Motherplants: Mycelium Network and Artistic Research

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Abstract

In 2015, we embarked on an artistic research project involving organic organisms such as plants and fungi, focusing on their role in the processes of recycling of e-waste. Motherplant explores how these systems create feedback audio signal transmission through the interplay of moisture and decomposition of the circuit boards. Specifically, it harnesses the natural decomposition process to transmit audio signals by converting the soil's acidity and electronic compost into electrical signals.

Keywords

Artistic research project, electronic compost, mycelium networks, soil acidity, symbiosis, mutation of technologies, e-waste.

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Introduction

The surge in global electronic waste (e-waste) volumes, as reported by the Global E-waste Statistics Partnership (GESP), is cited by the World Health Organization (WHO). Between 2014 and 2019, there was a substantial increase of 21% in e-waste generation, resulting in a staggering production of 53.6 million metric tonnes of e-waste during the latter year. "For perspective, [in the year 2020] e-waste weighed as much as 350 cruise ships placed end to end to form a line 125 km long. This growth is projected to continue as the use of computers, mobile phones and other electronics continues to expand, alongside their rapid obsolescence." (Johnson, 2021) The repercussions of this escalating e-waste problem are dire, encompassing adverse effects on both human health and ecosystems. The e-waste stream comprises a multitude of toxic substances, ranging from neurotoxins to heavy metals, which pose significant risks (Jain et al., 2023). These hazardous constituents have the potential to inflict severe harm upon individuals and the environment, underscoring the urgency of addressing and mitigating the detrimental consequences associated with mounting e-waste volumes.

Figure 1: Motherplants-installation view - 2018. ©APO33-Nantes

This project revolves around the intriguing intersections of mycelium networks, audio diffusion, and the creation of novel computing experiences. Motherplant engages with the notions of symbiosis and mutation of existing technologies to explore new modes of interaction with recycling, art research and implementation of new network models based on mycelium communication cooperation systems.

Motherplant : Computational Mycelium Recycling Network

Using dead and discarded motherboards extracted from obsolete computer systems, we attempted a transformative process with the aim of repurposing these printed circuit boards (PCBs) into "micro-farm" environments. The primary objective of Motherplant encompassed three key facets: firstly, to experiment with sustainable recycling of all motherboard components; secondly, to harness their inherent properties for the generation of electrical current; and lastly, to contribute to the development of an alternative open system designed to facilitate the exchange of computational data. This fusion of electronic and organic realms introduces a harmonious synergy, wherein the motherboard's original purpose converges with the natural processes of growth, decomposition, and nutrient exchange.

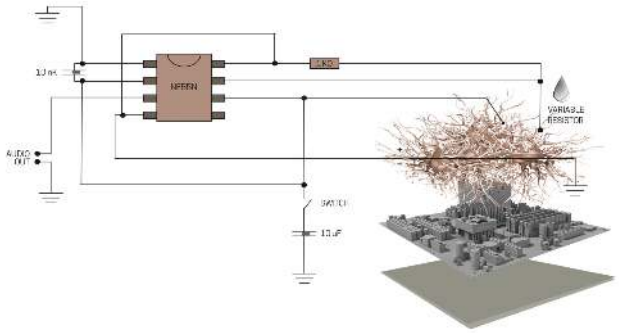

Figure 2: Motherplants-schematics 2023. ©APO33-Nantes

Re-creation of the fungal network as an electronic mutation

In Motherplant we are trying to create a novel electronic circuitry that mutates in tandem with a primitive fungal network. It is important to clarify that our fungal network is a simplified "primitive" representation, distinct from the extensive rhizomatic networks deployed by mature fungi across vast expanses of soil, connecting plants and trees. We acknowledge that nature excels in this regard, and our intention is not to replicate nature's proficiency but rather to cultivate and orchestrate a symbiotic relationship between electronic circuitry in a localised fungal network.

This begins with a few spores settling down on a nutrient-rich surface. When these spores wake up in close proximity to one another; they initiate germination at approximately the same time, giving rise to thread-like cellular structures known as hyphae, which extend outward at comparable rates. This unique fusion of electronics, powered by solar energy and moisture-rich soil infused with (DIY) mycelium growth, establishes an intricate information superhighway. As an information superhighway the interactions between a large, diverse population of individuals speeds up. It allows entities who may be separated to communicate and help each other out. It also allows them to commit new forms of communication.

This symbiotic relationship between electronic circuitry and a fungal network not only bears relevance to the creation of a new information exchange paradigm but also holds significant potential in the context of e-waste recycling. Fungi possess the ability to break down and transform a wide range of organic and inorganic substances, pesticides, hydrocarbons and heavy metals, making them valuable agents for cleaning up contaminated environments (Tomer et al., 2021). By virtue of fungal bioremediation, the fungal network may play a pivotal role in the sustainable degradation and recycling of electronic components.

Schematics for Motherplant

This iteration of Motherplant comprises a redundant, nonfunctional motherboard as its foundational structure, upon which mycelium is cultivated within a composite medium consisting of straw, soil, and integrated circuitry. The degradation of the motherboard's components initiates an acidification process within the medium, subsequently generating electrical signals. These electrical signals function akin to a battery, delivering an approximate output of 1.5 volts, which in turn powers an audio circuit. The frequencies generated by this audio circuit exhibit variability contingent upon the dynamic activity of the mycelium and the pH levels of the surrounding soil.

Renaturing the Motherboard

The Motherplant concept can be traced back to an earlier experiment initiated at APO33 in Nantes 2015 and presented during NEAR #1 as part of Nantes Digital Week. During this meeting, the growing need to address e-waste issues was discussed alongside concerns about the exploitation of workers, recycling components without protective clothing or in adequate conditions (Ottavi and Pickett, 2015). These first experiments went on to be presented at the Nomad Village during COP21 in Paris, later on that year (Ottavi, 2015). Electronic waste is toxic and hazardous to human health, PCB's are hard to recycle and demand a lot of energy and sometimes the scramble for precious metals and minerals contained therein, sacrifices members of our human community (Wittsiepe et al., 2015; Beaumont, 2019). Usually, this heavy cost is hidden from our sleek conscientious recycling certificates. Yet it could take decades, sometimes centuries, before some of these components will be totally recycled. In 2019 Europe ranked first worldwide in terms of e-waste generation per capita, with 16.2 kg per capita (Forti et al., 2020).

With Motherplant by employing plants, flowers, and fungal organisms as instrumental agents in the recycling of electronic waste, we set about composting the motherboard. The heart of any home computer or laptop, the Motherboard is a concealed symbol of this cyclical consumption and our relentless obsessions for digital speed. With Motherplant we sought to counteract this hidden world of consumer electronics recycling and make visible the complexity of such a task if left to nature, as well as the sheer disregard for the problem by the shipping of our waste elsewhere. The idea of Motherplant was to produce electricity to feed electronic circuits, so that, in turn, they endlessly sustain a sound installation. This undertaking represented a confluence of art, ecology, recycling practices and the exploration of alternative energy models. The shape and layout of a motherboard is called the form factor. The form factor affects where individual components go and the shape of the computer's case. We design Motherplant in such a way that the classical function of the motherboard decomposes to produce a new kind of computer. One that won't consume electricity anymore, but instead will become a receptacle for plants and spores to grow.

Mycelium computation: a new paradigm in bioart and sound art research

This new kind of Mycelium computation is about to begin, as we search for quantum processors, we are looking for Mycelium based hijacked computer circuits. The spore computation is not just another form of computer research in the tradition of engineering

production, it's an all-new vision about computers. In 2018, Professor Andrew Adamatzky, Director of the Unconventional Computing Laboratory at the University of the West of England in Bristol, UK, wrote in his article "Towards a fungal computer", how a series of scoping experiments, provided evidence that electrical activity recorded on fruits could potentially serve as a dependable indicator of the fungi's reaction to thermal and chemical stimulation. (Adamatzky, 2018) It diverges from the prevailing landscape of technological industrial mass production, presenting a concept characterised by fragility, inherent hazards, and a multitude of uncharted pathways, and prototypes of computing mycelium bound composites. (Roberts and Adamatzky, 2022).

A mélange of Bioart (art using fungal bioremediation and technology) with sound art (sound as a profound production of vibration) serves as a conduit for the cultivation of exchanges and ideas within a networked context. Within the domain of bioart, the convergence of innovative gardening techniques and the exploration of mycelium-based experiences culminates in the facilitation of multifaceted networks characterised by a wide array of functionalities that will serve multiple purposes such as recycling, production of energy, circulation of electricity but also production of sound waves, feedback transmission and autonomous art installation.

From the perspective of sound-ecology, listening to the world holds significant importance in numerous practices. However, in the case of Motherplant, it transcends mere observation of nature; it involves a collaboration with nature to generate a sound installation on a minute scale, characterised by low impedance and microsounds, all within the dimensions of the sculpture itself. In terms of sound levels, our focus aligns more closely with the realm of ants and insects than that of elephants or storms. This reveals the potential inherent in the amalgamation of nature, mycelium, and soil within our artistic patch.

Art frequently detaches itself from its own reality, often transported and displayed within galleries or dedicated venues, creating a sense of isolation. In contrast, Motherplant seeks to recreate a natural context intricately linked to the artwork itself, ultimately transforming the context, nature, environment, and aesthetics into the art itself. Sound plays an integral role in the production process but whilst it doesn't represent the final objective, it is a vital component within the broader framework. The various iterations of the art piece over the last 8 years, also contribute to shaping the sculptural essence of Motherplant. The process that we describe here and the relation between nature, technologies and production of energy is not separated from the poetic facets of our artistic research.

Recycling plastic and other dirty electronics to produce low currency (power)

Beyond the artistic sculpture of the Motherplant, we had assigned to this project two other important research perspectives. Whilst these are not the main goals, they resonate with the other aspects (art, sculpture, sound, visuals...). The first enables us to think about and experiment with the recycling of electronic wastes with the Motherboard. In this context, the concept of the "mother" assumes a central and symbolic role, representing the origin from which life emanates. This archetype of the mother extends beyond the human realm to encompass broader notions such as Mother Earth and Mother Plant, all of which evoke contemplation of the nurturing and life-giving aspects associated with motherhood. By integrating the concept of the "mother" into the project's narrative, we establish a profound connection between technology, nature, and the cycle of life. Which underscores the intricate interplay between electronic devices and the environment. How can we care for electronic waste management and recycling? Motherplant embraces maternal sustainability and environmental awareness, towards recycling e-waste and engendering a new computation network. Secondly, recycling e-waste costs are very high compared to disposing them in landfills, mainly because it often contains hazardous materials that need to be dismantled and processed properly. Also, the lack of recycling infrastructure poses problems to handle the large volume of e-waste generated each year. Finally, due to the lack of awareness from the public, most people have no idea of the importance of recycling their computers and e-waste. This lack of awareness ends up in huge amounts of illegal dumping or in the wrong landfills and incinerators producing more pollution but also exposing people to hazardous materials.

We decided, as artists working in electronic arts and media, to engage in this protracted undertaking of the project Motherplant, and develop our own way of experimenting with living networks. Rather than adhering to the conventional and often inefficient approach of classical digital art research, which typically involves a relentless cycle of producing more work and tirelessly pursuing galleries and festivals for exhibitions,

we have chosen a different path. We consider this process in the broader context of "decroissance" or degrowth, lowering our consumption, decelerating our expectations of results, and embracing the temporality associated with decomposition. The philosophy of degrowth posits that the relentless pursuit of economic growth is inherently unsustainable in the long term. It contends that, in order to safeguard the environment and enhance societal well-being, it is imperative to curtail economic activities and their associated impacts.

The other part of this research centres on the production of electricity. While it's important to note that this production is characterised by low power output, it has nonetheless proven to be a sustainable source of electrical current over the past few years, requiring no additional input other than the periodic watering of the Motherplant. This enduring supply of electricity has so far facilitated a continuous eight-year run of our sound installation.

The motherboard, serving as the fundamental underpinning of our installation, adheres to a decompositional timeframe, thereby providing a robust scaffold for the continuous provision of electrical current. This enduring electrical supply, in a reciprocal fashion, sustains the seamless operation of our sound installation, ensuring its uninterrupted functionality. This approach to both energy generation and artistic expression accentuates the intricate interplay amongst technology, ecology, and the dimension of time.

Figure 3: Motherplant : Close-up 2018. ©APO33-Nantes

Documentation

View the 2015 video on Climate Solutions: MOTHERPLANT here: https://www.youtube.com/watch?v=CSUeSdR6n1Q. View the 2018 video on Motherplants here: https://vimeo.com/301201120

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Authors Biographies

Julien Ottavi, holds a Doctor of Arts from the Université de Lorraine. His practice covers sound, intermedia, and digital network arts. He is the founding member and artistic director of association APO33, based in Nantes. APO33 has produced

numerous ground-breaking explorations in experimental music and electronic arts, and collaborated with artists and musicians across the world.

Jenny Pickett is a member of the APO33, where she works on projects ranging from interactive installations to experimental music and performance to international collaboration in art and technology. She is currently a PhD Candidate at Cyprus University of Technology where she is attached to the Media Arts and Design Research Lab (MADlab), she is also the Vice Chair for Toolkit of Care a EU COST funded cooperation, as well as an associate lecturer at the Nantes School of Architecture (ENSA).