Listening Instruments

By Alex Braidwood
a@listeninginstruments.com
www.listeninginstruments.com
2011

Abstract

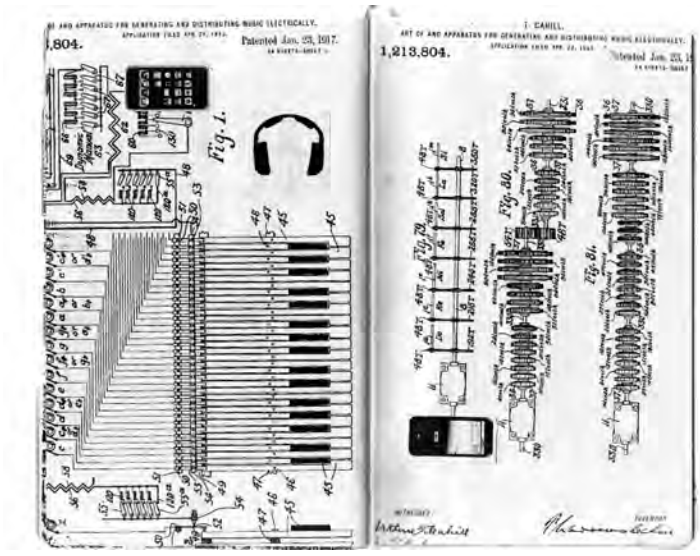
With increases in urbanization comes an increase in noise. It is primarily the result of resources, services and activities that make our way of life possible. Considering this along with the necessity of certain noises required for navigating and orienting oneself within a space, complete cancellation or elimination is not feasible. As a result, research into the affect that these noisy environments have on communication, behavior and health continues to emerge. Informed and inspired by this research, Listening Instruments is a project that is not concerned with canceling or eliminating unwanted sounds. Instead, the project is a collection of critical investigations that explore methods for transforming the relationship between people and the noise in their environment.

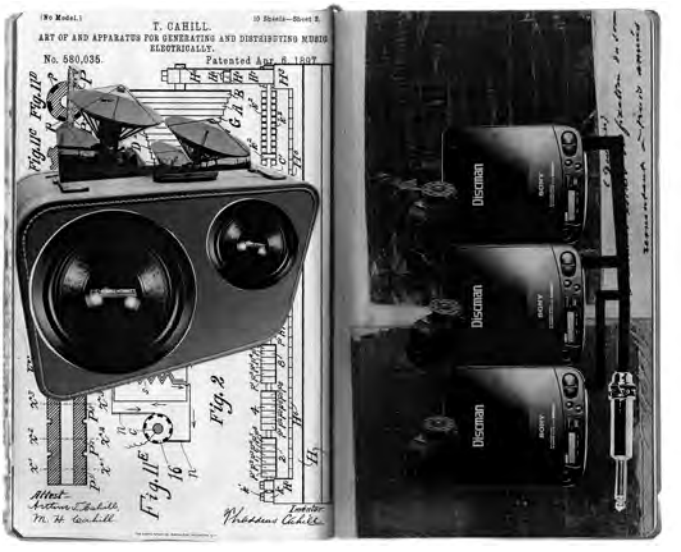
Sketch Process

Throughout this document, I will be using scanned spreads from my sketchbook to visually illustrate how my ideas develop. My sketching process involves the creation of colleges as an act of idea visualization as well as idea generation, a type of visual brainstorming. It allows me to take a general thought and work it into something that represents a more complex idea. It also forces me to slow down my thoughts, analyze the elements that I am investigating and synthesize them in new ways. At times, this provides new combinations of themes and leads to new directions for exploration. Some of the assets used are found images however most are from photographs that I have taken of things that I find interesting for one reason or another. The collection of assets is a collection of ideas, forms, themes and objects that represent certain interests as related to the work that I am making. These parts are then saved for use when the time comes to begin visualizing an idea or synthesizing various themes in order to see what new territory might surface for exploration.

This sketch process is a very important step in the development of my work. Just like the act of writing is a way to generate ideas, so is this act of sketching. It forces me to visualize concepts such as “networked, user contributed audio performance” or “personal controlled performance listening experience.” By forcing the visualization of such abstract and ambiguous thoughts, potential directions for experimentation emerge.

The asset collection is not random. The pieces saved are all related in some way to the themes that are explored within my work. They are also all reduced to a similar visual language. The use of black and white images allows for the source of the image to be varied yet when placed in context with one another, the separate images work to build one composition. Through this visual treatment, the source of the image becomes less relevant. It matters less if the original image is from my DSLR, camera phone, webcam or a scan from an encyclopedia. Through this unifying visual treatment, images created from a variety of different technologies can more seamlessly occupy the same visual space and not be a distraction to the larger meaning they are intended to create.



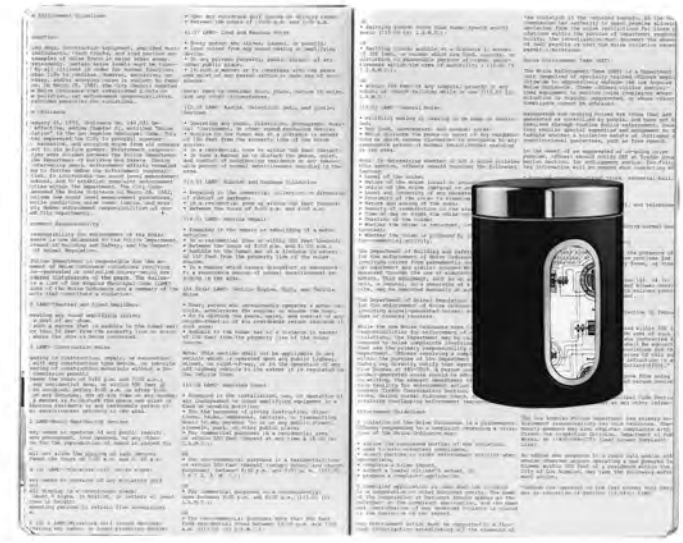


Noise?

Noise is an ambiguous word. It's definition is difficult to pin down. It means drastically different things to different people in different contexts.

To get a sense for what aspects of noise I was the most interested in, I spent time in some noisy places. Near Bob Hope International Airport in Burbank California, it is possible to be very close to where commercial airplanes land and take off. I visited these spaces in order to observe what types of things where going on in these areas and to witness how people interacted with or responded to the noise.

Very near the jetway is a small outdoor shopping center. It contains a chain sandwich restaurant and chain coffee shop, each with outdoor seating. While taking a coffee break and sitting outside I noticed that the people in this space seemed very accustomed to the jet noise. It seemed to be the type of place that was more visited by locals than by travelers. Many of the small groups I observed during my time there had walked across the parking lot from the nearby office park. What I found to be the most interesting was how they adjusted their conversations around the jet noise. The noise wasn't sudden like a clap. It built up. You could hear it coming. Then once the jet had taken off or landed, the noise subsided gradually either as a result of the jet flying off into the distance or because the engines had been shut off or idled down. Since the people in the outdoor seating area could hear the noise coming, the conversations would continue until the noise hit some critical level where it was too difficult to speak over it and the speaker would stop. Then, once the noise had subsided, the conversation would carry on from the exact same point. I heard this happen time and again in various places within the seating area. It was also happening with people talking on their mobile phones although with a little more explanation and apology to the listener on the other end. The people had adapted the way in which they communicate around this large and imposing industrial noise. The noise came with the territory.



In contrast, I also spent time in places that one would assume to be quiet spaces. Parks, gardens and libraries for example. What I found in these places is that with such a dramatic shift in context, the expectations changed and as a result, so did the defining of noise in terms of unwanted sound. Although the definition is fluid, context is of significant importance to the identification of noise. This is as true when walking in a wooded park as it is when trying to concentrate in a library. Certain spaces carry with them certain expectations of sound type and level and anything that invades or violates that then becomes noise.

Noise Forager app collecting bus noise in Los Angeles

I was also interested in how others categorized sounds as noise especially while outdoors and in public. This lead me to develop a probe in the form of a mobile app named Noise Forager. This app simply prompted users to record a noise from their environment and submit it. The app itself added GPS data from the device so that once uploaded into the system, I could hear the noise that was submitted but also know the general location from which it was captured. For this experiment, I was more interested in the type of noise that was recorded and where it was collected from and less interested in the actual source of the sound. As the archive of geo-tagged noises grows I've started exploring different ways of developing compositions using the GPS data to inform the structure while the audio recordings remain as the material.

One such exploration is an app named GEOrchestra. This mobile app begins with the listener's location and builds a noise composition based on the physical distance between where the listener is currently located and where the most recently contributed noises were recorded. Each time a listener initiates a new composition, they will have a unique experience listening to the growing archive based strictly on their current location and the current state of the archive. Another goal of this investigation is to hear different noises transported and mixed from different locations. At any given time, a listener standing in Los Angeles could be hearing a noise composition

GEOrchestra screen grab. Listening from Los Angeles.

that contains bits of urban din from Detroit, New York, Florida and Nigeria. The intent with this experiment is to hear what happens when a mobile device transforms audio physics to the scale of GPS. It's an exploration of merging noises from different contexts together in order to compose a different type of relationship to the space directly surrounding the listener through the mixing of noise from other listener's surroundings.

See Also Noise cassette release.

Another outcome of the initial observation outings is a collection of audio compositions released in the form of a cassette tape title *See Also* Noise. Using collected noises from various places around Los Angeles, each track of the collection is an audio exploration of a synonym for the word "noise." The intent is to use noises that represent various characteristics of the different terms, such as din, tumult and cacophony in order to explore aspects of ones understanding of the terms through the lens of noise from the urban environment. Each track then developed as an investigation into the transformation of noise into something differently familiar. It was also important that the release be in form of a cassette. First, the work is built entirely from field recorded sounds that have been edited and looped, a practice which began with the introduction of magnetic tape and tape recorders. Secondly, the cassette as an audio format lead to the development of the Walkman® which for the first time allowed for a truly portable relationship with sound. Not only could the sound be transported like it could with a vinyl record but with the introduction of the portable cassette player, the sound could be easily listened to while in transit. This is beginning of private listening experiences in public places.

Early Recording Techniques as Listening Intervention

While visiting different locations, I documented my experiences in a variety of ways, including with a digital audio recorder. I am interested in how recording has changed our relationship to sound and how short the time period is in which recording has been easily accessible.

In the 1850's, the earliest known recordings were made in the form of a phonautogram. This was a visual record of a sound created in real-time. The artifacts that have been recovered and widely discussed online are recordings of the human voice. The recording system worked by speaking into a cone with a thick hair attached to a membrane at the opposite end from the speaker. Similar to the functioning of the human ear, the hair vibrated in response to the speaker's voice and the movement left visual marks on soot covered paper. These visual documents were never intended to be played back. Instead, they were to be a visual record of speech and other sounds used scientifically in the study of acoustics. This was a system made primarily for listening. It wasn't until 2008 when researchers developed a computer program that could analyze the visual marks that the original sounds used to create the document where able to be reproduced. [1]

This phonautogram recording predates Thomas Edison's recording inventions by a couple decades. However Edison was interested in not just recording speech but also in the ability to play back the recording. His earliest recording devices capable of recording and playback worked although they had rather defined limitations. The earliest recordings that he made were inscribed into tinfoil. Due to the material qualities of the tinfoil, the recordings could only be played three or four times before they were so degraded that the audio was beyond recognition. Each time a recording was played, it had a direct impact on the clarity of the next time that it would be heard. Having experienced only audio media that degraded very slowly, such as cassettes and vinyl records, or media that was not impacted at all by its playback system, such as compact discs and digital audio files, I found this direct and immediate impact of playback very intriguing. This process changes a listener's relationship to the recorded sounds but it also has the ability to change our relationship to the original source of the recording. The original source in this situation is presented in a constantly affected way as a result of the material qualities and limitations of the media. The temporal nature of sound in this environment becomes even more apparent. Audio is time based and by having a playback system that affects the original document, the

recording itself is now time based. It not only has a start and finish in terms of the sound that was recorded but it also has a beginning and an end in terms of it being an affective recording of sound.

This is the inspiration for a listening probe that I developed to explore the potential of a real-time, modified noise collection and performance system. The

intention of the portable noise collection prototype is to investigate a different way to experience the noise

Mobile Noise Collection Prototype

in various contexts based on the inspiration of these early recording devices. It is a quick and dirty prototype that works as follows. First, four channels of audio are sequentially created using real-time recordings captured from the surrounding environment at a set interval. Each channel is assigned a "material quality" variable which determines how much the recording will be degraded each time it is played. Once a channel reaches its full degradation, it is eliminated and a new recording is made from the environment and the process for that channel begins again. The process can continue for as long as the listener wishes. Enacting this system in various environments provides a new listening experience within each space. The first run was in a library and after that,

it was back to underneath where the jets take off. In each space, the noises that were most characteristic of that space became prominent within the compositions yet the overall listening experience was one that created an augmented relationship to the surrounding environment. This is partially due to the looping nature of the structure but is also impacted by the results of the degradation on the material being performed.

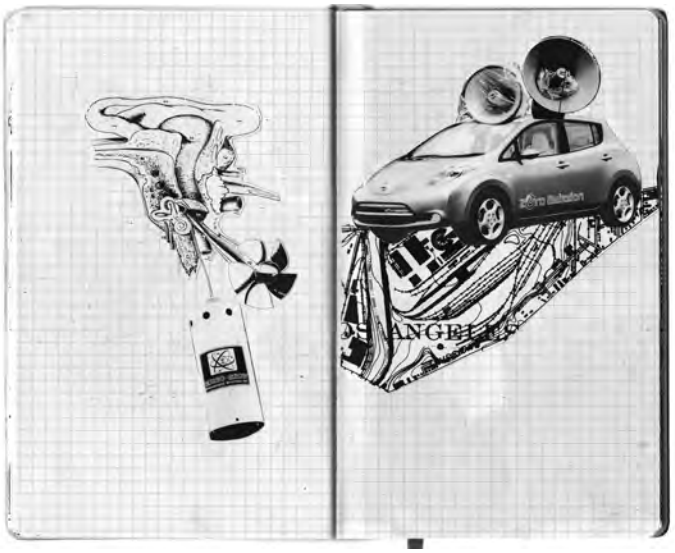
Considering the pervasiveness of urban noise, this different type of listening experience proved to have potential. This early, rough prototype points towards the development of additional interventions between people and the noise that surrounds them.

Staying Noisy

"We build quieter jets but then we put more of them in the sky." -Garret Keizer, *The Unwanted Sound of Everything We Want*

Urban spaces are noisy as a result of the functions and services that make this way of living possible. While there is work to be done on limiting how noisy these aspects of urban living are, there are certain noises that remain necessary for the time being. If we want public transportation, the train cars clank, the bus air brakes gasp and the names of the stops are announced. If we want garbage removal large amounts of garbage from multi-unit apartment buildings need to be frequently consolidated into larger vehicles for transport to a proper disposal station. If we want grocery stores, we need the vehicles that regularly deliver the fresh produce. If we want grassy parks, that grass needs to be maintained. This is not to say that nothing can ever be done about how noisy these elements of the city are. Instead, I'm interested in considering how we operate within these spaces as they currently exist.

In late 2010, the US congress began work on the "Pedestrian Safety Enhancement Act of 2010." [2] This would require that electric vehicles have noise added to them when operating at low speeds. It had been



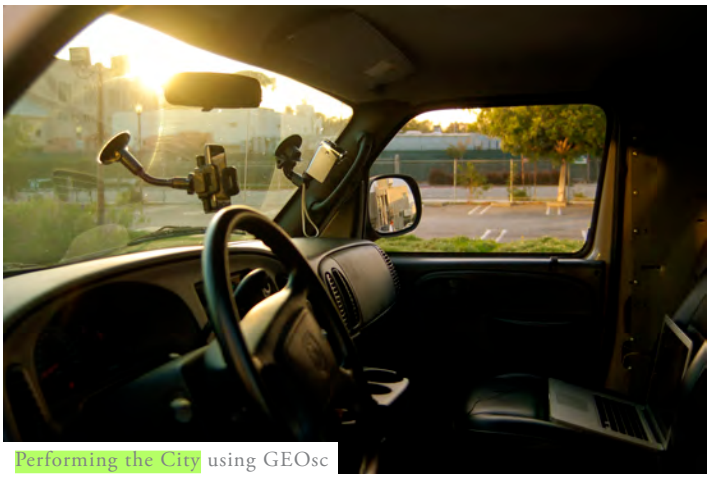
determined that the most recent electric vehicles were too silent to be safe for pedestrians, especially the visually impaired. This meant that cities are too noisy for a relatively silent vehicle to be safe for those around it. Several manufacturers were already working on the additional noise ahead of it being required by law. The Nissan Leaf was the first to get my attention in the matter. They assembled a team that worked with specialists from a variety of fields to tackle the issue of sound design for this new silent vehicle. [3] They settled on a multi-pitch synthesized sound that could be heard well through the din of a city.

There has also been talk that in the future, manufacturers might make alternate engine sounds available for drivers to choose from similar to the idea of ringtones [4] for mobile devices. In the meantime, Ford turned their Electric Focus noise selection process over to the public as part of an advertising campaign where users could vote for one of four possible sounds. [5] The variation between options is minimal and they have similar characteristics to the other artificial electric vehicle noise – relatively high-pitched layered noises intended to cut trough the low and mid range din of populated spaces.

In January of 2011, the "Pedestrian Safety Enhancement Act of 2010" was signed into law by President Obama. Interestingly, in SEC 3(e) [6] it also contained a provision that requires in two years, a new study be conducted to see if standard internal combustion engines have become too silent to be safe and if the addition of artificial noise should be considered for these vehicles as well. If this were to be the case, then we would slowly hear the vehicle noise in our city transition to an artificial noise-scape that has been even more overtly designed than the current practice of engine tuning.

Learning that the Nissan Leaf generated its artificial noise through the use of a synthesizer lead to the creation of a series of sketches investigating different ways in which the act of driving or the use of a moving vehicle could be used in the generation and performance of noise compositions. The experiment that developed from this is called GEOsc. It is an Android app that converts the phone's GPS coordinates into Open Sound Control (OSC) values and sends them over a network to a specified IP address. The values can then be used in a variety of ways for the control and performance of sound. In the case of the initial prototype, it structures and manipulates a series of compositions from various road

noise recordings. The result is a system that attempts to change the drivers relationship to the noise being made by their vehicle. The direction and speed of travel affect how the noises is modified and composed. The decisions the driver makes about their travel impacts the sounds being performed. The intent is to provide a different type of listening experience and possibly inspire a different driving experience as well where the GPS based system is not used for pin-point accuracy in locating a destination but instead inspires wandering decisions based on a curiosity of the affect that it will have on the noise.

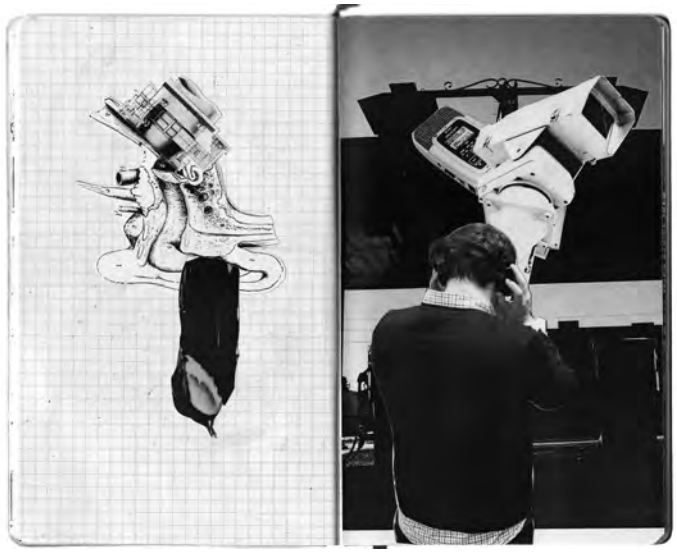


Performing the City using GEOsc

Biological Inspirations

Hearing has been given a lot of credit for human evolutionary development. [7] As hearing beings, our ears are always on and we hear in 360 degrees. This has kept us safe from approaching dangers for the duration of human evolution. Physiologically, we lack the ability to easily block or direct our hearing. This isn't the case with our visual relationship to the world. We have a certain level of control over what we experience visually. We get momentary breaks from visual stimulus when we blink. We can close our eyes or look in a different direction if there is something that we do not wish to see. Ears lack an equivalent to this. As both sound theorists and biologists have pointed out, we have no ear lids and so our ears cannot blink. We also cannot simply listen in a different direction. As a result, noise is very imposing based on this inability to control our listening experience. It also points to why "lack of control" is a key issue when a sound is identified as "noise." [8]

Over the past year, studies have begun emerging that show how certain birds have begun adapting to the noise in urban spaces. A study from the University of Melbourne showed that birds living in urban spaces had differing matting and territorial calls and songs than birds of the same species living in rural environments. [9] The inner-city birds were adjusting their calls in order to compete with traffic noise and the general din of the environment requiring that they sing at a much higher pitch in order to communicate through the noise of the city. The birds modified how they communicate in response to the noise that surrounds them. This is not all that unlike what I witnessed in the outdoor seating area near where the airport runways intersect with the surrounding community. The conversations there took on a characteristic of adjustment in direct relationship to the noise they had to contend with. The changes have thus far primarily been to the generation of the sounds being communicated. The bird song changed pitch and volume. Conversations over coffee changed volume and timing. Instead of considered different ways to generate the sounds being made, what happens if we start to consider the ways in which we listen within these spaces? What if we look to take back control over how we hear, not just how we speak, in these environments?

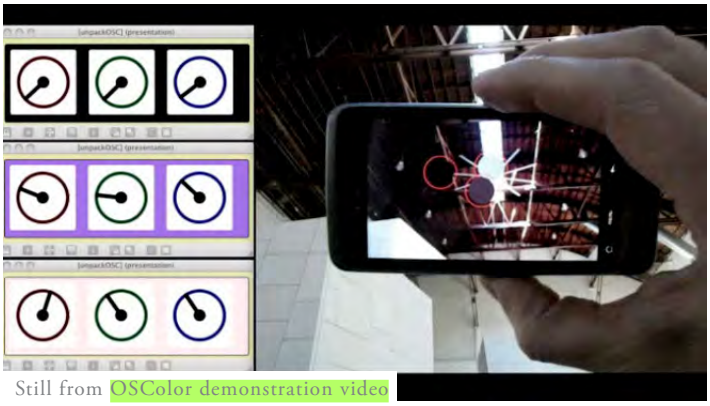


Issues of Control

Control is a major factor when considering a listener's relationship to noise, especially when looking to identify when a sound becomes unwanted. [10] As I spent time in various noisy public spaces, I became interested in the pervasive use of headphones and mobile devices. This represents one significant way people are attempting to take control of their audio space while in public. Pedestrians on the street, people on bikes, subway riders, bus patrons and airplane passengers all can be frequently observed wearing headphones in order to provide a level of control over their personal listening space. With digital music players and mobile devices, a listener can load up with hours and days of digital audio files to listen to while in transit. Essentially, when it comes to audio playback, these relatively powerful devices are being used in a similar way to the earlier Walkman®. Current headphone technologies make it easy to listen to this audio at levels that potentially cover up most of the noise that surrounds them. With this approach of covering up the surrounding noise through volume levels, it's no wonder people have been concerned for years that prolonged use of headphones at high volume levels could pose a risk of significant hearing loss. Beyond the physical damage caused, this approach to covering up the surrounding noise also removes the listener from their environment. Sound is an important aspect when orienting oneself within a space. The discussion of the electric vehicle artificial noise addition points to this.

Out of these observations came a series of prototypes and experiments that investigate how the capabilities of these mobile devices can be explored in order to provided different types of listening experiences and

in doing so, focus less on blocking noise or canceling noise but instead, create an experience that transforms the relationship between a listener and the noise that surrounds them. The first of which is an Android app named OSColor. This app uses color information gathered from the devices camera and sends the values over a network via the OSC protocol for use in the composition and performance of sound. It uses what it sees in the environment to act as a audio controller



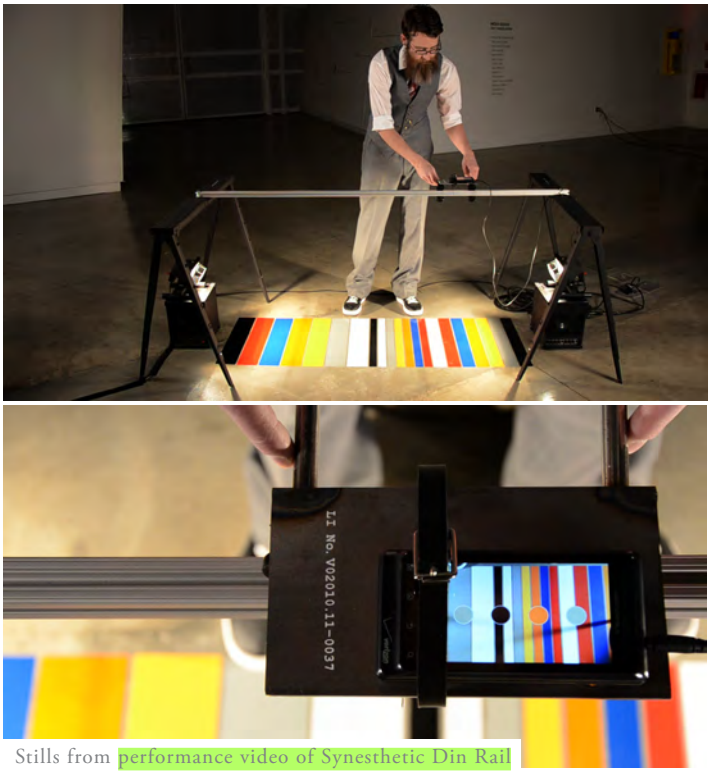
Still from OSColor demonstration video

essentially performing the visual surroundings. In the first prototype, I walked through an interior, quiet space and used the color values to manipulate the performance of an audio recording made while walking through a noisy park. The intent of this experiment is to see what could happen if additional capabilities of a mobile device are exploited in order to act as a moderator between a listener and their environment.

This lead to the development of Synesthetic Din, an app that uses the color information from the camera to perform a series of noise compositions all contained within the mobile device. The values from the camera are used to control and modify the playback of a series of individual field recordings made around the city. Each individual sound within the overall composition reacts to certain values coming form the field of view of the device camera. The difference between Synesthetic Din and OSColor is that Synesthetic Din is contained entirely on the mobile device and more strongly represents my hand as the composer of the system and the noises used whereas OSColor is open in the form of a tool to be used by other sound artists in whatever way they see fit. Synesthetic Din is also an experiment in releasing an app instead of an album and de-Walkman-ify these mobile devices. OSColor is an investigation into the mobile device as a way to wirelessly interface with a larger system as determined by the composer or musician who downloads and uses it.

Still from demonstration video of Synesthetic Din

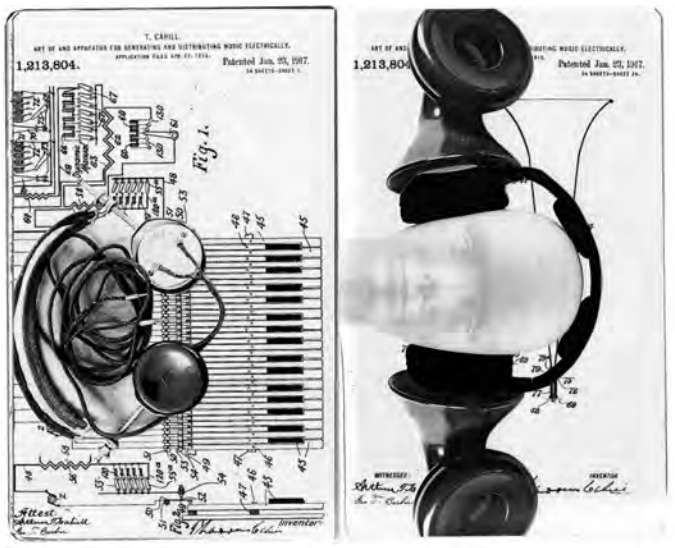
The second iteration of Synesthetic Din was to develop a physical system that could exist in a gallery context as an interactive installation yet provide the user with a listening experience based in urban noise in a way that would render the noise differently familiar. In addition to the use of the device's capabilities, I'm also interested in how these devices can be docked into larger systems in order to enhance their functionality. For Synesthetic Din Rail, I designed and constructed a system that a mobile device would dock into in order to enhance the instrument-like qualities of the Synesthetic Din app. The system would allow for the user to perform the visual space directly underneath the device which was mounted into a trolly that slides horizontally on a length of track. The space being performed is designed in such a way that relates to the environment in which the piece is installed. In the case of the example below, the floor was an imperfect concrete floor so the use of colors from the ground of urban spaces was appropriate. Colors such as no parking red, safety yellow, handicap blue and crosswalk white all attempt to build a sense of the urban marks used to visually identify different types of spaces within an urban context. This system then uses those composed colors to control the performance of a series of urban noise compositions based on the user's interaction with the system.



Stills from performance video of Synesthetic Din Rail

These projects are not concerned with the canceling or blocking noise. There are too many drawbacks in terms of both health and spacial awareness. Elimination may eventually be possible but if we are in a time when we are adding noise to objects because they are too silent, increased elimination does not seem as though it will be soon. Instead, my projects are interested in investigating ways of transforming the relationship between people and the noises that surround them.

As I spent more time sketching around ideas of headphones and controlled listening, I became interested in the potential for mechanically altering how we hear through the use of a different kind of headphone. The goal was to create a system that while worn, would change how a user hears in a given environment. It also needed to operate as a orchestrated performance able to be composed or designed by an artist as well as manipulated by the end listener. I was also reminded of the earlier thoughts regarding the human ear and its inability to blink. I set out to make a set of headphones that would allow for the mechanical control and modification of the listener's relationship to the noise around them. Not only would it alter the noise but, based on the earlier noise collection experiments, it also needed to provide a sense of structure to the noise around. This structure becomes one of the elements of control used to affect the otherwise steady stream of noise as it makes its way to the listener's ears.



Noisolation Headphones. Initial prototype.

The first Noisolation Headphones prototype was built simply to get the mechanical components and the electronics functioning. It was a cheap, quick and messy proof of concept. A three dimensional sketch that took the idea from the sketchbook out into space to begin thinking in different terms about how it operated. The mechanism worked but the primary realization now was the importance of the acoustic qualities of the materials selected. The initial prototype used plastic piping. It was light, cheap and easy to work with however it did not have the proper visual or auditory impact for the final

Final Noisolation Headphones worn by Mikey Tnasuttimonkol
Photo by Mikey Tnasuttimonkol & Jeremy Eichenbaum

experience. Like the early Edison tinfoil recorders that I am so intrigued by, the materials used have a direct impact on the entire experience of the piece. After some additional material explorations, copper piping was selected. It provided the most engaging balance between the aesthetics for the device and the acoustics for the listening experience. The valve operation is also integral to the listening experience. The valves are opened and

Noisolation Headphones
Alex Braidwood
2011

closed by the sequences programmed onto the mobile device. When they are open, they allow more noise to travel down the pipes to the listener's ears. When they are closed they block more noise. Also, while opening and closing the valves act as dampeners and change the resonant qualities of the copper pipe. When worn, what the user hears is the noise that surrounds them but in a modified way. The device creates an individual performance of the listener's audio surroundings. By using this mechanical listening appendage, the user is able to refocus their hearing attention in different ways in various situations. It offers a personal listening environment that draws attention to different aspects of the space and in the best case, inspires an exploratory listening experience to discover new relationships to noise and its sources. Different tones and frequencies resonate differently through the mechanical components causing a real-time remix of whatever noise is happening around the listener. Instead of simply blocking or canceling out the noise, the intent with the Noisolation Headphones is to render the noise differently familiar.

Conclusion

Populated, urban environments are not getting quieter and this is a direct result of what makes this way of living possible. As is indicated by the new kinds of noise being introduced into these environments for safety and communication, elimination is not a viable option at this time. Attempts to block the noise or cancel it out bring with it their own set of issues and shortcomings. Instead of working to cancel out the noise or eliminate it, these projects are interested in finding ways of creating different ways of experiencing the noise. These critical explorations attempt to transform the relationship between people and the noise that surrounds them by rendering the noise differently familiar. In doing so, the potential for new types of listening experiences emerge. The individual works that make up the larger Listening Instruments project are not concerned with hearing better. Instead, they are focused on listening differently.

References

[1] "Reconsidering Earliest-Known Recording." All Things Considered. NPR, June 1, 2009. http://www.npr.org/templates/story/story.php?storyId=104797243.

[2] Sen. John Kerry [D-MA]. Pedestrian Safety Enhancement Act of 2010, 2011. http://www.gpo.gov/fdsys/pkg/PLAW-111publ373/html/PLAW-111publ373.htm.

[3] Hall, Kenji. "A lot of feedback went into Nissan Leaf s sounds." Los Angeles Times, 2011. http://articles.latimes.com/2011/jan/01/business/la-fi-electric-car-noise-20110101.

[4] Boyd, Clark. "Adding Sounds to the Silence of Electric Cars." PRI s The World, June 27, 2011. http://www.theworld.org/2011/06/adding-noise-to-electric-cars/.

[5] "Now Hear This: Facebook Fans Help Ford Review Sounds for All-New Focus Electric", July 25, 2011. http://corporate.ford.com/news-center/press-releases-detail/pr-now-hear-this2658-facebook-fans-34958.

[6] Sen. John Kerry [D-MA]. Pedestrian Safety Enhancement Act of 2010, 2011. http://www.gpo.gov/fdsys/pkg/PLAW-111publ373/html/PLAW-111publ373.htm.

[7] Prochnik, George. In Pursuit of Silence: Listening for Meaning in a World of Noise. 1st ed. Doubleday, 2010. 67.

[8] Keizer, Garret. The Unwanted Sound of Everything We Want: A Book About Noise. 1st ed. PublicAffairs, 2010. 38.

[9] Potvin, Dominique A., Kirsten M. Parris, and Raoul A. Mulder. "Geographically pervasive effects of urban noise on frequency and syllable rate of songs and calls in silvereyes (Zosterops lateralis)." Proceedings of the Royal Society B: Biological Sciences (2011). http://rspb.royalsocietypublishing.org/content/early/2011/01/05/rspb.2010.2296.abstract.

[10] Keizer, Garret. The Unwanted Sound of Everything We Want: A Book About Noise. 1st ed. PublicAffairs, 2010. 38.