Echoes of the Land:

Exploring the Soundscape of Pre-Colonial Montreal Through RFID-Enabled Interactive Media

Prototype Progress Report

Documentation Website | Bibliography | Visual Design Document

Kathryn Lee
Computation Arts Specialization,
Concordia University
Montreal, Canada
l_kathry@live.concordia.ca

Jennifer Brown
Computation Arts Specialization,
Concordia University
Montreal, Canada
br_jenni@live.concordia.ca

Keywords

Emergent Soundscape; Interactive Design; Prototype Development; Radio Frequency Identification; Tangible Media.

Abstract

Our goal is to create an interactive soundscape representative of pre-colonial Montreal, invoking a desire for exploration, education, and an appreciation of the natural land on which we reside.

This report details the prototyping process to date as we develop our interactive soundscape, entitled *Echoes of the Land.*

Ideation, Iteration and Prototyping

Prototyping has been invaluable in our design and production process. While our initial design appeared to us as functional and easily implementable, working with our components and sensors greatly clarified the limitations we work within. Our design has evolved not only to better suit these strengths and restrictions, but to better serve our desired interaction.

Additionally, discussing our designs with others has provided us with crucial feedback, suggestions and critiques. We have learned how a tangible representation enables far greater communication of intention,
and allows for further discussion inaccessible when communicating via words and images alone. The consideration of electronics housing, internal stability, and component accessibility for troubleshooting has similarly been a significant process of ours, enabled and highlighted by the construction of a tangible prototype.

Division of Labour

Jenna

I primarily focused on the RFID reader setup and related circuitry throughout this project. Much of my focus has been on efficiently organizing multiple readers such that they may be placed easily within the housing, use minimal Arduino pins/breadboard space, and are easily accessible for troubleshooting. Alongside this, I have been coding and experimenting with the MFRC522 Arduino library (Balboa, 2012). Lastly, I have been working to maintain clean documentation, records of feedback, and citations.

Katt

I focused on the design aspects of the project. While the overall concept was thought of together, I drafted mockups and the logistics with our proposed plan and now revised prototype. I worked on compactly housing all the necessary components and built the initial prototype structure. Additionally, I have been researching other artists' work to create a living document of our progress and to host references regarding the visual design.

Sensors and Materiality

Sensors and Circuitry

Within our prototype, we utilize 3 MFRC522 RFID readers connected to a singular Arduino Uno. We aim to expand this to 6 readers for our final product. As a low-fidelity example of sound output, we utilize a passive Piezo buzzer. All wired components connect to a single breadboard, embedded within the cardboard housing.

Our use of RFID results in the ability to fully obscure circuitry and components within the board. Throughout prototyping, we tested the sensor's ability to wirelessly receive RFID tag information through varying materials of varying depths. We had great success with their ability to read through non-metallic materials like cardboard and wood up to distances of approximately 1.5 inches. While we plan on developing our final housing structure from wood, any RF-lucent material should serve our function (Payeur). Consequently, our sensors allow for a greater exploration in the visual design of the final result.

Our greatest difficulty in working with the MFRC522 reader was surrounding the implementation of multiple readers within a single microcontroller. This is a common intention amongst those working with these readers, and as such we were able to find several examples of different multi-reader implementation strategies. We primarily referenced Github user *Annaane*'s implementation (Annaane, 2019).

Within our prototype, we attach 3 readers to the Arduino, using only 7 pins, not including power and ground, connected via SPI. Each reader uses 4 pins for communication, 2 for power/ground, and one as a reset. The interrupt pin is unused in our context. 3 of the communication pins (MISO, MOSI, SCK), and the reset pin are shared amongst the readers. A final communication pin (SDA) is uniquely connected to the microcontroller for reader identification. As such, we are able to identify the location of a placed tag and read its information. Presently we identify tags via their UID - a unique identifier defined by the tag manufacturer - with the piezo buzzer playing a unique tone for each declared UID when detected.

Housing and Design

For our prototype, we opted for a table top display. We chose a minimalist approach to a topographical map for the design of the surface. Raised and depressed reliefs mimic the original landscape of the Montreal area. Regarding the visual design of our board and objects, we draw inspiration from Joon Moon and Moto Waganari who utilize simple silhouettes and shapes within their sculptural works. Waganari is a sculpture artist whose main medium is wire work; Joon Moon is an installation artist who incorporates AR technology with light and shadow to create stunning moving images.

Keeping to the style of the board, the miniatures would take on a more geometric shape. Up until the day of the prototype presentation, it was decided the miniatures would be made out of wire. What was still unclear was how representational they would be in form. Much of our efforts were focused on the board, as it is the central object in our piece.

Given the time we had, the main concerns were with the board itself and how we can effectively communicate our idea without explicitly telling the viewer everything. During this process we tried to keep in mind what someone who has no idea about the concept would do with what we're presenting them.

Changes Throughout Development

The core intention of our project - to create an interactive soundscape designed to educate and foster an appreciation for Montreal's pre-colonial environment - has been maintained throughout development. In this regard, no - our initial intention or meaning has not changed. However, there are of course more fluid elements.

Our initial design surrounded the use of a wall-mounted board to depict the landscape, constructed of a magnetic material allowing for tag-object placement anywhere upon the board. We intended to house RFIC readers underneath this magnetic board, and to visually display the pieces as 'shadow puppets', utilizing lighting directed up onto the board. This design includes some notable flaws, such as the RF-opacity of metallic materials and the readers' lack of radial range (MFRC522's are strictly effective at reading tags perpendicular to their face) (*In-Depth*, 2018), (Payeur, 2019). Additionally, the lighting would need to be a guaranteed distance from the tag-objects for the shadow projection to work as intended, and the vertical mounting likely would not have been conducive to our intended interaction and user experience.

Since, we have reconfigured our previous board design to consist of a tabletop piece, constructed of wood, topologically representing the island through layers of precision-cut wood. We have limited the placement options for our tag-embedded objects to a few areas cut to fit the object bases, directly above

one of the several RFID readers. This design presents far fewer challenges in working with RFID technology, and allows for more exploration within the visual design of both the board and objects. Similarly, the circular, table-top nature of the design creates a more communal interaction amongst participants, and allows for greater ease of object placement.

Bibliography

Annaane. (2019, January 19). *MultiRfid*. GitHub. https://github.com/Annaane/MultiRfid

Balboa, M. (2012, January). *Arduino RFID Library for MFRC522*. GitHub. https://github.com/miguelbalboa/rfid

Eiche, A. (2010, June 29). A Beginner's guide to Making an Arduino Shield PCB. *AaronEiche.Com*. https://aaroneiche.com/2010/06/24/a-beginners-guide-to-making-an-arduino-shield-pcb/

In-Depth: What is RFID? How It Works? Interface RC522 with Arduino. (2018, July 30). Last Minute Engineers. https://lastminuteengineers.com/how-rfid-works-rc522-arduino-tutorial/

Ishii, H., Mazalek, A., & Lee, J. (1999). *Bottles as a Minimal Interface to Access Digital Information*. MIT Media Laboratory. https://trackr-media.tangiblemedia.org/publishedmedia/Papers/466-Bottles%20as%20a%20minimal/Published/PDF

Ishii, H., Mazalek, A., Lee, J., Fletcher, R., & Paradiso, J. (1999). *musicBottles*. https://tangible.media.mit.edu/project/musicbottles

Joon Moon 문준용 *portfolio*. (n.d.). Retrieved November 4, 2023, from https://www.joonmoon.net/

Joseph, J. (2022, May). *Interfacing RFID Reader With Arduino*. Circuit Digest. https://circuitdigest.com/microcontroller-projects/interfacing-rfid-reader-module-with-arduino

Lewin, J. (2012). *Chandelier Harp*. https://www.jenlewinstudio.com/portfolio/chandelier-harp/

MFRC522 Standard performance MIFARE and NTAG frontend. (2016). NXP Semiconductors. https://www.nxp.com/docs/en/data-sheet/MFRC522.pdf

Miranda, E. R. (2008). Emergent songs by social robots. *Journal of Experimental & Theoretical Artificial Intelligence*, *20*(4), 319–334. https://doi.org/10.1080/09528130701664640

Moto Waganari – artist. (n.d.). Retrieved November 4, 2023, from https://motowaganari.wordpress.com/

Payeur, C. (2019, August 22). RF-Lucent vs. RF-Opaque: Component Materials in RFID Systems. *Computype*. https://www.computype.com/blog/the-importance-of-component-materials-when-constructing-rfid-systems/

Smart Lock for an Escape Room: Multi RFID Readers System. (2018, April 23). https://www.youtube.com/watch?v=ahc8Yai_sWI

Tangible, & Wu, J. (2011). *jelly swarm*.