OIKOTONICA — Digital Musical Instrument Bridging Play and Place

Sofia Viviani Helleberg
Interaction Design Bachelor
Malmö University,
Malmö, Sweden
sofiavivianihelleberg@gmail.com

Oikotonica, derived from the Greek words "Oikos" meaning home and the musical term "Tonic", or translating to "Sounds of Home" is a transitional musical instrument that adapts to its environment. The instrument functions as a MIDI controller to be merged with existing digital musical setups. Its pursuit is to help users build connections with surrounding ecologies via adaptive sonification, aiming for users to reflect on the pluriversality of places. By converting environmental data into MIDI signals during live play, Oikotonica creates ever evolving and non-replicable interactions. Oikotonica is a palm-sized, laser-cut MDF device with strategic cutouts for data collection through sensors. The flow of information can be modulated by covering the cutouts or repositioning the artefact. Three texturized LED buttons dictate what environmental factors will impact the live play. Respectively representing humidity, ambient sounds, and light of the setting.

I. Introduction And Background

Digital Musical Instruments enable consistent, cohesive, and replicable musical experiences across the globe, remaining uniform regardless of location, audience, or traditions. Adopting a Pluriversal perspective asks for preserving the mark of the cultural and environmental reality we inhabit, celebrating contextual nuances that exist in accordance to places [4].

This report documents the design process of Oikotonica, an instrument that transforms live environmental data— sound, light, and humidity—into MIDI signals. The unpredictable live sound alteration incorporates the environment's dynamic essence into the music. Through the combination of live adaptive sonification and the interaction of playing a musical instrument, this report explores the intersection of technology and environmental awareness as an artistic expression.

A Pluriverse is composed of places, cultures, and traditions, aiming to coexist in a reality that preserves and celebrates inherent differences. Toretta [4] expands the philosophy of Pluriverses to music by questioning the propriety and value of local musical instruments. The Brazilian Rebecca serves as an example of a Pluriverse artifact. Although constructed using classical violins, it is played and tailored according to individual preferences and native traditions. A Rebecca will, therefore, never sound or be played the same way. A world composed of Pluriverses is one where each space can be identifiable by its unique sound expressions.

3.1 Voicing Ecologies through Sonification

Although environments possess inherent sonic characteristics—either by human design or through manifestations of the natural world—there are aspects of their fluctuating ecologies that remain voiceless. These silent factors can be captured through data collection and expressed through Sonification. Sonification is a growing field where sound designers convert data into sound as information delivery, emphasizing shifts across time and through non-speech sounds [5].

Sonification traditionally occurs as a post-production process, but there is a call towards exploring live interactive dimensions. Design opportunities emerge while striving to connect users to sonified data via activities mediated by artifacts. Embodied actions could provide opportunities for Kinesthetic Creativity—the use of abstract bodily movements—as a means to explore through gestures, extend our senses, and consequently build awareness of surrounding ecologies [3].

3.2 Sensor based Digital Musical Instruments

Sensor-based data collection has been used as a method for constructing digital musical instruments (DMIs). Sensors extend the ability to leverage the material and corporeal qualities of musical artifacts. The post-DMI framework aims to reward curiosity by emphasizing changes experienced through musical instruments as transitional objects [2]. The fascination of change can be achieved through adaptive sonification, where the sonic characteristics evolve according to the spaces we inhabit, providing a Pluriverse lens to future DMIs [4].

II. Related Work

The following prior art serves as examples that resonate with the nuances of Oikotonica. Each project reflects individual approaches to sonification, play, and materiality.

3.1.1 Organum Vivum

Organum Vivum explores an interspecies approach to sonification and music, by introducing a self-grown bacteria to humans. The living material is sensitive to environmental factors such as humidity and temperature, which provoke a sense of unpredictability within the interaction. It encourages alternative ways of play through pinching, stroking, and the use of external materials [2].

3.1.2 S/A/S/A

S/A/S/A is a collaborative instrument, composed of 10 interactive blocks, five with capacitive sensors, and the other five with textured surfaces accompanied by a contact

microphone. The use of materials emphasizes the sonic characteristics of each block, coupled with tactile interactions in the form of scratching and stroking (Hinrichsen & Bovermann, 2016).

3.1.3 Breathless

Breathless, is a layered performance that addresses critical world events by sonifying live biological data, extracted by using a multitude of sensors–galvanic skin response (GSR), blood volume pulse (BVP), an accelerometer, and a thermometer. The information is expressed through a multi-sensory experience, combining auditory and visual elements. The author's abstract take created a space for personal reflections and interpretations [1].

3.1.4 The Sound Beings

The Sound Beings is a touch-based interactive system composed of auditory beings that evolve through external user input. The creators explore the turn from classical to systemic sonification. A so-called Sonic Dialogue is created between the system and the user–establishing interactions with the beings whilst simultaneously being influenced by them [3].

III. Imagined or existing prototype sketches/drawings/photos

A. Technology

An array of sensors was combined and converted into MIDI CC signals to be integrated with a Digital Audio Workstation, in the context of the project–Ableton Live. The interpretation of sound is subjective, prior experiences and cultural background affect the way users resonate with auditory changes [5], thus Ableton allows to map the sensors to different sound qualities e.g. being reverb, pitch, or pan. To encourage instances of Kinesthetic Creativity, BLE enabled embodied and free-range interactions with the instrument [3].

Two Arduino Nano Sense 33 BLEs were utilized due to their compactness, built-in sensors, and BLE connection. The sender returned the environmental data: HTS221 sensor recorded humidity, APDS-9960 registered light, and PDM microphone detected external audio. The sensors were activated via their respective buttons with built-in LEDs – blue for sound, green for humidity, and white for light. Recorded data was mapped to varying MIDI CC values ranging between 0-127, which were converted and sent by the second receiver microcontroller (see Figure 1). The Arduino MIDIUSB library was utilized to transform emerging data into MIDI signals.

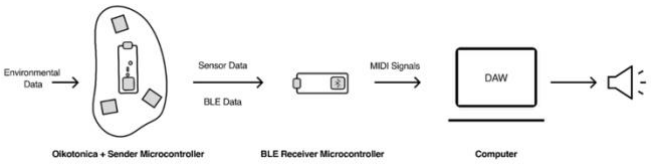

Fig. 1. The project's technical architecture diagram

B. Tangible User Interface

The tangible user interface consists of three buttons, each at a different extremity of a palm-sized MDF casing. The canter of the casing features a laser-cut pattern with strategic cutouts that allow external factors to be detected by the microcontroller while simultaneously keeping it protected. Additionally, they partially allow for influencing the sensor via direct user input. The buttons are color-coded through integrated LEDs and are covered by distinct textures, making them easily recognizable solely by touch.

Fig. 2. The final prototype of Oikotonica demonstrates the look & feel. Pay attention to the buttons, and cutouts.

IV. Responsible innovation

In terms of materials and sustainability, the prototype uses a small, energy-efficient setup and is housed in laser-cut MDF—a readily available material often made from recycled wood fibers. Future versions will explore more sustainable options, like biodegradable components or local fabrication methods. Oikotonica is meant to contribute to a more responsible way of thinking about technology—one that's creative, conscious, and rooted in place.

V. Author bio / experiences

This project was driven by my passion of exploring ways to give silent environmental factors a voice. I work comfortably with creative coding, and I have a strong background in information, interaction, and graphic design.

VI. Citations

[1] M. Hedayati "Breathless: A sensor-to-sound performace" *in Proc. 11th Int. Conf. on New Interfaces for Musical Expression (NIME '23),* 2023.

[2] A. Hinrichsen and T. Bovermann, "Post-DMI musical instruments", in Proc. AudioMostly Conf. (AM '16), pp. 124-129, 2016.

[3] M. Seiça, L. Roque, P. Martins, and F. A. Cardoso, "An illustrative design case of systemic sonification", in Proc. 17th Int. Conf. on Auditory Display (ICAD '22), 2022.

[4] N. B. Torretta, "Music & Power: Stories & invitations of resistence", in Waves of the Blue Sea – Future of Song and Sound, Media Evolution, pp. 68-93.

[5] J. Wirfs-Brock, J. Perera, and D. Geere, "Open sonifications: A manifesto for many ecologies of data and sound", in Proc. 2024 ACM Designing Interactive Systems Conf. (DIS'24), pp. 2660- 267, 2024.