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nowhere

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Overview

This thesis is divided into two sections: a research section and a project description. In the research section, as the background of the project, I discuss topics around the sound environment and the mobile computer. In the project description, I write about my two artworks using mobile computers, “h&s” and “2.4GHz Scape”. Or, this is the bricolage of my thoughts, projects and activities of the 16 weeks under the name of Master Degree Thesis.
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1. Introduction

1.1 Motivation and Personal Background

Now here is nowhere. Now here is everywhere.

Recording and mobile technology produces a fragmentation of time and space. The technology is still growing and affecting social and cultural matters. There are many possibilities for investigating the future sound environment and culture. For my thesis, I will research the soundscape of the mobile computer era and examine the possibility of new vocabularies for sound art using mobile computers.

What is a mobile computer? They are small, portable, often networked computers such as PDAs, mobile phones or PSPs. The functions of mobile computers tend to grow based on consumer needs. Now, your mobile phone, the most typical mobile computer, is not just a phone: It is a game player, a digital camera, a PDA, a web browser, and an iPod. "These little devices are constant companions and extensions of identity, worn on or close to the body, creating sonic cocoons, private communication spaces, or interfacing with the urban environment." (Ito 2005b) Now, the mobile phone is more powerful than the Macintosh Classic, the home computer of 80s. No one knows where the dynamic flow of the evolution of the mobile computer is going.

Kisekae Keitai (= a dress-up mobile phone). Japanese colorful skins for mobile phones.

Macintosh Classic Series

* keitai = means a mobile phone in Japanese
My background is as a sound artist who is dealing with field recordings and sound signal processing, and I have an interest in the fusion of the digital and the organic, the virtual and the real. I have a strong feeling that I am one part of the environment, and, in my sound compositions, listening and capturing the environment are as important as composing and making sound myself. As a computer musician, I am of the post-Max/MSP generation: When I started music activities in 1999, the real time DSP technology was well established, and many musicians were touring the world with only one or two laptops. We don't need the huge heavy machines for performance and don't need to wait one week to create 10 seconds of sound with the computer. We are nomads with portable sound devices.

I grew up in the city, in Nagoya and Tokyo, Japan. The environment of the big city is filled with many artificial things – the modern skyscrapers, the big LCD screens, the hum noise of air conditioners, and the invisible radio frequencies. Also, Japanese youth oriented gadget and techno fetishism culture affected me deeply. For me, the mobile computer "is a street-level device packaged and mobilized in the ongoing status displays of everyday life." (Ito 2005a) The mobile computer "isn't just a new technology, it's a new culture." (Momus 2006)

In "The Tuning of the World", Murray Schafer deals with noise as a problematic matter. However, for me, having grown up in the city, these artificial environments are the new ecology. They are as familiar as trees or volcanoes or mountains or sunlight. They may have negative physical consequences, but I believe we should try to find a way of coexisting with them.

I believe that a greater conscious awareness of this sound environment can cultivate a new way of making or enjoying music and sound. For example, in the traditional stage performance setting, the border between the artist and the audience is distinct. In many cases, audiences watch a show in a fixed time and space. One of my interests is how to deconstruct the performance setting as a place where this border between performer and audiences becomes more blurred. Also I am frustrated with the limitation of the length and linearity of CD. The mobile computer is inspiring to me, as it offers new possibilities for addressing these issues.
2. Context

2.1 The Ears of the Early 21st Century

Soundscape

Our world is filled with sound. If you close your eyes and concentrate on your ears. You soon realize that many things are happening all around you. Wikipedia says: “A soundscape is an acoustic environment or an environment created by sound.” We are living in an ocean of sound, and in our everyday life, the background sound is a huge pool of information even though we don't realize its existence. Murray Schafer, in *The Tuning of the World*, discussed the “contextualized artistic and scientific approaches to sound within a wider framework of global ecology and social imperatives.” (Toop 2000)

For Schafer, the worldwide soundscape is a macrocosmic musical composition. He asks, "What is the relationship between man and the sounds of his environment and what happens when these sounds change? Is the soundscape of the world an indeterminate composition over which we have no control or are we its composers and performers, responsible for giving it form and beauty?" (Schafer 1973)

Now, 30 years after Schafer's *The Tuning of the World*, computers are becoming smaller and smaller, and the wireless network wider and wider. The evolution of portable technology is filling the world with radio frequencies and changing what it means to be a city dweller. The progress of recording technology and electronic instruments has created an environment where everyone can enjoy music in their home. I believe that the changes in the sound environment can create new ways of making and enjoying music.

David Toop summarizes some of the core issues in 20th century music: "the relationship of the composer to the audience, for example, or the use of chance and accident in the creation of music; the construction of feedback systems or self-generating and adaptive mechanisms that shape sound; the exertion or abdication of control of a musical result; the modeling of music based on ecosystems and similar complex environments and the setting in motion of events that question the definition of music as a cultural production distinguished from noise or unorganised sound by human agency and intentionality." (Toop 1995) What kind of music can we listen to
and perform in the 21st century?

**Schizo Sound**

The birth of recording technology is as important as the invention of the alphabet. The sound of the recording age is separated from time and space. The sound source is split from the event and can be analyzed. The invention of recorded sound has given birth to music concrete, turntablism, plunderphonics, and acousmatic.

Glenn Gould, who experimented extensively with recording technology, suggested that, before recording equipment was available, music enjoyment took place in the concert hall. "The more intimate terms of our experience with recordings have since suggested to us an acoustic with a direct and impartial presence, one with which we can live in our homes on rather casual terms." (Gould 1966)


In 1980, the Walkman gave portability to recorded sound, and this schism in the relationship of sound source and sound became more pronounced, as the opposition of the original intention with the two input design showed. People use the Walkman as the private experience, and refuse to share their sound environment with others. Here, people choose to live within the sound cocoon of their choices, not in the open chaos of the soundscape. The listener becomes a player who rearranges the sound around him, and "a soundscape that increasingly represents a mutable collage: sounds are selected, sampled, folded in and cut up by both the producers..."
and the consumers." (Chambers 1994) In 2001, the nature of the Walkman was inherited by the iPod, which has larger disk volume. Now, people can bring whole sets of their (and often their friends') favorite songs suitable for any situations and moods.

Then the mobile computer came onto the stage. The mobile phone combines all the schizophrenic sound devices – a telephone, a recorder, and an iPod. Moreover, it is networked. Unlike the private soundscape of the Walkman or iPod, the device makes sound and requires you to talk.

The schizophrenic tendency of the device is not accepted in some countries and generations, as talking anywhere is a rude behavior. On the other hand, in a big city like New York, it is common to see people who talk by themselves with the devices or headsets. Sometimes they are so into their phone conversations that they forget that their voice is being scattered around them.

**The Laptop is My Home Studio**

With recording technology, the experience of listening to music in everyday places became easy and casual. The next step is to play music. Now, it is possible to produce professional quality recordings with only a laptop computer. "Today, millions of people play the guitar because it's fairly easy to play, it doesn't cost too much, and you can play the sort of music that people like to listen to now. What contemporary technology has added to this is the ability to assemble music in what used to require a very large studio. Now you can do it in your own bedroom or your own family room with a computer and a couple of electronic instruments." (Moog 2000) As Bjork answered in an interview, "It's all being in a little house, on your own. You're creating paradise with your laptop, or underneath your kitchen table where nobody knows about it." (Toop 2004) The laptop is not only for making music: "They have used the Internet both as a tool for learning and as a method of distributing their work." (Cascone 2000) These artists are collaborating through the Internet and are traveling all over the world with their laptops, which are their studios, their offices, and their musical instruments.

The casual enjoyment of making music doesn't mean everyone can be Madonna or Aphex Twin. However, the online communities like mySpace are offering a new style of listening, making, communicating, distributing and sharing music.
"Friend" is the key word here. It's true that many of them dream to be “musicians” – who release a real CD, not CDRs or mp3s, or live only with music. On the other hand, some of them don’t want to be “musicians.” They have regular jobs and enjoy making and sharing music with their “friends” in their spare time.

Ring Tone Identity

When we are thinking about the soundscape of the mobile age, the ring tone is the one of the most characteristic topics. According to mobile phone Internet sites in Japan, 67.7% of users download their own ring tones. The second most popular download is “wallpaper,” with 35.0% of users downloading. (Mobile Communication Research Group 2002) Regarding the popularity of ring tones, Japanese researcher Tomoyuki Okada asks the question, "Why has this function made such progress, deviating so far from the features of the conventional telephone?" This question Okada answers with words like the formation of one's "turf" with an "acoustic wall" (Gumpert 1987) and "turn urban space into a theater" (Hosokawa 1981). "The concept of ‘playing one’s preferred music outdoors’ is similar to audio devices such as headphone stereos and portable stereos." (Okada 2005)

However, Okada overlooks the difference between the head space sound and the ring tone: As Rushkoff points out, the ring tone is a sound for other people, not for the owner of the phone. It is not the purpose of the ring tone to enjoy the music.
as private, but the real purpose is to express their identities for people around them. It is "a very different orientation to music than, say, downloading songs from Napster for private use." (Rushkoff 2005) Also, Rheingold cites the word of one of the young architects of Helsinki: "The fact that I have Madonna's not-yet-released single as my ringing tone says something about me." (Rheingold 2002)

Mika Sasaki makes ring tones like writing a diary. She is not a music enthusiast and does not aspire to be a musician. Her friends guess she never bought a CD. (From the liner note of “memories of Sasaki san”) She is a usual girl in Japan. Every day, everywhere, she brings her mobile phone; inside of it there are more than 300 short tracks of hers. Only because one of her friends has a CD label, Power Shovel Audio, a remix CD based on her ring tone sounds was released. The CD is titled “memories of Sasaki san.” For her, what does making "music" mean? Is it the same feeling with the usual artists and musicians or not? Sasaki's ring tone sound is the new way of self-expression with sound. Here, with the ring tone – short sound signal with many limitations expressing a personal style – the self-expression is more "light-weight" than the art. The feeling is rather close to the snapshot with the mobile camera.

City as Stage

In the Internet era, the entrance to the virtual world is in the office or home. You have to go there to login to the virtual world. However, in the mobile computing age, the entrance comes with you everywhere. The real space becomes fragmented and connected with the network. (Kohiyama 2005) Now, the everyday space can be a stage layered with real and virtual information.

Because of the "out-of-doors nature of mobile communication, as well as its low profile origins in the pedestrian technology of telephony," mobile communications are deeply connected to everyday reality, places, and social identities. "Internet studies have been tracing the increasing colonization by real-life identity and politics of the hitherto 'free' domain of the Net; keitai [= mobile phone] represent the opposite motion of the virtual colonizing more and more settings of everyday life." (Ito 2005a)

"Keitai connectivity is a membrane between the real and virtual, here and elsewhere, rather than a portal of high fidelity connectivity that demands full and sustained engagement."
The mobile phone doesn't require the clear acts of 'logging in'. Seamlessly and unremarkably, the virtual domain is being integrated into everyday life more and more. Keitai engagement is "ambient and peripheral awareness," at the same time. Both here and elsewhere are residing simultaneously. (Ito 2005a)

This virtual world is already common in our world with the mobile phone. "As more people on city streets and on public transportation spend more time speaking to other people who are not physically co-present, the nature of public spaces and other aspects of social geography are changing before our eyes and ears." (Rheingold 2002)

Tactile and visual virtual devices provide us with virtual experiences using sound in our daily life. Consider the Walkman. "The Walkman encourages us to think inside this new organization of time and space. Here, for example, the older, geometrical model of the city as the organizer of space has increasingly been replaced by chronometry and the organization of time." (Chambers 1994) Additionally, we can consider the Japanese traditional gardening sound devices like Suikinkutsu as a virtual device which adds the unnatural meaning or experience in the real world.

The virtual sound device adds layers of information to everyday space. With the mobile computer, we can connect to the database from anywhere and upload information. With their brain, human beings add unique meaning to real spaces – with memory. (Kohiyama 2005) Now, it is possible to store memories in your surrounding environment. "In today's emerging electronic mnemotechnics, information is stored in digital devices rather than heads, it is associated with physical places through geocoding, it may be presented in multimedia format on devices such as see-through video displays and audio earpieces. In this fashion, a whole city becomes a vast, collectively constructed memory palace that divulges its contents to inhabitants as they circulate through it." (Mitchell 2003)

Resonating World

Our world is resonating with various kinds of waves. These waves make harmony in the air. Human beings can catch the very limited signals of waves with their ears and eyes and use them for their communication. The bat and the whale have their own limitations and live their own sonic and visual sensory world. With radio frequency technology, people
expand the ways of communication using signals and the range of the frequency used for the communication. Although many of us do not realize it, we are surrounded with these invisible signals. Signals "(encoded in many different ways) that interfere with one another and signals that are cleverly multiplexed so that they don't interfere, jammed zones and Faraday cages, and the endless busses and bursts of electromagnetic noise. It is intricate, invisible." (Mitchell 2003) Sound is an environmental and spatial matter. For the resonating world, things which do not emit any sound also have important role. Like plants in the rainforests, "a sound environment is the consequence not only of all its sound-producing components, but also of all its sound-transmitting and sound-modifying elements." (Lopez 2001)

I believe that the future soundscape will be opened as a chaotic acoustic pool, and from there, many sonic information flows will be dynamically moved and exchanged.

"The music of the past 100 years has been characterized by a feeling of immersion. Musical boundaries have spread until they are no longer clear. Music has become a field, a landscape, an environment, a scent, an ocean. Media such as radio, television and cinema, or more recently, the Internet and the mobile phone, have fostered an image of a boundless ocean of signals." (Toop 2000)

2.2 related works

The new technology and social matter produces the new context of art and music. The electric guitar gives birth to rock music, the turntable to DJs, and the laptop to post-digital music. What will happen in the art and music world with the introduction of mobile computers?

Frauke Behrendt describes the taxonomy of mobile music. In his paper, "From calling a cloud to finding the missing track: Artistic approaches to mobile music", he analyzes art works mainly using two categories: the works exploring new ways of audience participation and the works using invisible signals. In the next chapter, I introduce related works in two categories and another genre, the Sound Walk.

**Audience Participation**

Mobile computers have changed the way the audience participates in performances. Behrendt says, "the use of mobile phones makes it much easier for people to participate in artworks or creative networks, because they are familiar with
the technology, the device is a constant companion and allows them to stay anonymous." As an example, he cites “Simpletext”, a collaborative audio/visual performance, in which mobile messages from the audience are essential for the output of the piece. In Simpletext, the performer-audience relationship changes from one way to two way; the audience can participate in the performance by sending text message from their mobile phone. (Behrendt 2005)

In Simpletext, the artist still has the role of the conductor or the rule maker. On the other hand, “SHARE”, the portable music device open jam born in NYC, explores a more open relationship. Participants bring their portable equipment, improvise and perform live audio and video. While some are making sound, others are chatting online and exchanging files. SHARE has recently spread to Montreal, San Diego and Wiesbaden.

![Pictures from Share. People are doing an open jam.](attachment:share.jpg)

**Invisible Signal**

The mobile computer uses radio signals for network communication. In the one-night event “Sky Ear,” 1000 extra-large helium balloons containing LEDs and electromagnetic sensors launched into the sky. The audiences can call and listen to the actual electromagnetic sounds of the sky, and the action of calling itself affects the sound and the color of balloons.

Before human beings started to use the radio frequencies, the earth was covered with the invisible signal of natural radio frequencies. Alvin Lucier's "Sferics" (1981) is a musical piece using the sounds of the ionosphere. It was 1967 when Lucier discovered a recording of a sound of atmospherics by an astrophysicist and started to get interested in the sferics, natural radio-frequency emissions in the ionosphere occurring in the human audible range. Over 10 years later, he finally succeeded in collecting the sounds himself. The sound samples in this work were recorded by Lucier with handmade antennas and a stereo tape recorder. (Sounding Space 2003)
Sound Walk

Behrendt suggests that new geographic context also influences music style and that the city can be a stage for artwork. (Behrendt 2005) Mobile computers add a new dimension for the history of art on the streets – fluxus to graffiti – and new conditions in sound walk, the traditional method to discover the soundscape. Among sound walk artworks, Janet Cardiff is the most famous artist. In her "Walks", the audience follows the artist's direction from a CD Walkman and experiences the story in a site. The soundtrack is put to a different meaning by the participant's walking in the real world. In the sound walk artworks, the intentions of the artists are only one part of their works. The surrounding environment is integrated into the work, and without the active participation of the living members of these environments, such works may never be complete. Our ears are automatically filtering and selecting sound. While walking in the city, you are editing and creating the sound symphony of environments in your brain.

Christina Kubisch's installations based on electro-magnetic sound transmission give participants the freedom to walk anywhere they want. Through movement, the listener, equipped with wireless headphones, can explore his own combination of sounds. Kubisch says, "Listening is, in itself, an activity that must be consciously learned and developed. In contrast to the conditions in concert halls, our ears, coupled with the other senses, perceive rotund, spherical and moving sound. Creative listening is the starting point for my sound installations and sound-zones in which the structure of the composition is combined with sequences of tone and movement." (Kubisch, 1990)

We can consider the mobile computer as the extension of our body. Mobile sensory technology expands the limitations of our body. If our ears were elephants' ears or light wave sensitive, what could we listen to? In Maebayashi Akitsugu's work "Sonic Interface", the participants explore the environment with an auditory filter like growing delay and overlap. Movements of the body and objects dispatch from the sound, and conversations with others become difficult. The participant may be disoriented at first by their modified sound environment, though after some minutes they start to discover the new ways of enjoying soundscapes and communicating with others or the environment. "Sonic City" is another project that explores the artistic possibility of using mobile sensory technology. Sonic City is a project exploring the everyday
music creation between a city and a body with sensors. With physical movement, local activity, and urban ambience, walking through a city with the system creates electronic music as the personal soundscape.

There are some art works using other technological functions of mobile computers. Using GPS technology, we can do tagging on the location data and can access the layers of information about different time, space, and viewpoints. We can come and go freely between the different virtual sound maps. Using the GPS technique, “the TSG Toolkit” offers an open source platform for cultivating public "sound gardens" within the city. With a WiFi enabled mobile device, people can "plant" sounds within a networked environment. “Nintendogs”, the communication game like tamagocchi for Nintendo DS, uses wireless communication for a playful system. When you meet someone who has Nintendogs on the road, your dog cries “bowow”, and the dog of the person you encountered comes to your DS.

A sound walk is the discovery process of the sound that surrounds us, in the city, or anywhere the world. With new technology, will our listening sensitivity be changed, or our ears become dull from overuse?

ULTIMATE PORTABLE WORK

The human brain is the most primitive and important portable memory storage. "Greek philosophers did not have offices and classrooms elaborately organized into departments and schools; they strolled freely through the groves and stoas of academe" (William 2003) with the only memory storage at that time, a brain. Yoko Ono’s instruction pieces can be called the ultimate portable sound work. They are scores that anyone can play and replay in their imagination at anytime, anywhere.

3. Project Description 01: “h&s”

3.1 Overview

What follows is a description of “h&s,” a sound walk art piece using geo-coding and bone conduction headsets. “h&s” means “hide-and-seek” as well as “hidden sound.” It is the trial to seek the hidden information of sound in the city. Geo-coding itself is not such a new technology and has been used in art works already. What I’m interested in is to
cultivate the possibility of sound enjoyment by using mobile computers to access an on-site information layer.

Common headphones cover the ears, creating a sound cocoon. My decision to use bone conduction headsets is to maintain the openness of ears for the existing sound environment and the open air.

My challenge in this work is to examine how to navigate the audience through the sonic narrative using the geo-coding in an urban sound walk experience with the bone conduction headset.

### 3.2 What is QR Code?

QR Code is a kind of 2-D symbology developed by Denso Wave and released in 1994. QR Code contains both the vertical and horizontal information, while a bar code contains data in one direction only. The advantages of QR-code are large capacity, small printout size, and high speed scanning. It contains about 7000 numeric data or 4200 alphanumeric data. Additionally, QR Code has error correction capability and the data can be read with partial dirt or damage. The small squares at the three corners make omni-directional reading possible. In general, the special scanner and software are used for reading and writing the code. The Java open source code is available for both making and reading the code.

**Error Correction Capability of QR Code. These are damaged but still readable.**

In Japan, QR Code is widely used for signboards, packages, advertisements in magazines, name cards, homepages, and receipts. Many Japanese mobile phones can read QR Code, and one can easily download the scanning applet if one’s phone doesn’t have it built in already.

For my project, I am planning to make a physical sculpture of QR Code (the original idea by Stephen), and at the same time, to put many QR Codes in one place.
3.3 Bone Conduction

Bone conduction sends sound waves through the skull bones, not air. Bone-conduction technology has been used in hearing aids, extra noisy situations, and underwater. With a bone conduction headset, the ears keep open for the outer soundscape. The drawback of the bone conduction sound system is that sound quality is inferior to common headphones.

3.4 Setting

My final goal is to create the applet in which many people can enjoy the installation with their own mobile phone. However, the disadvantages of this setting are that the mobile phone is still low power compared with a laptop, and that some of the phone speakers sound bad. Because of the power limitation, the sound system will be fairly uncomplicated, limited to playback of simply layered sound.

Because of this, I designed the prototype with a laptop and a camera phone. While this is a setback for the project in terms of usability, mobile computer technology is a rapidly developing field and new functionality is constantly being added. I hope that these technical problems will be overcome in the future.

Laptop + Bone Conduction Headset + Camera Phone

The advantage in implementing this combination of technologies for this project is that a more complex sound composing system can be used. The sound generating system
will use prerecorded sounds, DSP (Digital Signal Processing), and algorithmic synthesis using Max/mxj/MSP. The bone conduction headset will give the participant an opportunity to feel the mixing sound experience from the natural environment and the headset. For the scanning device, I use a Bluetooth compatible camera phone instead of a digital camera. The physical feeling with a camera phone is more a snapshot feeling than the usual digital camera.

3.5 Site

For the site of the walk, I have chosen the Bedford Avenue area in Williamsburg, Brooklyn. Here are the reasons for this choice. (Also see Appendix A – Sound Walk in N 6th Street and Kent Ave.)

- The contrast between N 6th St. (crowded, shops and restaurants) and Kent Ave. (silence, industrial and vacant)
- Kent Ave. is quiet in Sunday morning & afternoon
- Rapid change of development of the area recently
- The water view and the small waterfront park
- Mixture of living, shopping and industrial character

About the area in general
The area is a residential and commercial area populated by many artists and young people. Many warehouses are used for the residential loft and shop spaces. The area is still in developing, and the site is changing rapidly. Many new buildings are in the process of being built.

N 6th Street
On the street, there are residential spaces, clothing stores, restaurants, bars, and galleries, which are in the renovated warehouse buildings. The street is crowded with a mixture of residential people and those there to shop or hang out. Many of them are young artist type people, but sometimes families with small children can been seen.
Kent Ave.
Silent, industrial area with the warehouses, vacant lots, factories, and 2-3 old big warehouse buildings which are used as artist lofts and residential spaces. You can see a water view on the opposite shore of Manhattan. Also, there is the small waterfront park. At first the area seems without any living people, but once you are used to the area, you can find the people taking a walk or sitting in the sun there.

3.6 Sound Contents

For the sound contents, I am planning to use field recording sounds related and unrelated to the location of the piece. Each QR Code is unique, and each pattern becomes a feed for the sound generation system. For the laptop configuration, I will make an ambient sound generation patch with Max/MSP. For the mobile phone setting, I will create a Java applet that will play back audio material.

Also, in some places many codes are put, and each code plays back a short sound sample as the loop. The audience can make a remix as the layer of the samples. In a future version, I will invite several sound artists to create the sound contents, and the audience can play the mix of different artists’ samples.

![Putting many codes in one place and creating a remix.](image)

3.7 Problems

There are two technical problems as of now.

1) The speed of decoding the code is slow
2) The success rate of decoding is low

About 1), when I try to decode the code with the jar file on my Powerbook G4, it takes over 5 seconds. For the idea of using the code as the sound playback, the delay time is a crucial weak point. If there is a decoding open source for C++ or C, the time loss issue might be solved. As of now, there is
no solution for the delay issue with the open source Java library.

About 2), if the code is not put up flat or if the photo is not well taken or too shiny, the decoding fails. With my experiments with the mobile phone, the success rate was less than 50%. There are some programming possibilities to improve (cf. taking 5 sequence pictures and analyzing them), and the developer of the library mentions more recognition accuracy as the future task.

3.8 Future Idea

As a future idea, I’d like to use the visible light communication technology instead of QR Code. With the technology, we can send the information through light. The light signal becomes something like the radio frequency, and when people hold the mobile devices to the light, the mobile devices catch the information.
4. Project Description 02: 2.4GHz Scape

4.1 Overview

"2.4GHz scape" is a 2.4GHz spectrum ambient sound installation and performance. The audiences can enjoy the real-time sonification of a 2.4GHz signal around the space, and the ambient sound becomes one part of the immediate soundscape. Also, people can join the soundscape using their laptop or bluetooth devices such as mobile phones to make signal interference.

The 2.4GHz spectrum is widely used for WiFi, microwave ovens, bluetooth, baby monitors, cordless game controllers and other technology in the USA and Europe. The signal map varies in different places, and the activities of the signal usage change by the hour, day and year. It is like the seasonal changes of air.

Our world is resonating with various kinds of waves, and the waves create harmony in the air. Just as some fishes living in rivers communicate with electromagnetic waves, now people can communicate with others using radio frequency technology. With the experience of “2.4GHz scape,” the audiences realize the invisible existence of the 2.4GHz spectrum in the air.

Wi-Spy

To capture the data, I use Wi-Spy, a USB 2.4GHz spectrum analyzer. The Wi-Spy tool for Macintosh is written in C and can be used inside of Terminal or Max/MSP with shell external.
Basic setting for the experiments.

4.2 Trial with Processing

As sketches for the bigger work, I did some trials with Processing and pre-recorded data. I drew the moving graph from the amplitude, frequency and time of the 2.4GHz signal data. For the sound part, if the signal amplitude is greater than 50dBm, the sample is played back with the pitch relative to the frequency and the amplitude relative to the amplitude. A bell sound and a sine tone are used for the experiments. (CD-Rom: 01WiSpyRaw is the source code for Processing 0114. You need sonia library by Amit Pitaru to run the code. Watch 02processingWifi.mov and 03processingITP.mov)

2D visualization

3D visualization
Here are some examples of characteristic signals. The data of 01 and 02 are downloaded from Wi-Spy site. The data of 03 is recorded by me in April 2006. The visualization is done by my Processing program.

01: WiFi audio streaming

The signal is gathering around 2470MHz. The original data is downloaded from the Wi-Spy site and was recorded in a place with less interference, so you can see only the Wi-Fi signal clearly.

This recording is the result of continuous downloading. In the recording of Internet surfing, the spike continues only few milliseconds.

02: Codeless Phone (Frequency Hopping Type)

Spikes are happening in all frequency areas.

03: Sunday the 4th floor in ITP

Compared with figure01, the recording is noisy. Many interferences of signal from laptop, bluetooth devices, and microwave can be found here. At that time, 4 people were using laptops near me, and over 20 laptops were in the lounge area. Some people were testing their bluetooth applet on the mobile phones.

You can see the outstanding spike around 2470MHz, and it is the WiFi signal from the laptop near me.
I recorded the data in my home, the ITP floor and a Starbucks. All results of the usual home environment are something like 03 – with much interference of different devices and reflection of walls. Raffi Krikorian, our Every Bit You Make class teacher, told me that if people use many bluetooth devices in one place, the signal wave is near flat because all waves are added together. It reminds me of additive synthesis with sound. Although we can examine the math of sound waves on your laptop with DSP tools freely, there is a restriction about the usage of radio frequencies. The new technologies in wide bands of frequencies like Dewayne Hendricks are currently facing many difficulties in the point of raw related issue.

4.3 Trial with Max/MSP

Based on the trial with Processing, I developed the Wi-Spy Ambient Sound Generator as a standalone application of Max/MSP. The Wi-Spy Ambient Sound Generator creates ambient sound from the signals captured by Wi-Spy. To use the application, you need the Wi-Spy tool and Max/MSP runtime.
The Wi-Spy Ambient Sound Generator has four different modes – the morning mode, the afternoon mode, the night mode and the midnight mode – and the sound samples and patterns change depending on the time. For example, in the morning mode, the sounds of birds are used. Additionally, to notice the data flow for the audience, when 40dBm~30dBm signal (= WiFi signal) is coming, the bell sounds as the obvious sonic information. More detailed description about the sound design is in 4.4 Sound as Ambient Information.

In a future release, random sound selection from iTunes mode will be featured, so the tool can correspond wide types of audiences who have different taste of music.

(CD-ROM: You need Max/MSP4.5 runtime for 06WiSpyASG. You need to read bird.mp4 inside of the patch to see the visual. 07Maxtest01.aiff is the recording of early sound test. 08--- are the sound samples used in the program. 09final.aiff is the final result with the microwave data.)

**Technical Issues**

While the frequency hopping signals are just noise, the Wi-Fi signal has the sharp spike on a specific area. The area can be controlled with the router, and the timing can be controlled with hitting button on the web browser. Applying the Wi-Fi signal for sound processing as an impulse response or for granular synthesis is an interesting challenge. Here are some screen shots of waveforms in the trials.

![TRIAL01. Just dumping the signal into the buffer. The screen shot of the buffer. Clearly enough, the result sound is just noise. (CD-Rom: 05WiSPynoise.aiff)](image-url)
TRIAL02. The result of 1 smoothing and 1 slide. About 3 frames are dumped into 1 buffer. (The red line shows each frame.)

TRIAL03. The result of velocity and acceleration of the signal. Now, the signal becomes two sided.
TRIAL04. This signal is the result of 3 smoothing and 1 velocity. 5~10 impulses (grains) happen in every 15ms. With the smoothing variable, you can change the size of impulse.

Visual

The performance version of WiSpy Ambient Sound Generation has the visual option using jitter. The visual elements are hold 4 different variable in common with the sound elements and are used them for color, shape, size and movement. Additionally, you can control the color, alpha value and drawing patterns with the keys. In general, the audio reactive visual only uses 1 or 2 elements of the sound – in many cases, using only frequency and/or amplitude from the microphone input. In my work, because it is generating both audio and visual in one program, more complex relationships occur there. From my experience, when only 1 or 2 relationships of elements are happening, the audience can recognize within several minutes. However, when the relationships of elements become more than three, suddenly the audience tends to have difficulty to grasp the relation, even though each relation is obvious separately. About this topic, I'd like to do farther research and experiments in future. (CD-Rom: In 10-24GhzDrawing.mov, sound and visual is not synchronized because of the movie’s recording method.)
4.4 Sound as Ambient Information

The main challenge of the sound design in the work is to exchange the 2.4GHz data for ambient sound information. The application is created with the possibility that the user will play it back all day, and it tells the condition of the 2.4GHz spectrum in the room in a persistent and subtle way. For that, I did masking the obvious sound with 3 different sounds and making the subtle information drone. To hide the obvious sound information inside of the crowded noise created with many sound components is the technic I started to experiment from my 2nd album, "hum." In the album, the voice samples merge into the drone. Sometime the listener catches the information, sometime not. It is the attempt that the listener floats between meaning and meaningless, intensive and ignorance listening.

In real life, we get information from the immediate environment unconsciously. For example, you know the strength of raining from the sound of rain when you are going out. Although, you don’t take care about the same rain sound when you concentrate on writing in your room. What I try to achieve here is to create the sound information like that.
The Tangible Media Group at MIT’s Media Lab is one of the pioneers of displaying environmental information in an ambient way. Their early work, “kazaguruma”, which displays the stock market data as the speed of a windmill, shows these aesthetics vividly.

As a traditional example, Japanese garden equipment like Suikinkutsu makes sound with rain and the water of washing hands. When someone washed their hands, water dropped slowly, falling to the bottom of the pot, and the sound were amplified inside the water pot. The sound merges into everyday life, and people feel the rainy condition and existence of other people as background information. Burry Truax, my thesis reader, mentions in his mail that because the source is hidden, it acts like a virtual soundscape embedded within the acoustic one.

4.5 Future projects

“2.4GHz Scape” will be exhibited as the ambient room installation in the BAP festival on July 22nd, 2006. The main challenge there is to create a chill-out room next to a beat-oriented music venue. The “2.4GHz Scape” room offers for the audience a relaxing moment where they can join the soundscape using their WiFi or bluetooth devices. The sound is distributed from the usual speaker and the cushions with bone conduction sound system, which give them the opportunity to feel the sound signal through their body.
Also, I am now applying to show the work at some festivals as a sound walk with the Wi-Spy sonification setting. I will walk around the city with a cart inside of which a laptop, Wi-Spy and a boom box are set. During the walk, pedestrians can join the soundscape consciously or unconsciously. The dynamic chaos of 2.4GHz signal joins the soundscape in the city.

5. Postscript

“People like us, who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion.” Albert Einstein

To create the art work for everyday life is like a transplantation of plants: Sometime the plant is dead after the huge effort to transplant in the new place. Sometime the seed came with wind accidentally, and the plant breeds in high speed. The work lives and changes within the society.

With the advance of technology, our reality and the cognition is changing sometime dramatically, sometime slowly. What communication and expression style is used in near future? What kinds of relationship and experience are happening? What kinds of vision and illusion the artists can offer? What kind of sound we can listen there?
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Appendix A: the sound walk in N6 Street and Kent Ave.

I performed a sound walk for researching the soundscape of the area in April on Sunday the 2nd. I did the walk in two different time slots, 10:30-11:30 and 13:00-13:30. The route takes about 15 minutes, but because I was shooting photos in the 1st walk, it took a longer time.

**N 6th Street between Bedford and Kent (Map1, 2)**

**10:30**
Almost all shutters of the shops are closed. One restaurant's shutter is just opening. It makes sounds in the quiet morning street. There are few people and cars. At least 2-3 kinds of birds are singing. There is one factory on the street (Map 2), and it makes a low dull drone sound.

**13:00**
30-50% of the shops are opened, and the other shops are preparing to open. The air conditioners make a lo-fi noise from all the shops, but because the street filled with people talking, I don't feel the sound as a big noise. People are meeting their friends on the street and talking. Workers are taking lunch at the bench. A dog outside of the supermarket is barking. A plastic bag, which a man carries out of the market, makes a rustling sound. The bird singing is less clear than before. I listen to the music from each shop, but because each shop is big enough, the music doesn't mix together. A huge machine is being carried to a new restaurant by truckers.
10:30
The fences make a rusty squeaking sound with the wind. The birds are singing. A faint car drone from Manhattan comes over the river. (Map 3) The airplane sounds are bigger than in Manhattan because of the nearby airports. Industrial metallic noises and drones can be found in many places – not too loud, rather vacant. The sound in the vacant lots creates a unique resonance because of the empty space. (Map 4)
At 11:00, slight bell sounds of church are arriving with the wind from somewhere. (Map 5) There are fewer people than on N6 St. No one is talking except an old man with a
mobile phone. My footsteps in the gravel road are echoing. A huge truck runs through it with a heavy dull noise.

03.

07.

13:00
After the Sunday afternoon crowd of N6 St., suddenly I feel a vacant silence while standing on the crossing of N6 St. and Kent Ave. (Map 3) At first, I feel little scared and lonely with the emptiness, but after a few minutes, I find some people who are eating lunch on the side and taking in the sun. The plastic dust on the street makes a dry, light noise. A strange mixture of the industrial site and relaxed everyday life is there. Maybe because of the traffic light, 2-3 cars come in together every 1-2 minutes. Only one car spreads huge music (not Hip Hop but lounge music) from an opened window.
The diner between N2 and N3 is opened, and the waitresses are talking outside of the restaurant. (Map 6) The voices and music from the diner sound quieter than N6. Maybe because there are many vacant lots on the avenue, the sound is absorbed into the space.

**The water front park (08)**

10:30
The number of people meeting each other on the road increases near the park. I find people with dogs and people running. Approaching the water, I feel the smell and sound of the tide. (Map 8) The train on the Williamsburg Bridge makes a faint sound from a distance. (Map 9) Another park with a playground and a tennis court (Map 10) is crowded with families.

13:00
Three cars are parking outside of the park. More than 10 groups with 22 people are there. A helicopter is roaring over the river. A small boat is floating in the river.

**Appendix B: Sound Memories of NYC**

While I'm writing this thesis, I realize that I have fewer memories about the soundscape in NYC than in Japan, my home country. This led me to ask people about their own sound memories in NYC. I sent the questions to my friends, mySpace blog, mixi (Japanese mySpace) blog and the Phonography Mailing List. I got 5 replies, and here are some extracts from their stories.

<table>
<thead>
<tr>
<th>Spencer Kiser</th>
<th>The general image of the soundscape in NYC</th>
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</thead>
<tbody>
<tr>
<td>ITP student living in Queens. He had lived in</td>
<td>Constant background noise, which really bothered me when I first moved here. It's what gives the city its</td>
</tr>
</tbody>
</table>
Germany before coming to NYC.

inhuman energy, but it gets to you after a while. You end up turning your ears off. However, because of that, it's great when you do field recordings and come back to hear singing, squirrels, birds – things you don't notice when you're out walking around.

**Memorable story about sound experiences in NYC**

Hearing the landing gear engaging on airplanes flying over my apartment in Queens.

**Difference between NYC and where he had lived**

I lived in Heidelberg, Germany before moving here. I lived near a church and a school, so there I heard a lot of bells and screaming children. The constant background hum also existed there, but you could escape it if you tried. NYC is not necessarily worse, just different – more intense, so you need to get away from it occasionally.

| Ian Epps |
| Sound artist living in Brooklyn. My friend. He had lived in Rochester, NY before. |

**The general image of soundscape in NYC**

Sometimes I imagine the sounds of people's voices filling the city like a sea of water, crashing against buildings and spilling around the corner – in places like Chinatown, Riverside Park, Union Square, or Fordham Rd. in the Bronx – sometimes too loud, but definitely interesting to experience.

**Memorable story about sound experiences in NYC**

In the spring and summertime, Chinese men bring their birds (in their birdcages) to the park at Broome Street, between Christie and Forsyth Street. There are little poles to hang the birdcages from. It's really interesting, because it's like bringing these birds together for a social meeting.

**Difference between NYC and where he had lived**

I grew up in a couple of different places, but lived most of my childhood in Rochester, NY within walking distance to Lake Ontario and the Genesee River. I spent a lot of time listening to the way water moved or hit objects like rocks and sheets of landmass (waterfalls). Mostly I was interested in the space between the sounds. Sort of like Hemiolas. A hemiola is an accent of a beat, but I've always seen it as emphasizing the absence of sound or the space between the note/sound. Space in general... If you were to imagine the city as speaking syllables, NY speaks much faster and has less space between silences.
| **M (maria)**  
Replied to my post on mySpace. Living in Dublin and visited NYC as a tourist. | **My experiences:**  
sound mixed with smell (visual being obvious)  
rubbish/bin bags (phenomenal amount): Lower Eastside  
weird petrolly smell of subway steam: Midtown  
cars/fumes/pretzels/nuts/cakes/hot dogs: mostly everywhere  
**all above have accompanying sounds**  
whizzes, squeaks, whirs and voices – loud usually  
cabs: speed (in a cab in the UK, cabbie can only drive 30 miles an hour) in NY beeping whizzing in and out of lanes/low murmur or rumble of taxi man talking on an invisible talking device in an unknown (to me) language.  
also cab driving over newly placed raised lump of concrete  
(the cabs seem big and springy there)  
the underground and all its smell and noise, bands, beggars, drunks, suited drunks, money rattling and lots of staring... |
| --- | --- |
| **Scott**  
Replied to my post on Phonography mailing list. Living in Pennsylvania. Had lived in NYC before. | **My impression of the New York Soundscape is that it is loud and abrasive. My most immediate thoughts are of the subway where there is such a collection of scraping, squealing, screeching sounds along with the ever-present rumble. I love Saturday on the subway and often get off at Time Square to take the shuttle to Grand Central just to hear the musicians. I also love the do-wop street groups who sing in Soho, usually along Spring Street. The resonance for musicians is very forgiving.**  
The sirens of New York are particular to the city. One can tell it’s New York immediately. My most specific memory is not being in the city, but being in Pennsylvania. A friend called one summer night. In Pennsylvania the tree-frogs and cicadas were making a beautiful racket when I answered the phone. As my friend in New York said hello, I could hear a siren and the rush of engines over the phone. This sound transported me immediately to the corner of 6th Avenue and Broome. |
| **halcan**  
Replied to my post on mixi. Living in Japan. Had | **NYC**  
Cars honking  
The noisy siren of fire truck |
lived in NYC before.

<table>
<thead>
<tr>
<th>&lt;harlem&gt;</th>
<th>The theme song of the ice cream car</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>The voice of children playing</td>
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</table>

*Hip-hop music from car stereo (whole day)*
*The door man chatting*
*The speech of the minister of church*

<table>
<thead>
<tr>
<th>&lt;washington heights&gt;</th>
<th>The hit chart music of Latin America from neighbor’s room</th>
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<tbody>
<tr>
<td></td>
<td>People singing in the laundry</td>
</tr>
<tr>
<td></td>
<td>Boys saying &quot;You are beautiful!&quot; &quot;Hello, honey!&quot;</td>
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</tbody>
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<table>
<thead>
<tr>
<th>&lt;brooklyn&gt;</th>
<th>The high school students chatting</th>
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<tbody>
<tr>
<td></td>
<td>Portland words from TV in the restaurant in Greenpoint</td>
</tr>
<tr>
<td></td>
<td>Cheering for runners</td>
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</tbody>
</table>

*The metro sound coming from the air hole*  
*The metro coming into the platform*  
*The different speaking accents of the crowd*  
*The foreign languages of tourist*  
*The performers and homeless making sounds*  
*The helicopters flying*  
*Unknown Japanese people talking in Japanese*  

*The classes of dance, musical theater and singing*  
*The music from other class rooms*  

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<thead>
<tr>
<th></th>
<th>Crowded Chinatown</th>
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<tr>
<td></td>
<td>Noisy Times Square</td>
</tr>
<tr>
<td></td>
<td>The fireworks of the 4th of July.</td>
</tr>
</tbody>
</table>

Then, I drew a map of the stories on transparent sheets – each person is on one sheet.
The transparent sheet is good to compare the geographic differences of each story. At the same time, the physical texture gives me different feelings and inspiration from the map on the computer screen.
What I realized:

1) There are the stories about NYC in general (cab, metro, hotdog, car, etc.) and the stories about a specific space and time (Chinese men with birds on Broom St. in summer, the fireworks on July 4th, etc.). Also 3 of 5 mention the metro.

2) Each person has a different home range. (Halcan is describing Harlem and Brooklyn area mainly. Spencer gives the general idea about NYC and writes about only one specific place, his home in Queens. Maria, who is only the person visiting NYC as a tourist, describes diverse areas in NYC.)

3) Although 3 of them are unknown people for me, the stories give me vivid images of how they spent time in NYC.
halcan’s map

Spencer’s map

All 5 maps together