AUGURY : an interface for generating soundscapes inspired by ancient divination

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ABSTRACT

This paper presents the development of a multichannel sound installation about atmospheric processes. This instrument is an example of taking inspiration from ancient cultures for NIME design, and of sensing weather to extend the perception of the performer, who also then becomes a listener of atmospheric processes. The interface channels dynamics found in the atmosphere: wind's force and direction, air quality, atmospheric pressure, and electromagnetism. These sources are translated into sound by mapping sensor data into a multichannel sonification composition. The paper outlines the artistic context and expands on its interaction overview.

Author Keywords

Atmospheric Soundscapes, Sensing and Prediction, Weather Sonification, Multichannel Installation

CCS Concepts

•**Applied computing** → **Sound and music computing;** Performing arts;

1. INTRODUCTION

This instrument emerges from an artistic research that has revolved around environmental sounds and atmospheric processes, such as the wind and the electromagnetic spectrum. This initiative started by exploring generative and non-deterministic methods for music making. As a sonic exploration, it departed from the idea of creating soundscapes related to the elusive and often complex phenomena, that compose the weather. The process of translating these energies into audio is known as energy transduction [6] and relies on the attributes of physical and embedded-ubiquitous computation [5], such as micro-controllers. The relationship between the atmosphere and sensing technologies acts as an agent to augment the perception of environmental and surrounding processes that reach beyond embodied means of sensing and predicting the weather.

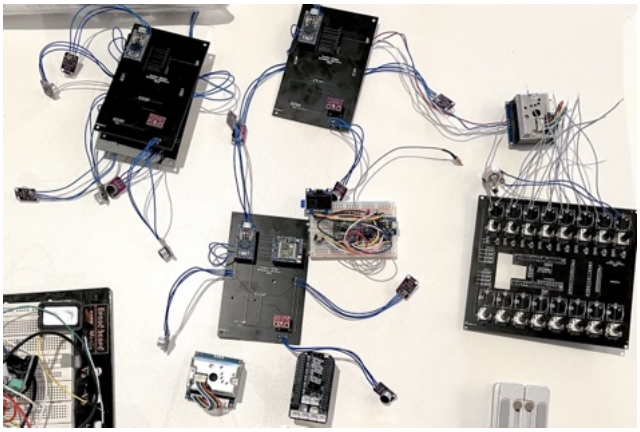

Figure 1: Prototyping weather stations and multichannel system

In this research, producing sensing technologies implies a set of translations through sonification across digital and analog signals. Hence, the wind's motion, force, and air quality are obtained by employing sensors and mapping this data into sound synthesis with Pure Data. This kind of ensemble can make audible the physical dynamics from the wind, air, and electromagnetism. These kinds of processes are familiar in today's environmental sensing media art [9], however, sensing and predicting the weather has a long history of experiments prior to computation and electronic media [11, 13]. Considering these cases which balance art and science, technology, and mythology, leads to a hybrid knowledge about our atmosphere.

2. ARTISTIC BACKGROUND

This NIME takes as reference instruments that interact with natural forces, for instance, the work by the Mexican artist Ariel Guzik, who creates sensorial ecologies with the environment through sonic instruments and installations that engage in counterpoint with non-human sonority [8]. Guzik and other artists from the Global South engage with recent indigenous technologies for digital musical instruments that reinterpret ancient technologies such as the Andean culture-inspired sequencer Kanchay Yupana [1] the Sonified Textiles -Text(il)ura [3] and the Tibetan Singing Prayer Wheel [12].

In media arts, technologies for divination have been discussed [10] as means to bring attention to things that we cannot normally or do not usually sense, that is, what we can interpret from the natural world which may be beyond

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Figure 2: Details of the built prototypes

our usual senses. This approach highlights the combination of embodied and technology-based sensing of the weather to proceed to the ancient art of divination through technology [10].

Recent claims from preemptive and speculative design in computing [7] point out information to draw reasonable expectations from predictions, thus, minimizing entropy in a complex system, such as our atmosphere, based on information feedback-preemption. Similar to the weather stations used in this project, predictive systems employ collaborative intelligence with distributed computing involving a network of autonomous agents to obtain interpolation and extrapolation based on long and short-run statistics in scheduling time and resources [7].

3. DESIGN OVERVIEW

As ancient knowledge, this project is inspired by a Greek weather prediction device known as Parapegmata, and the Aztec myth of Tezcatlipoca. These two sources inspired the design of the user interface and the overall performance of the instrument. The Parapegmata was a Greek-Roman astrometeorological artifact that registered astral and earthly events to forecast the weather. It consisted of an inscribed stone with movable pegs inserted into bored holes [11]. Thus, in this project, the user interface combines aspects from the Parapegmata, especially the combinatory movable pegs. Using lofty weather stations refers to another ancient divination practice known as Augury, which relies on observing the behavior of birds to anticipate future events [4]. The weather stations play a role as metaphor of emissaries or proxies who sense out the atmosphere and then feed the instrument to play alone. The dawn chorus is an atmospheric natural radio or electromagnetic phenomenon in the upper atmosphere happening in the early hours of the day sounding like a flock of birds chirping [6]. Tezcatlipoca is an Aztec deity associated with providence and divination, the night winds, hurricanes, and obsidian stones, among others [2]. Since the name Tezcatlipoca in Nahuatl means smoking mirror, in this installation this idea is represented with mist machines that react to atmospheric pressure density while the installation is running, the user interface also employs movable obsidian stones and one obsidian mirror disc.

In reference to contemporary methods, the piece employs weather stations equipped with four electret microphones placed in Cartesian orientation, a digital barometer, and a dust-particle detector, along with a software-defined radio device that is used to capture real-time radio signals obtained from the atmosphere. The weather stations transfer sensor data to the user interface using long-range radio modules. The user interface employs a Bela Mini Multichannel Expander with eight output channels. This multichannel system enables the sensor data to be treated as audio in multiple threads simultaneously, leading to an immersive experience of sound distributed through multiple speakers placed in a room, this arrangement corresponds to the data from different weather stations. The previously mentioned obsidian mirror has copper trace, which act as a touch sensor to trigger the installation. When the user positions stones into bored holes from a surface, this action enables to switch between types of sensors and number of stations that feed the generative soundscapes in this installation.

Figure 3: Current iteration of the multichannel system

4. DATA MAPPING AND SONIFICATION

The direction of the wind is measured across four cardinal points located at each of the four weather stations. This provides sixteen points for switching or modulating the sound panning across pairs of speakers in the installation. The direction of the wind is calculated from the strength of signal detected by the microphones on the stations. The barometric pressure and dust-particle measurements are averaged across the four stations, and these are used as weights to modulate a set of wave table controlled oscillators, filters, and envelopes that compose the generative soundscapes. Recordings from the dawn chorus obtained with software-defined radio are used as audio sources which are sampled into the wave tables. The system will store hourly average measurements every day per hour, and these will be compared with previous days to create estimations of future events.

5. USER INTERACTION

To start the installation, users should touch the mirror and keep pressed to switch between sensing and predictive modes. To indicate when the predictive mode is on a mist machine turns on behind the obsidian mirror. The user interface has eight movable pegs which control different sets of data mappings, therefore the data-to-sound mapping is reconfigured if the pegs are moved. When the stones are placed into the surface holes, user can switch across mapping modes, turning on one or many weather stations, or one to many sensor registers.

6. INSTALLATION SETUP

This system uses a custom circuit board that connects to the Bela Mini and an Arduino Micro, which is in turn connected to a Lora receiver. This circuit board also handles the sensor inputs for the movable pegs, the mirror, and the output for controlling the mist machine. The weather stations also have custom circuit boards that connect the electret microphones pointing at the cardinal points, as well as the dust particle sensor and barometers. These networked weather stations also have Lora modules that act as transceivers, hence, they will be configured to transmit data to the closest node to avoid transmission loss. The software is programmed in Pure Data to render the multichannel spatialization, converting data into wave tables to use for synthesis that make audible the data while the installation is running.

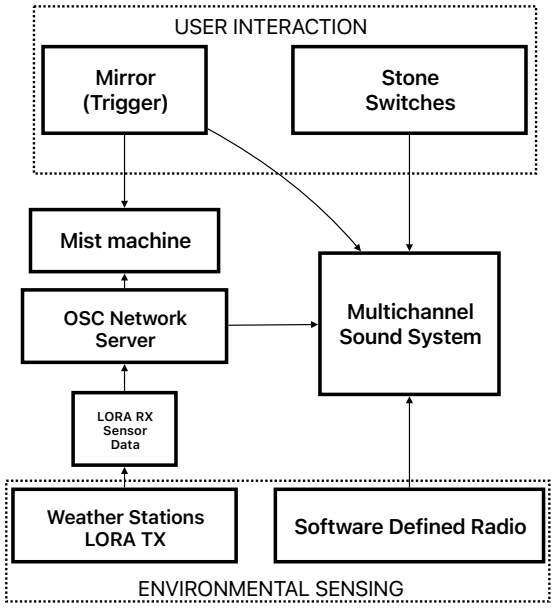

Figure 4: Interaction flow

7. SUMMARY AND FUTURE WORK

This paper presented an overview of a work in progress for a sound installation inspired by ancient methods of sensing and prediction of the weather, based on the Parapegmata and the myth of Tezcatlipoca. These methods come into being with interactive digital technologies agencies, and the experience from other NIMEs, and environmental media artwork. The predictive mode is still in process of development, as well as building and testing the user interface. It is also planned to include Ambisonics for more detailed spatialization. It is also expected to investigate how to register the dawn chorus with software defined radio.

8. ACKNOWLEDGMENTS

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9. ETHICS STATEMENT

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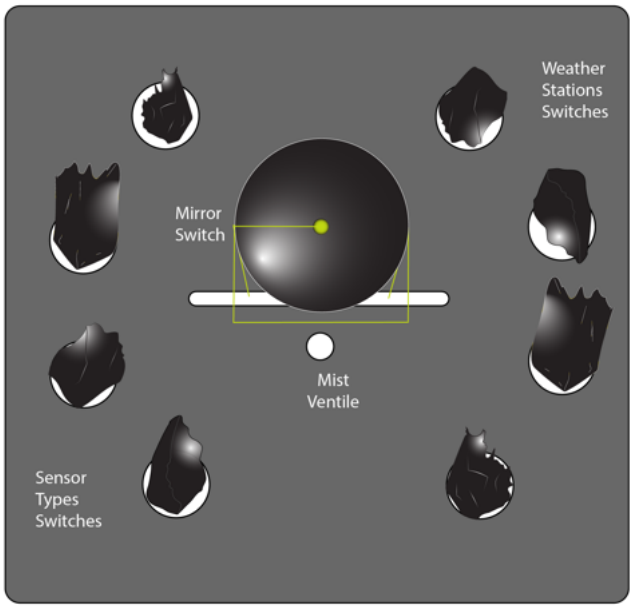

Figure 5: User interface

The prototypes were built and tested during the "Sensing Media" residency at Medialab Matadero in 2022.

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