *Walkthrough* for example, produces "clicks" which change in tempo and timbre (sonic coloring) based on current and dynamic weather patterns in the immediate area. The piece is located at entrances and exits to the station and addresses weather as a modulator of the installation to reinforce a subject of routine commuting. According to Neuhaus, "I could do it here because we notice change, even very small changes in a very familiar environment, one we encounter daily. This was a piece for the people who went in and out of that subway entrance every day" ("EVOCARE", pg. 2).

Similarly, *Times Square* produces sounds in consonance and sync with the pitches and rhythms present in Times Square. A number of tones are generated below a subway grate located on the pedestrian island in Times Square which accompanies the sounds of traffic and thousands of pedestrians filling the streets and walkways every day. The presence of these tones is not instantly recognizable, but to the listening ear they begin to unify the ambiance of Times Square, bringing clarity to an otherwise indistinguishable soundscape. The tones also shift cyclically as the rhythms of traffic patterns change throughout the day and night adding sonic depth to the piece as well as changing its spatiality. Neuhaus describes the piece as creating "a large block of sound, which you walk into." This proximity in which this "block of sound" can be heard is ever changing as traffic patterns become more congested and ease up, trains come and go, and people gather and clear away. Although executed in an entirely different manner, *Times Square* is as much alive as Byrne's *Playing the Building*.

Taking cues from the above projects, a study titled *Music Table* took shape in earlier phases of the thesis. *Music Table* was an attempt at marrying ideas of consuming and producing music (or *analyzing* and *synthesizing*) within a collaborative environment using sounds built from the surrounding soundscape. As an interface (which will be discussed in depth later) the table consisted of a memory foam top with varying thicknesses; inside the foam were a series of pressure sensors, tactile speakers, and microphones. The table would periodically record clips of the soundscape and add the recordings to a bank of sound loops. In interacting with the table, pushing down on specific areas of the foam, recorded loops would playback and be manipulated in speed depending on where a person pressed. The effect was to impose a way of *listening* to the soundscape through a musical interface; as Midolo put it, to "…stimulate curiosity as it captures and shows the richness of variety of possibilities that live within the sonic layer usually taken for granted." The project takes a passive role in terms of *acoustic design* as the system places the role of design on the users. Sound is understood as taking on a role of social inclusion. As described by Pallasmaa, "we stare alone at the suspense of a circus, but the burst of applause after the relaxation of suspense unites us to the crowd." (pg. 35) Therefore, we feel an immediate connection to an exterior existence – we become socially and materially embedded within space and time. The idea was that by singling out moments in sound and tying them into an interface, which is at the heart a social interface, mundane sounds would gain significance. The work has the effect of re-tuning the ear to the everyday sounds of acoustic environments as alternative forms of "organized sound."

Figure 4 Performing the Music Table prototype

Conclusion

   The purpose of this section of the thesis is to set the foundations for the ways in which sound has and will further be looked at throughout research. Fundamental to *Rhythmsynthesis* is the idea that musical understandings (such as instrumentality, rhythm, and even melody) can be drawn out through fostering specific ways of listening to existing soundscapes - or, everyday sounds. Sound in this context is immediate; one hears a sound and immediately understands something about its proximity, source, and physical environment the sound was produced in. These qualities have an effect on the coloring of that sound, giving spatial cues upon listening; it is here and now; it is sensational. The interfaces developed in this thesis have all been a consequence of specific ways of understanding and exploring sound. In particular this has revolved around looking at sound as a social factor (as described by Pallasmaa), confusing the sense of sound by embedding tactile experiences, focusing on everyday sounds existing within a given soundscape, and above all encouraging focused *listening* as opposed to passive *hearing*.

Rhythms of the Everyday

> "As a place of drifts and ambiences, the Situationist city of the future would consist only of participation: social and aesthetic games and performances of and in the everyday. In a rapidly changing surround of technology, the ennui of daily life would be eradicated by the perfumelike spell of new inventions embedded into and activating the very environment in which one lived." (Salter, pg. 350)

Just as hearing is a social sense, so architecture is a social medium. Not only can I sit in my living room and converse with company within its confinements, I am also connected to generations before me. I can *feel* the endless count of time as the old withers away and the new takes its place. Sitting at a coffee shop one can take note of the micro-conversations taking place. But the proliferation of wireless networks and communications rapidly transform the way we act in space; at the very same time there are global conversations taking place at nearly every scale. During this time, one is removed from their physical surroundings (placed into the background) and virtually transmitted to another place and time. This is common to see not only within architecture, but on the streets, inside of cars, and virtually everywhere as computing becomes ever more ubiquitous. Our immediate environment is becoming secondary to a global communicative reach, meaning a pocket-sized device may have more influence on our interactions with people and space than the space itself. It is no wonder that using a cellphone while driving a car has become an illegal act.

Media and advertising never cease to promote the next-best-thing in mobile computing: tablets, phones, thinner and thinner computers. We are constantly bombarded with a need to keep up with the latest and greatest, or fall behind forever. Juhani Pallasmaa writes, "The incredible acceleration of speed during the last century has collapsed time into the flat screen of the present, upon which the simultaneity of the world is projected" (Pallasmaa, pg. 52). He contrasts this statement by claiming that architecture provides an opportunity for us to once again feel the "healing flow of time." To argue against this claim, it is a position of the thesis that the power of architecture to enable this feeling of time is fading away. As I have stated earlier, our immediate environment is becoming secondary to a global communicative reach.

Access to never ending information at seemingly the speed of light is an amazing feat of mankind; this is not the problem I am trying to bring to the discussion. The problem arises when the physical, the real, the immediate surrounding begins to fade away into a blur, drawing our attention to a space which we can only access through a virtual device and invisible network.

The Everyday

In a Lefebvrian sense, the everyday is, "the most universal and the most unique condition, the most obvious and the best hidden" ("The Everyday and Everydayness", pg. 34). The everyday is free, open, left for adventure and play on the one hand, yet on the other controlled, structured, and calculated.

Figure 5 U.S. Department of Defense advertisement

Lefebvre declares that the everyday is imposed by a structure of organized passivity, stating that even "in private life, it means the imposition of consumption, since the available choices are directed and the needs of the consumer created by advertising and market studies" ("The Everyday and Everydayness", pg. 36). In contemporary examples we find this ever so relevant in advertising of technology products, especially in a context of consumption. At the same time, advertisements commissioned by the U.S. Department of Health and Human Services towards the youth pushes slogans like, "Get up and play an hour a day." Similarly truck commercials can be seen advertising the ability to go so far away from civilization that no cell service can be received, thus promoting a "break" from the network. These commercials can be read as such: promoting a healthier lifestyle, promoting personal social interactions, as well as reconnecting with the "natural" world; overall, a change in lifestyle. Lefebvre comments on this method of advertising, referring to the politicization of life change, "In the

process it [the injunction to change life] has degenerated into political slogans – 'Live better!', 'Live differently!', 'the quality of life', 'lifestyle'" (*The Production of Space*, pg. 59).

In the late 50's and early 60's Lefebvre become involved with the Situationists, putting a focus on a transformation of the problematic everyday life – burdened by structure and capitalistic agendas – into moments of estrangement, play, and "situations" prescribed by artistic interventions. Sited heavily within everyday contexts, "… the Situationists proposed a 'permanent transformation' of urban environments through individual spatial interventions or 'contructed situations'" (Ouzounian, pg. 92). Just as Lefebvre believed that the imposition of an organized structure impacted the everyday negatively, the Situationists believed "that environments determined and fixed social behaviors, and that contemporary modes of urbanism were forms of repressive social conditioning" (Ouzounian, pg. 91-92). Urbanism in this sense refers to examples of universal forms in office blocks and structured living spaces whose consequence resulted in passive modes of living day to day. The everyday thus in relation to architecture, urbanism, and even cartography rejects formalism, novel design, and commodity for "a more sensitive engagement with people's everyday environments and lives" (McLeod, pg. 11).

Figure 6 Image of Mourenx, France which "the Situationists, who published this image, described the town as embodying the 'concentration camp organization of life.'" (McLeod, pg. 23)

Accompanying Lefebvre's focus on social transformation through writing and the Situationists "constructed situations" were the practices of the dérive and psychogeography. Both are forms of spatial understanding through personal experiences which are interrelated. Often a dérive results in a psychogeographic map. Guy Debord, who led the Situationists, describes in the *Theory of the Dérive*,

> "The lessons drawn from dérives enable us to draft the first surveys of the psychogeographical articulations of a modern city… One measures the distances that actually separate two regions of a city, distances that may have little relation with the physical distance between them… it is no longer a matter of precisely delineating stable continents, but of changing architecture and urbanism."

These two methods of spatial sensitization can be compared to the listening practices of soundwalks in the cases of Schafer and Neuhaus. Both attempt to learn, *see* in new light, qualities of lived experience which already exist but are either unnoticed or undocumented. Temporal relationships become of utmost importance, where Schafer calls for "knowledge of the rhythms and tempi of the natural soundscape," (Schafer, pg. 238) While Lefebvre, and consequently Situationist practices, believed that, "The relative and the absolute are reflections of one another: each always refers back to the other, and the same is true of space and time" (*The Production of Space*, pg. 181). Thus the goals of a dérive are to discover these space-time relationships, where borders, paths, regions are more so relative than absolute.

While not a dérive, Eric Paulos and Tom Jenkins' *Urban Probes* provides a contemporary example of spatial understanding in relation to computers, studying the relative qualities rather than absolute. With an urban computing agenda, *Urban Probes* provide an "approach for asking early questions about urban computing in order to focus and influence future urban research and application choices. It is also a useful
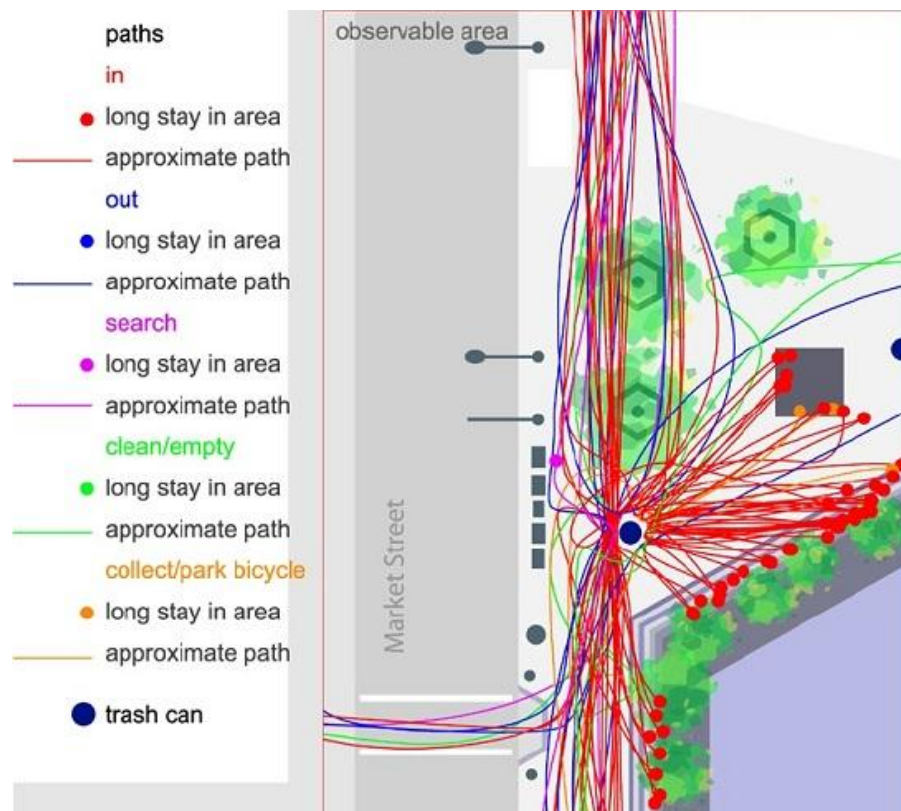
Figure 7 Paulos' Trash Can urban probe study of user's paths before, during, and after interaction with the trash can

methodology for conducting rapid urban application discovery and evaluation metrics" (Paulos, pg. 3). Essentially, *Urban Probes* is a method of studying specific aspects of urban space to understand the social implications of and applications for urban computing. Just as Lefebvre and the Situationists felt they needed to put their efforts into ideas closer

related to the body and experience, Paulos and Jenkins declare their interests in embracing "the full scope of urban life with all of its emotions and experiences." In their paper, Paulos and Jenkins describe an example of an urban probe: a trash can located in downtown San Francisco. Here they utilized a few methods for documenting the space surrounding the trashcan, including logging the patterns of trash entry and exit, tracking the movements in an out of the space, types of trash thrown in and taken out, and video footage of the immediate space surrounding the trashcan. They note, "We were able to extract many insights into the interrelationship between people, place, actions and trash. Plotting the paths taken by the people that interacted with the trashcan revealed that many of them stayed in the immediate are for several minutes or more." (Paulos, pg. 6) In context of the thesis the importance of *Urban Probes* is the way in which was analysis and documentation revealed complex and dynamic relationships between people, materials, space, and a singular mundane object. This relationship in terms of time and directionality can be seen in Figure 7.

Rhythmanalysis

The *Urban Probes* documentation reveals a rhythm of time and space surrounding a specific object. As Lefebvre describes, time has become a tool for dividing spatial functions: work, leisure, public, private, domestic, etc. As such, an analysis of everyday rhythms becomes an important method of studying the everyday, manifesting into the practice that Lefebvre coined, *Rhythmanalysis*. Rhythm as seen by Lefebvre imposes a political and capitalistic structure upon everyday life; it "appears as regulated time, governed by rational laws." Although he contrasts this governed time by claiming it is also "in contact with what is least rational in human being: the lived, the carnal, the body" (*Rhythmanalysis*, pg. 9). Rhythmanalysis is the study of everyday rhythms, the cyclical and linear processes of time and space and lived experience, social rhythms and governed rhythms. Along with rhythmanalysis comes the rhythmanalyst, who will "listen to the world, and above all to what are disdainfully called noises, which are said without meaning, and to murmurs, full of meaning – and finally he will listen to silences." (*Rhythmanalysis*, pg. 19) The rhythmanalyst studies *all* rhythms, focusing on the four types of rhythms as

described by Lefebvre: arrhythmia (a conflict or dissonance between two or more rhythms), polyrhythmia (the existence of multiple rhythms in consonance with one another), eurythmia (a discernible interaction between multiple rhythms), and isorhythmia (a syncing of rhythms).

Distraction enters the realm of rhythmanalysis as well, especially technological distraction. "You can leave the TV or radio on and go about your business, distractedly following the ocular and verbal chatter" (*Rhythmanalysis*, pg. 47). This can be paralleled once again with more modern forms of technological distraction. Cell phones for example are constantly seen as a distraction, even when hidden away in a bag or pocket they constantly ping the network looking for new messages from endless social networks, e-mails, text messages, and voicemail with both a tactile and audible feedback system of vibration and ringtone. To personify the cell phone for a moment, "Go about your day, but remember, I am always just a reach away!" Thus I began to look at spaces of transition, which are overwhelmed with distraction. These transitional spaces have qualities of temporary inhabitation, often spent distracted by advertising or media devices, and overarching schedule determining a global rhythm, and spaces which are visited by more or less the same people day to day; habitually encountered spaces. These spaces became interesting to the thesis because: architecturally they are, for the most part, ignored by their inhabitants, the rhythms imposed on the space govern both social and political life, and sonically they are rich in soundmarks and ambient soundscapes.

"Lefebvre emphasises the tendency for the rhythms of capitalism to pervade the everyday, commodifying previously untapped areas of quotidian experience, setting down the beats through which work and leisure proceed, and thus rendering the everyday banal and meaningless, an alienated realm" (Edensor, pg. 13). Thus, a study of rhythms opens up the potential for social intervention (partially the reason he was attracted to the Situationists), breaking the routinized divisions of time and reducing the banality of the everyday while increasing its potentials for creativity, chance, and pleasure. The following spaces were studied, in a context of rhythmanalysis, with a written and audio recorded documentation: hallway space in Knox Hall (Figure 8) on SUNY Buffalo's North campus, the platform of Buffalo's Main street subway station (Figure 9), and the Liberty Building in downtown Buffalo (Figure 19).

Rhythm Studies

The purpose behind a written and diagrammatic graphical documentation of these rhythmanalyses was to reveal a personal experience of rhythms in a place. By contrast, if the space were rigged with sensors that recorded people passing by against time, this idea of "rhythm" would be fundamentally different than a personal account of perceived rhythm(s). This method also allowed for a realization in the type of rhythms I was in fact interested in, without explicitly knowing it previous to the studies. Specific ideas of rhythm became of interest, reinforced through a methodology of personal experience. The following passages consist of excerpts taken from each rhythmanalysis of the above listed sites.

Knox Hall

Figure 8 Visual diagram describing the Knox Hall rhythmanalysis

Immediately I can hear the mechanical buzzing of a building – heating/cooling systems, vending machines.

There is a constant flow of people; a combination of conversation, swishing of winter jackets, and a tap-thump-smacking of footsteps: a flow that fluctuates rapidly.

The sound is rather warm, slight reverberation, along with the constant drone of the vending machines down below. A quiet presence of people can be heard from all over, reverberating into each other.

People preoccupied in their own business – eating while walking, listening to music, typing on a cell phone.

Every few minutes there is more noise than usual; it dissipates within a few seconds.

There are many different footstep sounds, more than I can describe in words.

The cacophony of footsteps fills the space.

There is almost complete silence, except for the buzz within the space.

A rhythm begins to become apparent in the space. It is not fast, but not too slow. It fluctuates between a normal state of a few people walking throughout and a state of flux with groups of

people talking loudly with each other, usually on the lower level. This flux occurs for only a minute at a time, if that long.

Subway Platform

Figure 9 Visual diagram describing the Subway platform rhythmanalysis

The mechanical screeches are overwhelming in this space. Buzz, whistle, ring, moan (cyclical), clattering, all at the same time.
The wind brushes very slowly through the tunnel
There is a very loud constant buzz, almost like a light bulb as it is about to burn out.
Some of the train sounds fade as other become more apparent, they cycle – taking turns.
The bells go off, the doors close, and the train rides away.
The wind is extreme now as the train screeches down the track, fading into the distance
The lights dim slightly, it is now almost completely silent except for one lady walking with a rolling walker
Two people in the space begin to talk, she sighs slowly
I can now hear the elevators in the distance without the overbearing sound of the waiting train
A few moments after the train leaves, a sound can be heard down the track. It is a mechanical sound. A drone in the distance can be heard, getting louder as the wind grows stronger
The drone gets louder, with rumbles-bangs-and thumps, it is climactic, the train rolls in, the breaks can be heard depressurizing
It stops, beeps, and the doors open. A large flow of people pour out of the train.
The rhythm thus far is not smooth; it is slow with bursts of extreme energy, and very calculated. It is very repetitive.

From the imagined perspective of the "rhythmanalyst", a few things stood out. It seemed like actions took precedence, and mostly actions with sonic consequences, repetitious rhythms were recorded, objects in space became highlighted as having their own rhythms. This led to a realization in relation to Lefebvre's *Rhythmanalysis*. I realized I was not interested in looking at everyday rhythms in terms of Lefebvre's entirety – political ties, cyclical rhythms of nature, and even a huge complexity of rhythms which surpass the immediate surroundings of the subjected space. What became important were the rhythms of spatial use, actions and interactions, which were produced as people moved through space –

such as the flow of people moving up and down a staircase. And even more importantly, the sonic consequences of spatial action and interaction, because after all it is an argument of the thesis that sound is a socially binding sensation as we can decipher many aspects of space just by *listening*. This can be seen as problematic according to Lefebvre's numerous descriptions of what rhythmanalysis actually is – warning a misinterpretation of movement for rhythm. Although, in critique of his text, the only example of a rhythmanalysis he provides reveals his focus on movements, interactions, and sound. In the chapter *Seen from the Window* Lefebvre depicts an urban scene looking down upon a street intersection in Paris which I will pull out a number of quotes from: "the attentive ear begins to separate out, to distinguish the sources, to bring them back together by perceiving interactions", "people produce completely different noises when the cars stop: feet and words", "after the red light, all of a sudden it's the bellowing charge of wild cats, big or small", "a second of silence and then it's the rush, the starting up of tens of cars, the rhythms of the old bangers speeding up as quickly as possible", "the noise that pierces the ear comes not from passers-by, but from the engines pushed to the limit when starting up." It can be seen that Lefebvre, despite his warnings, characterizes spatial rhythms largely in terms of acoustic rhythms as well as physical movements. Rather than viewing this as a reduction of Lefebvre's rhythmanalysis, this thesis claims that movement and acoustic rhythm are a central locus of spatial-social experience and understanding.

Interface

> "In the everyday world, our field of view is related to the way we are moving through the environment, and we have the opportunity to stop, look around, and so build a better picture of what is around us by exploration." (Dourish, pg. 119)

Methodologically, this thesis has regarded interface as an iterative process expanding upon ways of working with sound, technologies employed, and different contexts in which to intervene or create. While interfaces were built and explored further through first-hand experience, theoretical concepts on sound, interaction, and the everyday also provided frameworks for which interfaces were tested against. Unifying interface with the body and space essentially becomes a question of methods of interaction. In other words, how can we design a spatial computational interface which not only engages the body, but stimulates already present actions (such as making a fist, or running) and sensations (such as smell and hearing)? I would like to discuss concepts in which interfaces were born out of, and then explore iterations of interfaces designed throughout the thesis, some of which have already been discussed in other terms. First, phenomenology will be discussed in an architectural context, drawing on ideas of Juhani Pallasmaa. These ideas led to research in embodied interaction and tangible computing, which eventually came full circle setting *the everyday* as the site of intervention, bringing architectural space back into the thesis.

Phenomenology

With sound at its fore, this thesis has always been concerned with relating body and space through the senses. Our skin, the haptic sensory system, defines the interface between our interiority and the world's exteriority. Nothing has a more immediate feeling than the sense of touch. When we touch something we are physically connecting our body with another thing in the world. Touch is intimate; it is sensitive; it is pleasurable; it is painful. Materiality in an architectural space elicits tactile sensations, from fingertips to feet; the grain and cracks between floorboards are not only seen but felt as we move

through a house. The uneven brushes of paint on a wall, the beautiful imperfections, stimulate our sense of touch. "I felt an irresistible temptation to walk directly to the concrete wall and touch the velvety smoothness and temperature of its skin" (Pallasmaa, pg. 58), writes Pallasmaa, referring to Louis Khan's Salk Institute. One can sense the cycles of time as a space becomes heated and cooled as the rises and sets, causing trees to cast temporal shadows as clouds pass through the sky.

Throughout Pallasmaa's rhetoric, we can read the connections his arguments make between the body and the exterior world: social, geometrical, and material. "The tactile sense connects us with time and tradition: through impressions of touch we shake the hands of countless generations" (Pallasmaa, pg. 56). Or, "The sound of church bells echoing through the streets of a town makes us aware of our citizenship" (Pallasmaa, pg. 51). Architectural space, which ultimately includes *everyday* space, establishes a dynamic of interactions and interrelationships with time and people. There is an issue arising though, which stems from a technological repercussion: the relevance of designed space as having a significant role in the ways in which we conduct our day to day lives is diminishing. Not only are structures being designed with standardized, artificial, and sensationally bland materials for the sake of time and money (an issue which Lefebvre discusses quite frequently), but space itself as a physical *thing* is deteriorating. Along with the diminishing importance of immediate physical space is the deterioration of *the body* as playing an important role in our interactions with that space. Seen clearly in consumer technologies, "Pictures Under Glass [touch screens] is an interaction paradigm of permanent numbness. It's a Novocaine drip to the wrist. It denies our hands what they do best. And yet, it's the star player in every Vision Of The Future." As Bret Victor argues, new technologies are desensitizing our experience of the world, reducing tactility to a smooth glass surface with "pictures" underneath it. The visual representations presented on a touch screen are completely disconnected with the interface with which we interact.

Glove, which was one of the earliest studies of the thesis, attempted to address sensual relationships between body and space, touch and sound. In this study, I was trying to address both hearing a touch, relating them to one another and putting the user in a position where experience would reveal a new understanding of certain spaces, objects, and materials. Technologically speaking, the glove

studies used piezo microphones, which are contact microphones that pick-up sounds of internal material vibrations rather than vibrations in the air as with all other soun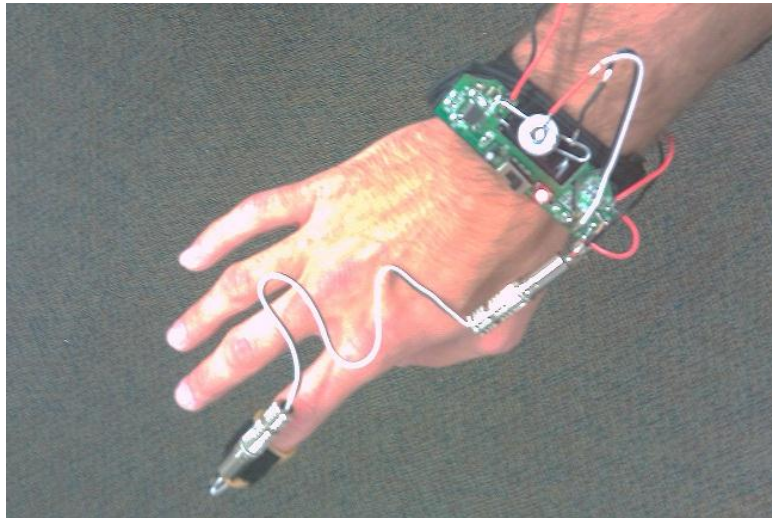ds. Therefore, intrinsic to the technology employed, there was an inherent relationship already established between material and sound; a one-to-one relationship. The design of the glove went through many phases, beginning actually without a glove at all. The first instantiation consisted of a rubber fingertip with a piezo microphone attached to it, and then

Figure 10 First "glove" prototype

wires traveled from the finger down to a wrist strap which housed a small amplifier. From the amplifier the device wearer could plug headphones in and listen to sounds being picked-up by the microphone. Aesthetically this looked like a polygraph device, even hinting at torture functions. Functionally (as I
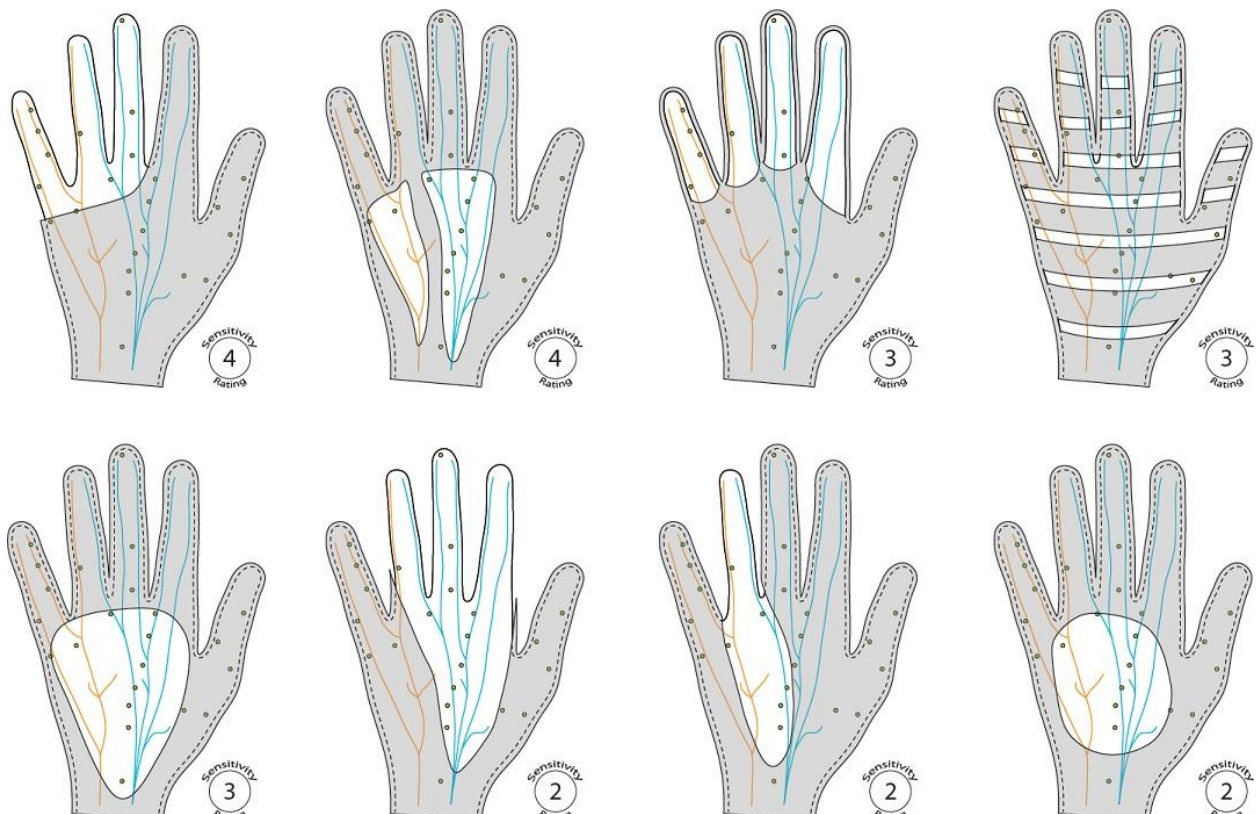

Figure 11 Drawings of each glove iteration that was tested for an increase in tactile sensitivity

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discovered later), leaving the entire hand exposed does not actually maximize sensitivity to touch. This realization to the latter point opened up a much more interesting interface study which addressed very minute details of the hand.

Drawing on a diagrammatic map of the main nerves running through the hand as well as acupuncture points, a series of voids and slices were cut out a number of gloves. These cuts were made specifically following different acupuncture point clusters and combinations of nerves. The intention here was to isolate known sensitive areas of the hand to further increase sensitivity. The results were tested, purely on a tactile level, and rated in terms of how sensitive touch became while wearing the different iterations. The resulting prototype consisted of a hand-sewn glove, with cuts made imposing a heightened sensitivity to touch, and piezo microphone and amplifier sewn into the glove. Experientially, using the device opened up amazing realizations about the "unheard" sounds of space. The ability to hear, in a great detail, the sound of running your hand across a concrete wall, or wooden door, or glass table became possible. And not only were the sounds produced interesting, but the experience of simultaneously *hearing* and *feeling* a material caused a state of never ending exploration; suddenly a coffee maker sounded like a jet taking off. This sensation can be related to an excerpt of Walter Benjamin's *The Work of Art in the Age of Mechanical Reproduction*, "With the close-up, space expands; with slow motion, movement is extended. The enlargement of a snapshot does not simply render more precise what in any case was visible, though unclear: it reveals entirely new structural formations of the subject. So, too, slow motion not only presents familiar qualities of movement but reveals in them entirely unknown ones."

Figure 12 Final glove prototype with sewn circuitry

Embodied Interaction

Stemming from phenomenological thought, how can interaction and interface design relate closer to the body? More importantly, how does this interaction relate to everyday space? These issues relate directly to concepts like ubiquitous computing, tangible computing, and embodied interaction. Where ubiquitous computing, as coined by Mark Weiser, attempts to place computers in a context related much more with everyday space, embodied interaction advances further by redefining the actual interface and redefining the methods of interaction – expanding context to be more than space but the body as well. As such, Paul Dourish describes embodied interaction as "the creation, manipulation, and sharing of meaning through engaged interaction with artifacts" (Dourish, pg. 126). *Meaning* implies the ways in which signs

and symbols may be navigated and acted upon in interactive systems. In other words, how does the representational structure of a system communicate its functionality to a user? Interaction design in these terms can then be understood as a three-part system: body, context, and interface. What action is being performed by the body, in what setting is this action taking place, and how is interaction communicated through the designed device or computer space? "Embodiment is about engaged action rather than disembodied cognition; it is about the particular rather than the abstract, practice rather than theory, directness rather than indirectness" (Dourish, pg. 189).

A look at one of the earliest models of tangible computing will clear up the type of interaction which is being described: Durell Bishop's *Marble Answering Machine* (1992). Briefly, this work contains marbles representing messages that flow along a track when a new message is received. Picking up a marble plays that message, and putting it back saves it, or moving it back to the top of the device erases the message. Rather than the conventional method of moving through buttons to skip ahead, repeat, or delete a voice message, there is a coupling of inherent actions of the body (picking an object up) and common objects (a marble) to allow the manipulation of a system. Moving from an abstract action of "pushing" a button, to an evolutionary learned action of using our hands to pick something up relates the interaction with a computation system directly to the body.

Figure 13 Reactable being performed by multiple people

Another project which embraces these ideas is the musical interface by Jorda, Alonsa, Geiger, and Kaltenbrunner, *The Reactable*. This interface relies on tangible objects, known in the field as "phicons" which can be placed on a digitally topped table. Each phicon is a representation to the computer system of a different type of instrument of audio manipulative effect, communicated to the user by

graphics both on the phicons themselves and animations portrayed on the digital surface. By placing phicons on the surface, moving them around, and twisting them, the user effectively affects different music generating algorithms by changing variables. Rather than abstract sliders, buttons, and icons on a computer screen as in standard methods, *The Reactable* (2003-present) establishes a connection between physical body-action-system interaction and changing/manipulation musical sounds. In embodied interaction terms, the interface communicates meaning through visual and sonic feedback systems where physical manipulation of the input system results in a direct change in the output system. Another interesting feature of this project is the multi-user potentials. As with traditional music, many people playing instruments together a results in a social feedback between musicians. Since the form is that of a table, there is an inherent opportunity for more than one person to use the interface at a time. The table becomes a social object for creating music.

Dourish describes, "Embodiment is a feature of interaction, not of technology. It does not distinguish one sort of interface from another – embodied from nonembodied… In general, embodiment is a question of how the technology is used (Dourish, pg. 188). Therefore, in terms of design, context and action come first with interface being designed to support the connection of the two. In the case of the *Glove* study, context was less of an actual place and more of a theoretical questioning of how to relate feeling and hearing materials. The glove as an interface option was chosen because of its common understanding of relating to the hand; hands are essentially our main form of *feeling* the world.

Drawing on methods employed in *The Reactable* and continuing the study of a touch-sound relationship, the *Music Table* was developed. Already discussed above, the *Music Table* consisted of a memory foam surface, pressure sensors, microphones, and tactile speakers. Not only was this device designed for the exploration of everyday sounds through a social creation and manipulation of music, it was designed specifically as an interface for embodied interaction. Memory foam urges the body to come into contact with it. With a built-in relationship to sleep and comfort, one cannot resist but squeeze the material. This as a material option for an interface imposes a type of interaction of pressing, squeezing, lying, and feeling. Interaction of this type greatly supports concepts of touch outlined above. To continue this idea, tactile speakers effectively turned any material they came in contact with into a speaker. As

users interacted with the table, sounds would emanate from the structure and foam surface and vibrate the whole table in a sonic-tactile feedback to the user's touch. Sound, touch, and material become unified as people gather around and play with the table. Creating an environment which enabled a shared experience of sound, resulting in a feedback between consumption and production of "music," was a critical aspect to the thesis at the time.

The social networking paradigm (Facebook, Twitter, Youtube) brings upon communities a blurred boundary of consumption and production. All of these sites would not exist if it were not for the user-base acting as the main source of content; content producers. In turn, that same user-base actively consumes the content in which they themselves are producing. Therefore, a question the thesis often posed was: "How do shared auditory and tactile experiences affect new forms of participation and embodied interaction?" To answer this question, grouping hearing and touch into a combined experience results in novel interface forms as well as embodied interactions; embodied because the interaction supported by the interface relates directly to qualities of the body. Ultimately a synesthetic relationship is established; sound is felt and feeling is heard. Furthermore, the direct recording of sound in the immediate environment supports a self-realization mode of listening; multiple people talking in the area would result in pieces of their

Figure 14 Rendering of the *Music Table* being performed by a communal group

conversation being included in the pool of looping sounds produced by the table. People inherently want to be a part of a shared environment, they want to be known, and recognize their influence in a larger scheme; hence the phrase, "15 minutes of fame." "Developing an appreciation for how our own actions

are reflected in the information space helps us to understand how a particular state of affairs might be the result of a sequence of activities by someone else" (Dourish, pg. 165).

While addressing the body – its senses and ways of acting – as well as social ideas of production and consumption The *Music Table* lacked spatial context, it became an object created in abstract space with conflicting ideas about site. While imagined to be sited in an outdoor public space, this typology was never integrated into the design, leaving a prototype which felt very much like a museum kiosk. The conflict of ideas of site was due to this absence of site while treating the medium of sound quite specifically: tied to everyday spatially and socially constructed sounds. Sound clips which were used for loops in the prototype were often sounds of people talking, doors slamming, cars starting, air conditioners running. Therefore, the qualities of sounds were very much related to people acting out in space. The sounds were of the everyday, while the interface was completely foreign. This meant that, in terms of interface and interaction, the *Music Table* was lacking one very significant aspect of embodiment according to Dourish. "Designers of interactive systems have increasingly come to understand that interaction is intimately connected with the settings in which it occurs" (Dourish, pg. 19).

Everyday Architecture as Interface

With *site* as an ongoing issue, concepts of the everyday became very relevant. Sounds of the everyday, which were always a central focus, were seen as being produced as consequences of moving through and interacting with architecture. "In the real world, where the artifacts through which interaction is conducted are directly embodied in the everyday environment, these [work tasks, artifacts, and setting] are all manifested alongside each other, inseparably" (Dourish, pg. 20). To pose an idea: Architecture is the epitome of embodied interaction. Every interface within an architectural space conveys meaning related specifically to the body; all design revolves around the scale of the body, from the largest aspect (the body in its entirety) to the smallest (a hand). Furthermore, every interaction with space creates a sound embodying the action and the materials involved. For example, a door being shut reveals the speed at which a person closes the door as well as if the door is a sliding door, made of wood or metal, and so

on. "We feel pleasure and protection when the body discovers its resonance in space" (Pallasmaa, pg, 67).

An early example of an interactive work which adheres to an idea of architectural interface is Christopher Janney's *Soundstair* (1978). Consisting of photocells (light sensors), reflectors, and speakers attached to the steps and railings of a staircase, *Soundstair* turns an ordinary staircase into a musical instrument. The technology relies on photocells to s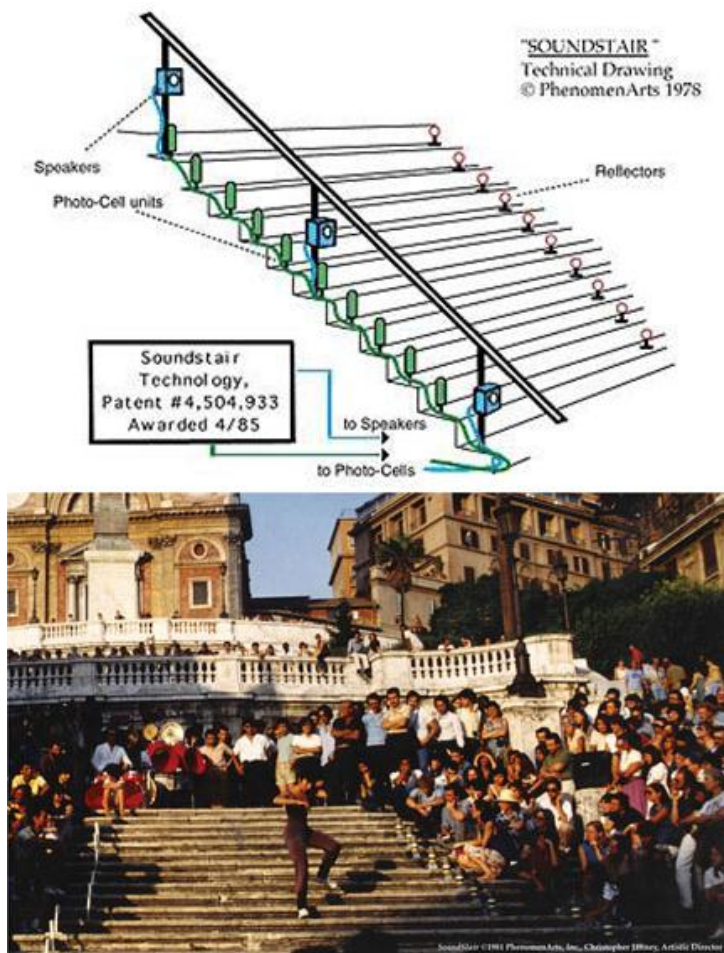ense movement on the stairs and dynamically produces music from speakers attached to the railing. The interaction is encouraged through a discovery of the musical consequences of moving through a staircase, provoking people to remain on the staircase and move around in ways unconventional to the function of a staircase. The method of inviting interaction through discovery is similar to that of Max Neuhaus. The sounds utilized in *Soundstair* revolved around piano-like tones which increased and decreased in pitch in relation to the elevation changes of the staircase. In this sense, the "musical" side of this project was fairly one-dimensional with no real thought-provoking questions about the sound

Figure 15 Top: *Soundstair* technology diagram Bottom: *Soundstair* beign performed

itself. Regardless, the method of interaction was very interesting and provoked people to play with an object of space in ways they never would have done before.

Hyun-Yeul Lee's *Audio Bench* is a more recent work dealing with ideas of everyday objects as audio interface. In this work Lee designed a bench equipped with audio processing equipment, speakers,

microphones, and IR sensors which *listens* to the immediate soundscape. Through a system of sensing people in the area and listening to the soundscape, the bench records samples of sound throughout the day. By sensing people the bench would then playback time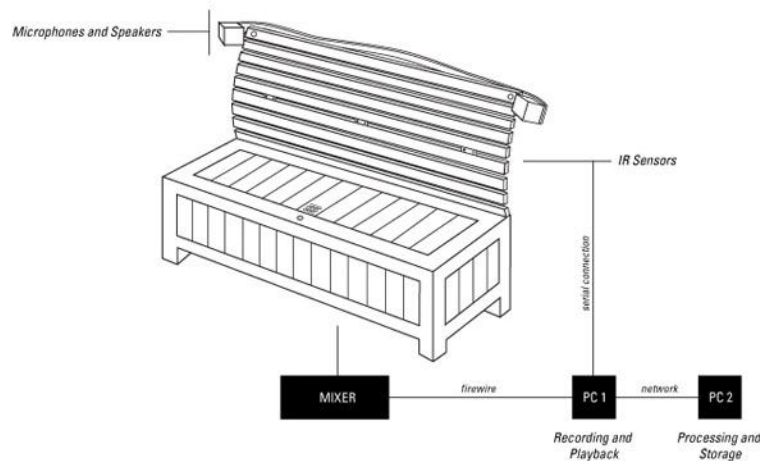-specific sounds such that a historical relationship would be made through playback consequently narrating a story through sound. "The design of storied objects is bounded by the object's point-of-view; objects have capabilities to record their experience, look back upon the captured records and reconfigure the recordings in order to re-play what actually happened" (Lee). While the project focuses on storied objects – audio narratives in a first person point-of-view – the work engages "users" by disguising itself as an everyday object, yet becomes activated and responds out of the norm upon interaction. This idea of disguise was an aesthetic I became very much interested in and exploring further.

Figure 16 Technical diagram of *Audio Bench*

A point of departure between a work like *Audio Bench* and investigations I pursued in terms of everyday architecture interfaces entails a desire to embed sensing/audio technologies into already existing spaces and objects rather than designing and building my own like Lee's bench. *Audio Bugs* live on existing objects in space such as chairs, columns, doors, and tables. Still with ideas of a touch/sound combination, tactile speakers were attached to these objects turning them into resonating speakers.
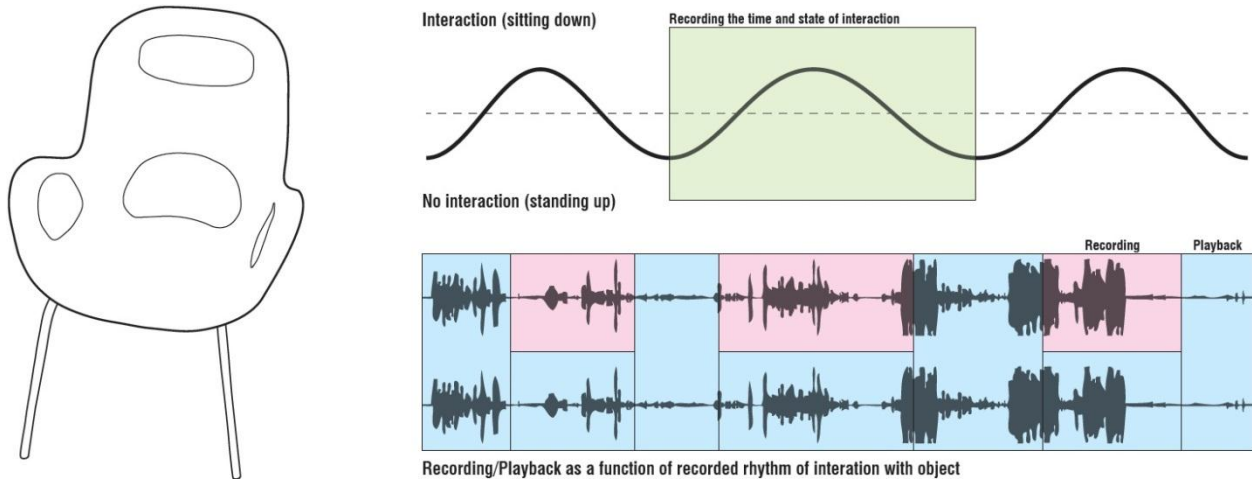
Figure 17 *Audio Bugs* diagram of rhythm analysis and audio processing functions

Although unrealized, the audio bugs would fill up a space hidden from view and record sounds in response to interaction. For example, if someone were to rest their hand on or brush up against a column, that *bug* may begin recording an audio sample. Recorded samples would then be played back rhythmically according to temporal recordings (data not sound) in interaction. The main ideas behind the *Audio Bugs* were to address ideas of body, hearing and touching, rely on sounds of interaction, hide interaction within already existing forms, both materiality and functionality, and respond to and disrupt rhythms recorded in the space. Through this intervention, a space which was deemed transitory resting in the background to its everyday inhabitants would become significant through sound and an imposition of manipulated rhythms. As Lefebvre describes, "We are only conscious of most of our rhythms when we begin to suffer from some irregularity" (*Rhythmanalysis*, pg. 77). A discovery of the new interactivity between everyday objects and their normative modes of interaction would reveal and already existing potential to enjoy the mundane environments in which we inhabit and pass through every day. An important aspect to *Audio Bugs* was the interactivity between the objects as well; they became autonomous in some respects. The networking of these objects was a way to gather a globalized soundscape which could be manipulated and transformed as a whole as well as singularly, it also opened possibilities for a level of reflexivity between the objects both in terms of rhythms of interaction and the sounds recorded/played-back. This would add complexity to the system in terms of functionality (sensing rhythms and recording periods for sound) and audio playback.

In the end, *Audio Bugs* lacked site specificity, not only site as an overall space, but site in terms of the objects themselves. It was proposed that the space for this would be Knox Hall on SUNY at Buffalo's north campus, but the goal of embedding the "interactive" technology as hidden parts of already existing objects resulted in a missed opportunity to design this intervention as very contextual with material and formal relationships to the objects and space in which it is sited. Instead of relying on an aesthetic of out-of-sight, removing all sensibility for design, the thesis took on a form of "hidden in plain sight." This means that the methods of attaching to existing objects could be more closely tied to the qualities of the overall space and

Figure 18 Prototype of an *Audio Bug*

the objects themselves as well as an aesthetic of being visible but resting in between background and foreground. The intended experience of this aesthetic would be one where unknowing participants may or may not see the intervention, but upon discovery it would provoke questioning and probing further to understand the interactivity between an everyday object and the newly ascribed functionality embedded within it. A new site was also to be selected with more specific intentionality coinciding with the new aesthetic direction.

Rhythmsynthesis: an event

> "Intervention through rhythm has a goal, an objective: to strengthen or re-establish eurhythmia."
>
> (*Rhythmanalysis*, pg. 68)

As a title, *Rhythmsynthesis* directly comes from Lefebvre's *Rhythmanalysis*. Where Lefebvre saw this act as a means for learning and discovering spatial, social, political rhythms through analyzing and writing, *Rhythmsynthesis* had an approach of exposing, synthesizing, and playing with these rhythms through an interactive intervention looking towards practices of the Situationists. First, as with Knox Hall and the Main Street Subway Station, a rhythmanalysis was in order. The following consists of excerpts of a rhythmanalysis performed at Buffalo's Liberty Building where the thesis would ultimately become sited.

Figure 19 Visual diagram describing the rhythmanalysis of the Liberty Building

The space is rather still, with quick moments of people passing by.

You can hear footsteps and the; sounds of people and metal

Elevator door opens and man walks out, quickly another elevator, and more people walk out

As the revolving door moves a gust of wind enters the space, and a man slowly shuffles up the stairs

All of this happens quickly, within a few minutes

Elevators seem to open randomly with people walking out

To and from the bank, from both entrances, the main entrance provides a longer linear path for people

There seems to be equilibrium in the space. As two people enter, two more leave, either from the bank of from the elevators

There is periodic downtime. This doesn't last long

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They shuffle into elevators

Every sound in the space echoes. Clicks and pops can be heard, as well as an airy drone

Many people move quickly through the space, the elevators seem to explode, and a rush of people walk down the stairs with a consequent explosion of the revolving doors

The space quiets quickly with one woman left waiting for an elevator

Every now and then you can hear the security guard radio

The woman still waits for the elevator as a few people move through the linear space

Continuing with the idea that this thesis is concerned with materials, objects, and rhythms of interactions in space, and the consequent sounds that are produced, the Liberty Building was chosen as a the installation site. Brass detailing can be seen throughout the entire lobby space of the building which creates a visual rhythm as eyes glance from end to end. Sonically, the elevators are the most prominent sounds, but not overpowering the richness of the soundscape within the lobby. Revolving doors can be heard constantly as well as people going up and down stairs and knocking/brushing against the brass railings. Spatially, there is a long linear path bordered by elevators with a cove of stairs and revolving doors branching off towards one

Figure 20 Diagrammatic isolation of interation elements in the Liberty Building

end of the hall. Coinciding with Lefebvre's thoughts on rhythms, the Liberty Building is a commercial building, providing office space for a variety of businesses. As well, two banks sit at each end of the lobby. Therefore, the entire space cycles through the day based on business hours, people inhabit the space only for business and commerce. The time of "labor" as Lefebvre calls it, dictates the overarching rhythms of the space. The lobby itself is a transitional space, acting only as a means for pushing people through further inside the building or back outside.

Local Amplification: inhabitants

It has been established that a building, and its elements, are under consideration in this thesis as *the* interface for interacting with a sound-computer system. Although, as seen in *Audio Bugs*, something has to be done in order for this to happen, such as attaching hardware to objects. As discussed, simply attaching sensors to a chair, for example, does not suffice as an interesting architectural/artistic intervention; it lacks specificity and ignores design sensibility. Therefore, looking specifically at the materials inherent to the space of the Liberty Building would allow a design which addressed the building spatially and materially. Brass can be found all throughout the interior of the building; it is hard, opaque, glossy, and cold to the touch. By contrast, a material such as rubber inherits almost the exact opposite qualities: soft, translucent, glossy or dull, and generally maintains room temperature. As well, rubber

Figure 21 Rubber inhabitant prototype testing in studio

invites a sensation to *touch* similar to the memory foam seen in the *Music Table*. Visually, the contrasting qualities of rubber to brass would essentially allow the installation to be *seen* but rest in between foreground and background of sight. Another interesting feature of rubber is the friction it produces, allowing one to stick a piece of rubber to another material temporarily. The temporary adhesion properties of rubber, tectonically speaking, were very attractive, since the installation of *Rhythmsynthesis* in the Liberty Building was going to be a temporary installation. In the end, rubber was chosen as the material to design with for attaching sensors/audio equipment to the building.
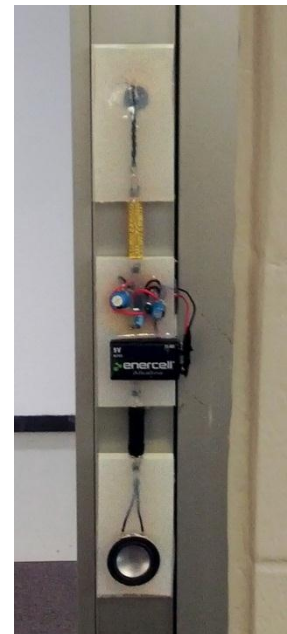
Figure 22 Original Inhabitant design prototype

Stemming from technical issues, the interaction design dropped ideas of networking and communication between devices as seen in *Audio Bugs*. As a result, the installation was broken into two parts: local "inhabitants" – small objects that loiter within space and on available surfaces – and global synthesis. These local "inhabitants" constructed out of rubber were seen as instruments that would stick

onto objects in the space and transform the building into a musical Figure 23 Inhabitatnt pressed against railing in the Liberty Building

instrument. As a material to be temporarily attached, the rubber units were designed with circular cut-outs on the bottom, this had two distinct functions. The first was to function as a suction cup, allowing the rubber units to be attached through pressure to brass surfaces, creating a very strong connection. The second function was to press a piezo microphone against the attaching surface as tightly as possibly. Therefore, within the circular cut-out was a piezo microphone embedded into the mold. When the rubber unit was pressed against a surface, the suction cup helped the unit tightly while pressing the microphone right up against the surface allowing the piezo to pick-up maximum sound. Connected to the rubber inhabitants would be an amplifier and speaker. Initially, the 3 components of the inhabitants – rubber,

amplifier, speaker – were all constructed out of rubber; embedding different components inside of rubber casts. Casting a speaker into rubber turned out to be a counterproductive act, completely deadening its ability to project sound.
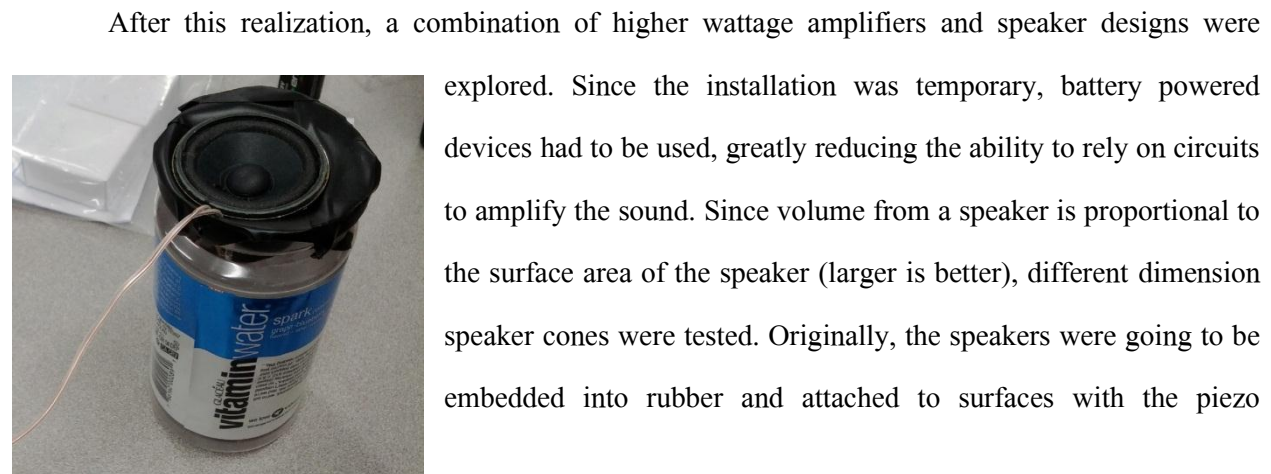
After this realization, a combination of higher wattage amplifiers and speaker designs were explored. Since the installation was temporary, battery powered devices had to be used, greatly reducing the ability to rely on circuits to amplify the sound. Since volume from a speaker is proportional to the surface area of the speaker (larger is better), different dimension speaker cones were tested. Originally, the speakers were going to be embedded into rubber and attached to surfaces with the piezo

Figure 24 Vitamin water speaker cabinet

microphone units, but since technically this would not be feasible (not enough surface area) a 6" speaker cone was chosen for a maximum amplification while maintaining a small dimension. While technically the speakers needed to maximize sound projection, aesthetically the design of the speakers were to sit within a blurred boundary of conscious and unconscious vision; foreground and background. Different options for a speaker cabinet were then explored: brass enclosures to compliment the brass material in the lobby, coffee cups and plastic water bottles were repurposed, and

glass jars. Brass ended up being a much too expensive option as well as going against all design intentions in using rubber for the inhabitant's material. After deciding on a 6" speaker, coffee cups and water bottles were no longer viable; this option also left the space looking dirty with "garbage" lying around rather than trying to blend into the environment – both existing and

Figure 25 Final glass jar speaker design

designed. Glass jars became interesting because of their transparency while sonically provided a unique coloring of the sound produced by the speakers. Visually, a relationship was established between brass, rubber, and glass with each respectively becoming more transparent. The connection process went as followed: brass building material to brass piezo microphone, embedded inside a translucent rubber unit partially displaying wires running inside the mold, connected to an amplifier sitting clearly inside the glass jar, and then connected to the speaker resting on top of the jar. This created a progression that became increasingly transparent visually, technically, and sonically.
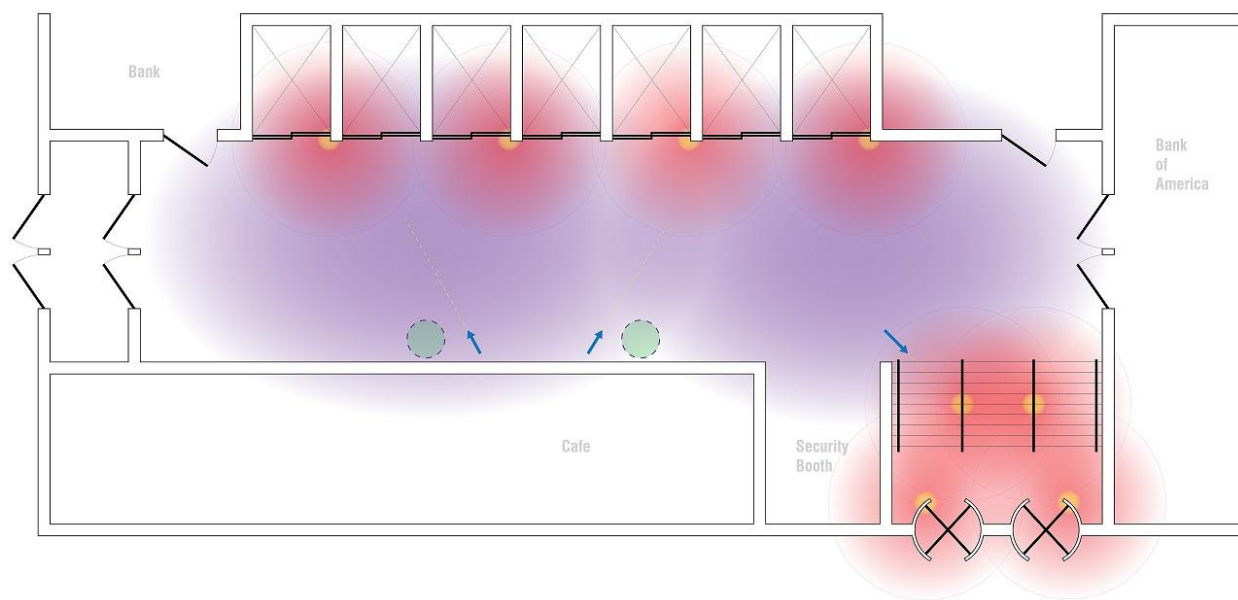

Figure 26 Spatial composition of Local Amplification

The goal of the local amplification through rubber and glass inhabitants was to directly expose a sonic rhythm within the use of the Liberty Building lobby. It would also communicate directly to the fact that interacting with a space produces sounds, sounds that can be controlled once realized. It was hoped that through this realization people would begin to play with the building and consequently create rhythmic scores either alone or with other people. As a result the rhythms of interaction which exist in the space, ruled by time of work, would become immediately disrupted and manipulated – transforming a building occupant to a participant; a content producer. Adding sonic complexity to this direct amplification, microphones were arranged around the lobby which pick-up all the amplified sounds of interaction.

Global Synthesis

This local amplification method did not actually involve any computation, unlike the networked communication between objects in the *Audio Bugs*. As in Max Neuhaus projects like *Times Square*, there was a desire to implement a generative audio synthesis which would be responsive to dynamic qualities of the space. This synthesis relied on microphones arranged in the lobby to pick up sounds amplified by the "inhabitants," sounds of conversation, and ambient drones which were produced by the reverberation of sounds within the space. Using the audio environment of MaxMSP, these three types of sounds were used as inputs, processed, and synthesized for a global sound output. The overall synthesis was intended to sit in between background noise and sound which one cannot help but listen to. Similar to the visual intentions, this would position the sounds in a state of discovery, where only the conscious ear would hear it. In combination with the local amplification, which sonically was more foreground sound, the global synthesis reinforces an interaction of discovery, and once realized would encourage play and further exploration of the system.

Ideas of notation and composition became apparent while addressing methods of manipulating audio. Before a true method of synthesis could be established, there were a few iterations made in notating the intentions of the synthesis using experimental notation examples as references. Rather than notating specific sounds or actions though, these scores portrayed a process of working with sound. There is a fundamental difference between this and referenced scores, where referenced scores communicate to a performer how to play an instrument or multiple instruments. While the scores I produced were outlining methods for synthesis, rather than conducting an instrument, they were conducting a process. Regardless, the scores provided a method for designing, with specific intentionality, a process of audio manipulation. They helped contain the never-ending possibilities of computation and maintained a clear working method for sound.
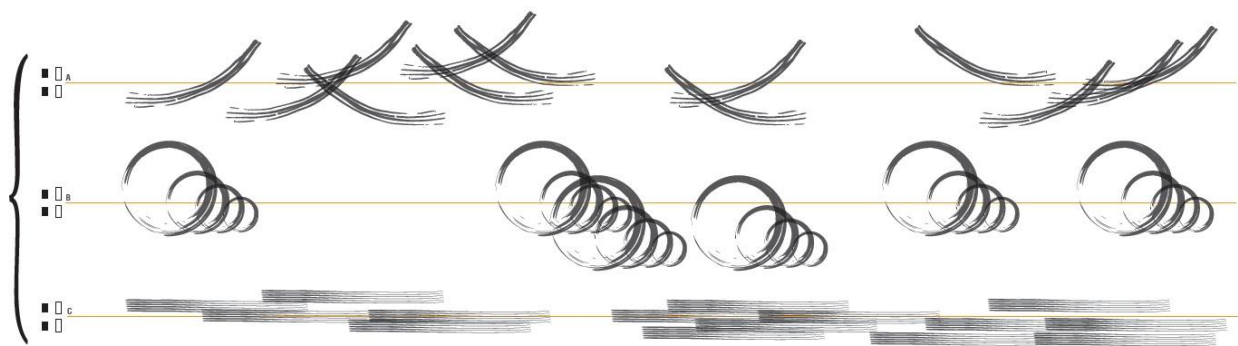
Figure 227 Rhythmsynthesis graphical score, initial diagram
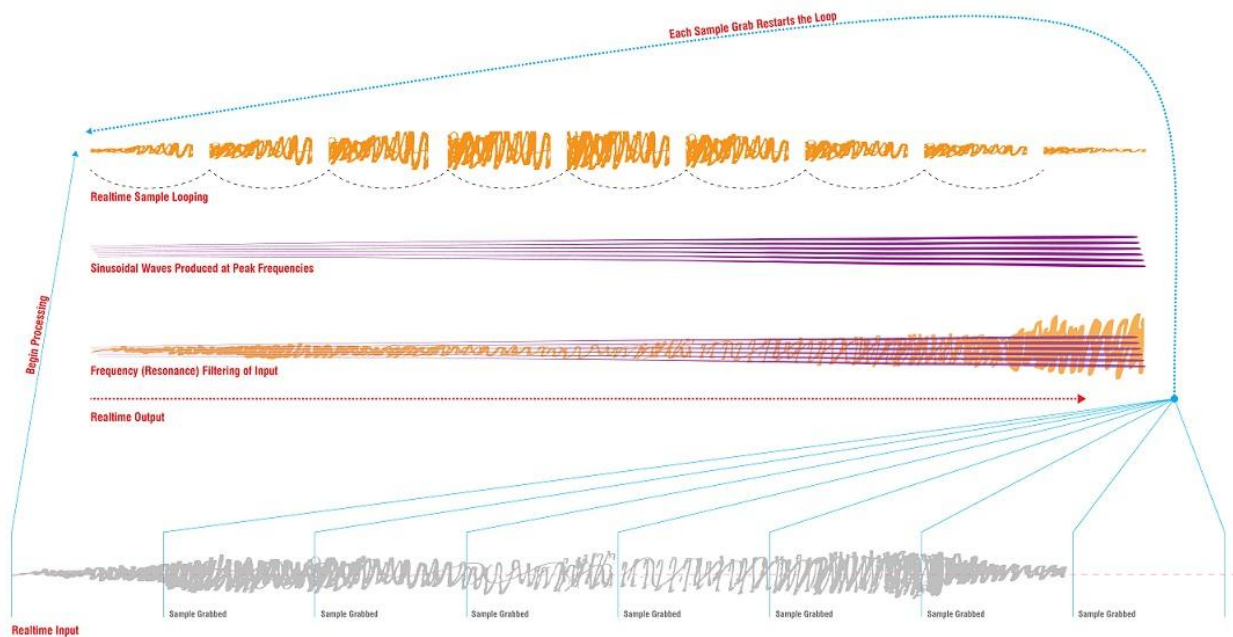
Figure 238 Rhythmsynthesis graphical score, final diagram

The global synthesis attempts to reinforce an existing ambiance of the space as well as expose new rhythms through both a passive and an aggressive process. The passive process takes a sample of real-time microphone input and analyzes the sample for peak frequencies. These frequencies are turned into four different tones which flow into the space, first fading in and then fading out. The purpose of the fade

is to reduce the attack and release qualities of the sounds; it allows the output to fill the space slowly and gradually. The aggressive process records a two second clip each time a sample is taken in real-time, this clip is then looped for one minute accompanied by the new tones generated by the passive audio process. This one minute process would then restart at the end of the minute, continuously restarting at the end of each minute. Since the microphones picked up sounds of people talking in the space, during the "aggressive" process of synthesis, past conversations would suddenly be reanimated within the space. Overall, an ambient mixture of past interactions and current frequency resonances were mapped onto the lobby structuring both a melody and rhythm synthesis of sounds which already existed and computer processing.

Critical Assessment

On April 27th *Rhythmsynthesis* was installed, experienced, and presented at the Liberty Building in downtown Buffalo. Among the audience were the following critics: Omar Khan, Jordan Geiger (committee chair), Mark Shepard, Erik Conrad (committee member), Jennifer Oakley, Nicholas Bruscia, Curt Gambetta, Philip Beesley, Mike Silver, and Etienne Turpin. Teri Rueb (committee chair) was unable to attend the final event due to sabbatical travel and lack of internet access at the Liberty Building for video calling. The presentation and the project was the first time it was set up in its entirety. Previously, only portions of the project were installed for testing purposes, never once being heard and experienced as a whole. I would like to preface the following comments with that point. This issue was due to its temporary nature because of the site that was chosen and the project would have succeeded on many levels had it been installed more times or more permanently. While eventually allowing the installation, the Liberty Building owners were reluctant to give permission to install the project there.

To outline the event, critics arrived separately and wandered around the space until the event official began. Upon beginning, I simply announced that I invite the critics to explore the installation for about twenty minutes, and then I will gather everyone into one area of the lobby for a formal presentation. The event for this time period was very informal and irregular, especially in the context of an architecture presentation. Once the exploration was finished, we gathered on the lower level of the lobby by the staircase and I presented the project in a more traditional way. The presentation was often interrupted though by people walking by and producing sounds through the building, clattering up the staircase and knocking into the railings. This was an interesting occurrence which I have only come to understand now, which addresses an observation Mike Silver had about the event. He talked about how this particular event, in the context of an architecture review, transformed the confrontation between the student and critic, being asked to come into a space away from the school they were invited to and actually test out the *real* project. I find this to be very interesting and can relate it to an unintentional realization of the thesis. If we look at the architecture review as an "everyday" space and event, then pulling it out of its context and usual spaces, then it would only make sense that it would become both disrupted and transformed. From this perspective, the act of manipulating the review format works very well for the

thesis conceptually, yet concretely it is an unfortunate failure because, as Jordan Geiger put it, "this event is not for us [the critics]." The event was for the everyday inhabitants of the space and opening it to a group of critics actually begins to undermine the intentions of the piece.

This point was a common topic for the critic's comments. Mark Shepard pointed out that it was hard for him to experience the work and not think about being at a review for a sound installation. Etienne Turpin criticized a comment I had made about the installation being successful because the "reviewers began to play with the space in unconventional ways." He claimed that by stating this, I am doing injustice to the work itself and the concepts behind its existence. On the one hand, I agree with him. It is undermining to say that I was content with the fact that critics played with the piece, because in the end the setting of critics and a review – and even an art installation – is not how the project should be experienced. This work should be experienced in situations similar to Max Neuhaus' installations, unannounced, unmarked, in everyday settings. On the other hand though, it was extremely successful because I got a chance to hear the work with participation from other people (even if they were critics) in the space it was meant to be installed in. Conceptually speaking, it did not address issues of everyday rhythms to them, but at the same time, in Mark Shepards words, "the architecture gets performed in ways it wasn't originally designed for through your provocation. It produces a different kind of patterning to the way the space is normally occupied." In this sense, the installation was successful, regardless of who was actually "performing" the architecture. Even so, Etienne Turpin's critique of the work being presented in a misleading context holds true, and in regards to that, I think continuing the project further and installing it more permanently would be exponentially beneficial. It would allow the piece to be experienced by people who inhabit the space every day and can analyze its affect more precisely.

Related to the issue of context, Turpin also brought up questions of documentation. How do you document this work such that does not just show us sitting here talking about the work? Does video work? Do you simply show people what it sounded like? How does documentation begin to address the same issues that the thesis is trying to address? Once again it becomes an issue of event installation rather than "everyday" installation. I would like to explore this question of documentation further in a more permanent form of installation. Without that, I am limited to the documentation methods employed during

the event itself: video camera, still camera, and audio recording. While it is not idea, through editing it is possible to remove the aspect of a formal review and communicate a space in which people are exploring an intervention producing sounds from space. In this sense, it is literally a documentation of *what happened* during the installation, but it loses the formal critique aspect which was seen as hurting the event. Also related to documentation, Curt Gambetta asked what the success and failures of the installation. Equally Mark Shepard asked how the installation can get back to ideas of rhythm analysis and communicate new rhythms generated in the space as a consequence of the installation.

There were critiques from Mark Shepard and Philip Beesley which were concerned with the relationship between both methods of sound treatment (local versus global). Shepard suggested a further study of how the two sound methods can play with each other; the sharp, jarring, and immediate sounds of the contact microphones and the slow, rhythmic cycling of the global MaxMSP synthesis. Mike Silver referred to this global synthesis as slowing down activities and stretching them out over time. Sonically, Beesely called the synthesis approximate, expressing a desire to engage with it outside of affecting only the sound that is played back. In response to both Shepard's and Beesley's comments, the project needs to get over a technical hurdle which would result in the networking of objects. Networking these objects would allow them to be treated as sensors and singular inputs to the overall system. Therefore, banging on a railing wouldn't just result in an immediate sound amplification but cause a specific affect to the system globally. This would allow a person to interact with parts of the building and hear their effects on the overall system, suggesting an engagement similar the Beesley's desires. If the objects were networked and become part of a larger sensing system, the relationship between the two methods brought up by Shepard would become clearer. Although in defense of the current method of local amplification and global synthesis, the two methods were designed to relate to each other in contrasting aesthetics. While the local amplification is sudden, short in duration, loud, and sharp, the global synthesis was designed to be slow, wave through cycles, gradually increase and decrease in volume, and sound more ambient. In this scheme, people could immediate interact, misuse, and explore specific parts of the building which make sounds while at the same time they could dwell in the space and slowly ponder the soundscape as the global synthesis proceeds through its sound analysis, processing, and output. I think that designing the

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objects to be networked and act as sensors is a desirable effect, but I also think that this contrasting relationship between two methods of sound processing is a successful aspect of the project; Beesley agreed with this point. He thought the contrast of something resonating and something stuttering was successful but needed to be addressed with more precision.

While Beesely suggested a more precise treatment of sound, he also felt the visual relationship between the intervention and the space it was installed in could be more precise. He claimed that my "elements" (the rubber inhabitants) only amplified a narrow band of objects, leaving an ambiguous relationship with the place. He argued that there was a generic quality to the rubber inhabitants. To that point, I had argued that they were designed with a certain level of generic design. They were intentionally designed to be appropriated in many different types of spaces, even though materially they were designed specifically for the Liberty Building. Beesely pointed out that the way I was approaching the design could benefit from asking questions that a normal building renovator would ask, "shall I restore, shall I shift, shall I add?" He agrees that there is an intentional generic quality to the design, not arguing that it was unintentional, but feels the relationship to the place itself could be more precise; similar to the relationship suggested in sound. Beesley comments that there is a lot more refinement and development in the interface and its relationship with the space. I cannot help but ascertain that Beesely may have misinterpreted the aesthetic (visual and aural) intentionality of the project. The work was very carefully designed to uncomfortably sit on the boundary of consciousness and unconsciousness; hidden in plain sight. This may have left the aesthetic as feeling approximate, but it was through interacting with the system that it becomes precise and relatable to the space. This, once again, could be a problem due to the fact that the project was never experienced in an everyday environment, only being installed during the review.

Another comment made, relating less to the thesis as an installation, by Curt Gambetta was the viability of released the project as a "technique." This is a very interesting idea both sonically and spatially in terms of rhythmanalysis. Can the project as a score be released as well as instructions for constructing the rubber inhabitants and their amplification system? This would allow the project to expand geographically and test multiple sites at a time. Musically, it would benefit from a more potent

notational system for creating a score. As mentioned in the previous section, the score used in the project provided a process for which to organize the sound synthesis. Could a notational score be produced though which would communicate an instructional way to approach the sound synthesis, both musically and spatially?

Conclusion

Rhythmsynthesis attempts to draw on various fields of study related to sound, interaction, and place, often through a lens of close attentiveness to mundane qualities. *Listening* to space reveals a vastly rich soundscape of everyday life progressing through the day. We are tied to space through hearing our surroundings. Likewise, we become intimately aware of the space around us through touching with our skin. Of the five senses described *traditional* senses – sight, taste, smell, touch, and hearing – the only two which cannot be "shut off" are hearing and touching. One can close one's eyes, nose, and mouth to turn off these senses. But anyone will know who has been to a concert for example, closing your ears does not work the same way as closing your eyes. It can be said then, this thesis, at its core, is concerned with relating people to each other and their surrounding environment through *feeling* and *listening*. I use the terms feeling and listening rather than touching and hearing because they imply a more attentive quality to the senses, actively sensing rather than passively receiving.

Bringing in ideas of the everyday and rhythmanalysis from Lefebvre provided the thesis with a temporal grounding to space and interaction. It helped guide the thesis to an understanding of space which sees the quotidian as interesting, while critically evaluating contemporary uses of technology as causing an increasing attitude of the public to disregard our surroundings; replaced by mobile computing. Lefebvre's philosophies related ideas of everyday *space* with existing ideas I had and wanted to pursue on everyday *sounds*.

Attempting to stay as related to common, mundane space and sound, Dourish's ideas on embodied interaction – stemming from ubiquitous computing and tangible computing – provided a background for relating computer interfaces and interaction design *directly* to the body. This allowed for a phenomenological exploration of interface design which surpasses traditional methods of human-computer interaction. Studies yielded projects such as the *Glove* and the *Music Table*, as well as in depth experimentation with technologies such as piezo microphones and tactile speakers – both relying on touch and sound equally.

The thesis saw iterations[3] throughout research, manifested mainly as interface designs trying to address various issues of the body-space relationship which were ultimately established through Lefebvre and Dourish respectively. Interactions with buildings which occur almost invisibly (using a railing to help walk up stairs) and their consequent produced sounds became the subject of design for the thesis. The thesis as a physical creation attempted to repurpose building elements as interfaces for both disrupting rhythms of spatial use and musical exploration of everyday sounds. This resulted in a few successes and a few failures as outlined in the above section.

In the end, can moments of everyday rhythms – going to work from 9am to 5pm every day, walking past the same column, the same staircase, the same elevator every day, traveling on the same road to and from place to place every day – be disrupted by small interventions such as attaching a microphone and speaker to a staircase or doorknob? By bringing a sound such as a door closing into the foreground, singling it out, and making people aware of its existence in space, can we suggest a more attentive approach to going about your day to day life? Even though the thesis never made it to a long term everyday context as initially planned, the temporary installation points to a positive result in terms of answering these questions. Erik Conrad pointed out that even though the microphones attached to the revolving doors in the Liberty Building did not sufficiently amplify the sounds that were produced by using the door, it was clear that more people cycled through the door and listened to the sounds it made than ever before. It is moments like this that the thesis is trying to create, a method for bringing our everyday environment closer to our bodies and establish an intimate relationship which is being detached by modern computing technologies. The next step is to actually implement mobile computing technologies in an attempt to use them for this very purpose. This will make us aware of our relationship to these technologies and the contexts in which we use them.

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[3] This work revealed a method of working through iterative prototyping and diagramming a complex problem, one that, as in the case of *Rhythmanalysis,* has no such visual or material presence.

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