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Plantorumori - first report

Paper

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Abstract. *Plantorumori*, our research and art work, is about complicity with plants. Our aim is to use music as a conciliator to create subjective communication channels with nature, particularly with plants. The communication channels that we want to “open” with plants are, however, a utopia. We are dealing with entities that do not manifest themselves in ways we humans can easily perceive. We are attempting to understand how relationships could be outside the realm of logic, numerical truths or intersubjectivity. To accomplish this desire, we want to explore the opening of “communication channels” with plants using a wide range of technologies and interfaces to nurture a subjective relationship with nature and to integrate that “contribution” in musical performances.

Keywords: Music Performance, Plants, Interfaces.

Introduction

The general purpose of the *Plantorumori* project is the creation of sonic worlds emerging from symbiotic relationships between humans, plants and digital interfaces. This is a path that we have been pursuing in our artistic work over the last few years, both individually and together^{1 2 3 4}. We share a common philosophical and technological ground that, we believe, could give rise to innovative artistic questions and artistic experiences that could be beneficial not only for the arts community but also for public awareness. Looking at plants and nature and creating art that also raises awareness is especially important at this moment in the history of our planet, considering the immense challenges of global warming, pollution, public health or sustainability. The main outcome of the *Plantorumori* will be a performance (and its ideas) supported by a hybrid symbiotic installation. We believe, nonetheless, that this research can really open up a series of possibilities that will transcend the timeframe of that particular event, both for the scientific project and to our own artistic activity. To support and structure the performance, we are developing a “sonic language”, (i.e. technological tools, sonic vocabulary, theoretical ideas) made of sonic gestures that could work as the “idiom” of a communication process to bond plants, interfaces and humans.

We have referred to some of our previous work has “tuning people, birds and flowers” and some of our projects, artistic and educational, have addressed the concept of “soundscape” proposed by Murray Schaffer (1980)⁵. We also have worked in the development of tools to allow artists, educators, the “common person” and the “not so common person”

¹ Lopes, F. and Paulo Rodrigues. 2014. “POLISphone: Creating and performing with a flexible soundmap.” *ICMC*. pp. 1719-1724.

² Lopes, Filipe, Paulo Rodrigues and Helena Rodrigues. *Pensamentos POLISfónicos*. (Lisboa: Fundação Calouste Gulbenkian), 145-171

³ Filipe Lopes, “Labjazzica: Afinação das sementes”, *Revista Portuguesa de Educação Musical*, nº 142 -143 (2017): 78-89.

⁴ Lopes, F. and Rui Ferreira. 2017. “Cant(a)eiro: A program for music creation in schools”. *X International Research in Music Education Conference*. pp 66-67

⁵ Schafer, R. Murray. *The tuning of the world: Toward a theory of soundscape design*. Philadelphia, PA, USA: University of Pennsylvania Press, 1980.

(the disabled) to express themselves musically⁶. In the *Plantorumori* project these work experiences are regarded as our background which we wish to expand, thus, *Plantorumori's* challenge will be to deal with "soundscapes" that are still unknown to human ears.

Plants were regarded, for centuries, as primitive beings, until fairly recently we started to understand that they have sophisticated communication strategies that allow them to communicate between themselves and with the environments they live in. For instance, it is now widely known that the roots of plants and trees behave as the plant's "brain" because they talk, trade and wage war on one another to survive⁷. In fact, plant bioacoustics is becoming a field of study and we are gradually realising that the paradigm of plants as passive beings with which humans cannot communicate is gradually changing. Whether it is sound as we know it (audible vibrations) that will allow us in the future to communicate with plants is unknown and it is possible that the main problem in bonding humans and plants might be that we seem to live in "different time scales". We humans seem to live at a much higher pace when compared to plants (i.e. we move faster, we talk faster), an idiosyncrasy probably related to the advancement and survival of our species (plants and humans). The purpose of our project is not clarify this, our proposal is intrinsically artistic, i.e., we want to "create the possibility" of communication between humans and plants by developing sounds that can relate to each other in a manner that is simultaneously musical, as we humans understand it, and functional or "organic" as we tend to perceive the natural sounds that surround us. Our vision of the *Plantorumori* project is of a system composed of sensors and actuators that will allow us to make music with people and plants in a wide range of situations: in cultural spaces, in the open air, in schools and community facilities. Lastly, our project has a clear allusion to Russolo's *Intonarumori*, a group of experimental musical instruments, created by the Italian futurist Luigi Russolo to perform the new music that he had envisaged and proposed in his *The Art of Noises Manifesto* (1913)⁸. Like Russolo, we think that current technology offers great opportunities for musical creation and we regard the sounds around us as an important part of the sound vocabulary we consider when creating musically. Unlike Russolo, we are not mesmerized by technology itself or by sounds of its intrinsic working, but by the tools it provides to allow us to relate to other beings in a deeper, meaningful way.

The Art of Human to Plant interaction

Plants have been present in the artistic world since immemorial times and the particular case of music is not an exception. The distinction between popular, traditional or classical certainly does not segregate plants: in music, plants seem to be as ubiquitous as in real life taking into account the varieties of approaches ranging from pure inspiration, imitation or using sources of data retrieved from nature. Translating plants features (their morphology, pattern of growth, etc.) into organizing principles for music creation with "real musical instruments" was, in the past, the closest possible musical relationship between plants and humans. In the late 20th century, increasingly sophisticated and available technology allowed to diversify both the features that could be "observed" and the sounds to be used in the "translation" of these observations. Living plants became interfaces for human-computer interaction in artistic projects at the time when human-computer interaction was heavily based on very specific technical devices, a very different scenario from the current IoT⁹ world we live in today, where all daily objects are candidates to mediate the interaction between humans, computers and the world. The work of bio-art pioneer Richard Lowenberg in the seventies is undoubtedly at the root of these developments as well as the controversial book *The Secret Life of Plants*¹⁰ by Peter

⁶ Gehlhaar, R., Paulo Maria Rodrigues, Luis Miguel Girão, and Rui Penha. "Instruments for everyone: Designing new means of musical expression for disabled creators." In *Technologies of inclusive well-being*, pp. 167-196. Springer, Berlin, Heidelberg, 2014.

⁷ <https://www.youtube.com/watch?v=yW0qeyPIVRo>, accessed on the 5th of November

⁸ Russolo, L. "The art of noises: Futurist manifesto." (1913). *Audio culture: Readings in modern music* (2004): 10-14

⁹ Internet of Things

¹⁰ Tompkins, Peter, and Christopher Bird. *The secret life of plants*. No. QK50. T651 1973. New York: Harper & Row, 1973.

Tomnkins and Christopher Bird. Some years later the work of Christa Sommerer and Laurent Mignonneau, also influenced by the same book, was determinant in the emergence of the idea of human-plant interfaces as a tool for artistic creation by media artists, rapidly inspiring not only the visual culture but also the sonic culture, frequently both. With their 1992 installation *Interactive Plant Growing* they contributed decisively to the consolidation of the emerging field of art, science and technology. Sommerer and Mignonneau's stated that their "artistic objective was to create a link between humans and plants and thereby challenge our relationship to the vegetal world through an artistic and engaging experience"¹¹. In the essay *The Art of Human to Plant Interaction*, Sommerer, Mignonneau and Weil cover the main aspects of this "short time history", analyzing the technological present-day approaches as well. These authors acknowledge that scientific evidence is increasingly supporting the view that plants "do feel their environment and that they are more intelligent than has been commonly believed"¹². This point of view is shared by scientist Stefano Mancuso, the founder of the study of plant neurobiology and widely known for his recent books *Brilliant Green: The Surprising History and Science of Plant Intelligence*¹³ and *The Revolutionary Genius of Plants: A New Understanding of Plant Intelligence and Behavior*.¹⁴ In both books Mancuso narrates and discusses how plants have evolved in our world when compared to humans, how plants communicate and many specificities about plants which, until recently, were considered an absurd.

We will now give a very brief description of the technologies to perform bio-sensing, as well as examples of art works. Both aspects are described in detail by Sommerer, Mignonneau and Weil.

Resistance

Using plants as resistors has been one of the most common approaches and it is often used in musical interfaces. This approach measures how conductive a plant, which is then used to produce a specific task. Some examples of artworks using this approach include *Plantas Parlantes* (2010) by Ricardo O'Nascimento, Gilberto Esparza, Javier Busturia, and Jigni Wang, *Baumark- tmusik* (2011) by MSHR, *Kraft Test Drummie and Robert Plant* (2012) by Cristian Martínez,, *Mosszillator* (2012) by Stefanie Wuschitz or *Genesis of Biosynthia II* (2011) by Benjamin Kolaitis.

Contact microphones

The use of contact microphones (piezoelectronic sensors) is another simple approach in using plants as biosensors. Contact microphones can detect vibrations in solid objects, useful to trigger events and amplify sound. Some examples of artworks include *Mogees* (2012) by Bruno Zamborlin, *From the Hills* and *Frishasin Pijamas* (2013) by Cristian Martínez and *Tree Listening* (2012) by Alex Metcalf.

Capacitive sensing

Capacitive sensing is a technology based on capacitive coupling that can detect and measure anything that is conductive. It is particularly useful to measure touch, proximity and humidity. Many spatial sound installations use this technique, like *Akousmaflore* (2007) by Scenocosme, *Baumarktmusik* (2011) by MSHR, and *The Plant Orchestra* (2013) by Alexandra Duvekot.

¹¹ Bristow, Tom, Pansy Duncan, Andrew Howe, Michael Marder, Laurent Mignonneau, Guinevere Narraway, Alan Read et al. *The green thread: dialogues with the vegetal world*. Lexington Books, 2015.

¹² Ibid.

¹³ Mancuso, Stefano, and Alessandra Viola. *Brilliant green: the surprising history and science of plant intelligence*. Island Press, 2015.

¹⁴ Mancuso, Stefano. *The revolutionary genius of plants: a new understanding of plant intelligence and behavior*. Simon and Schuster, 2018.

Electric field measurement and biopotential measurement with electrodes

This technique is similar to capacitive sensing, however, measuring the electric field with electrodes provides more accurate sensor values in terms of electrical changes. Some of the art works done using this technique include *Plantron* (1993) by Yuji Dogane, *Anthroposcope* (1993) by Sommerer and Mignonneau, *Yucca Invest Trading Plant* (1999) by Ola Pehrson, *Pieces for Plants* (2002) by Miya Masaoka, *I/O Plant* (2007) by Satoshi Kuribayashi, Yusuke Sakamoto, and Hiroya Tanaka, *Jurema Action Plant* (2011) by Ivan Henriques, *Pulsu(m) Plantae* (2012–13) by Leslie Garcia and *Plant Cyborgs* (2020) by Daniel Slattnes.

Recent developments

Nowadays there are many sensors available to be used in sensing plants activity, plants environment and even ways to generate electricity using plants¹⁵. It is not uncommon to see Arduino projects to automate house gardening, for example. Some of these new technologies, usually mixed and updated based on the ones previously mentioned, have been transformed in commercial products. Some of these products include the Midi Sprout¹⁶, Makey-Makey¹⁷ or the The Plant Spiker Box¹⁸. These products are almost “plug and play” in the sense that one does not need to build any circuit or have any kind of knowledge on electronics, and quickly can interact with plants and play music. The availability of many of these technologies has prompted the possibility to imagine larger projects that are not exclusively about a certain technology or technique. Just like music, at least in a way, one is now able to devise projects with plants, technologies and art that aim more generic holistic approaches. Some projects like the one carried out by the artist Mileece¹⁹ or Flora Robotica²⁰, relate different analogue technologies, digital technologies and poetics to develop a certain approach to life, art and nature. These projects are quite inspiring for our *Plantorumori* project.

Plantorumori

Plantorumori is a part of Xperimus, a larger project about musical experimentation. *Plantorumori*'s main goal is to develop a hybrid system based on plants, electronics and acoustical sound sources to create and perform music. In addition to this main goal, there are some complementary objectives we wish to achieve, namely: to develop systems to create automatic soundscapes based on plants data; to develop means to listen to plants (e.g. underground microphones) and, finally, to develop means to share over the internet any garden's “soundscape and music”. This paper is mostly concerned with reporting our main goal.

The analysis we performed on artistic works relating music, plants and electronic music, showed us that there are two main approaches to plants being employed: 1) plants as *listeners* and 2) plants as *producers*. While there are many examples of music for plants (e.g. to promote health), we are not looking at these studies and approaches. We do care about plants as *listeners* but not plants as sound recipients *per se*. We are more interested in plants as *producers* and, within this view, we believe that there are two main approaches being applied: 1) plants as interfaces and 2) the sonification of plant's bio-signals. In either approach, roughly speaking, we feel that plants are used in a “passive” way. In other words, they are not contributing actively to what is being played/created, but, instead, they are triggers or just a source signal to be transformed into sound (i.e. sonification). Our aim is to design a system which retrieves idiosyncratic signals of plants (e.g. galvanic measurement, electrical changes) and signals from its environment (e.g. sounds, light measurement, moisture measurement) in order to devise a holistic approach to natural environments to create and perform music. In addition to this, we want devise custom acoustic

¹⁵ <https://www.plant-e.com/en/>, accessed on 5th of november

¹⁶ <https://www.midisprou.com>, accessed on 5th of november

¹⁷ <https://makeymakey.com>, accessed on 5th of november

¹⁸ <https://backyardbrains.com/products/plantspikerbox>, accessed on 5th of november

¹⁹ <https://www.mileece.is>, accessed on 2th of november

²⁰ <https://www.florarobotica.eu>, accessed on 2th of november

sound sources (e.g. bowls, bells, bambus) to complement the electronic sonic system, thus, producing more exciting soundscapes/music. Finally, and quite important, we want to be as precise as possible regarding the measurement of plant biological data (e.g. read voltages, observe leaf growth) but we will be mainly concerned with the poetics of the project. In this sense, some of the instruments we will use to make the measurements will be of low cost (i.e. diy) which means, of course, that they could not be used to report and conduct detailed investigations for biological purposes. We will, nonetheless, make use of commercial products such as the Midi Sprout or The SpikerBox to enhance and complement our diy sensors. In practical terms, it is more important to refer to the biological variations that plants may produce in response to certain stimuli than the accurate recording and analysis of those values.

Technical Approach

In order to achieve our main goal, we decided to: 1) install a cluster of sensors on plants in a fixed place (we called it The Seed) and 2) present some performances along the years 2020 and 2021. Both The Seed and the performances will be the main practical outcomes of the *Plantorumori*. The Seed has two main purposes: the first one is to “feed” the performances with real-time data (e.g. to do modulation, to generate visuals); the second one is to collect and record data (e.g. sensor’s data, photographs, thermal images) during a long period of time. This data will be analysed and will be used during the performances but, specifically, it will be used to study the variations that occurred at The Seed during that period. The performances will be music concerts which will feature plants, sensors, interfaces and acoustic objects. We will now describe The Seed and the performances in detail.

The Seed

The Seed will be a closed space, preferably outdoors (e.g. greenhouse), filled with plants and sensors. We will use sensors to retrieve the following data: indoor air quality, moisture on the soil, temperature and moisture on the atmosphere, thermal images, regular pictures, luminosity, and sound pressure (dB SPL). These sensors will be connected to a Raspberry Pi 3 and connected to the internet. A specific server will be coded to host and display the data from the sensors, and to make it possible to “play” such data in real time (e.g. trigger an audio file and change its pitch according to numerical data). Now, we are on the final stages of developing the software and the hardware.

The performances

Our performances will be focused on achieving deep complicity between humans, interfaces and plants. We want to explore the opening of “communication channels” to allow us to establish relationships with plants and to integrate that “contribution” during the musical performance. We want to think about that complicity exploring the strategies explained earlier, both the theoretical ones and the practical ones, and using all the devices developed and built within this project.

Plantorumori’s first concert

We already had the opportunity to carry out a performance, integrated in a residence of the XPERIMUS project, held in Mateus, Portugal. This concert, which has not yet had any contribution from The Seed, served mainly to get in touch with the sensors (e.g. Midi Sprout, Plant SpikerBox, Makey-Makey, contact microphones, various sensors connected to an Arduino), to experience our physical relationship with plants (e.g. touch, gesture) and the relationship of our setup in interaction with conventional instruments played by other musicians, e.g. piano, guitars (see Figure 1 and Figure 2). The experience was quite positive but two main aspects were noted: 1) the dependency on conventional music strategies (e.g. the need for a plan on musical form, the use of drones) to improvise music and 2) some difficulty on how to physically approach the plants (i.e. play music with the plants as opposed to do conventional touch gestures).



Figure 1. Plantorumori setup



Figure 2. Plantorumori performance

Conclusions

Connecting real plants to computers has become easier and more common than ever before. There is, however, an immense “territory” to be explored both from the artistic and the scientific/technological points of view, preferably from angles that can effectively articulate both, bearing in mind the ultimate goal of creating not only knowledge but also awareness, fruition, consciousness and well-being. These immaterial ideas are very close to aspects of our own artistic work which has music as a starting point but explores many transdisciplinary approaches. It allows us to explore the idea that art, music in particular, might have biological roots related to the need to communicate and be in tune with others. *Plantorumori* is in its initial phase although the authors have already established the main conceptual ideas. The first performance and our initial tests are promising, and we look forward to include The Seed and our diy sensors to take this project to the next stage. The first performance experience has given us some food for thought, thus, there is future work to be accomplished that will be focus on technological aspects but also on performative levels. Only then will we be close to creating the performative and spiritual situation we desire to achieve.

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