



Plant Radio: Tuning in to plants by combining posthumanism and design

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ABSTRACT

The Plant Radio is an electronic device that makes it possible to perceive how (and that) a plant responds to its environment. The device works by artificially amplifying the EMG signals of a plant. Aesthetically, it builds on the metaphor of the radio broadcast receiver that allows for tuning in to intangible signals sent through the air. By drawing on mediation theory and making tangible the otherwise hidden signals of plants, the Plant Radio exploratively seeks to reconfigure the relationship between plants and humans by allowing new relations to form. In this pictorial, we present the design of the Plant Radio, and we discuss how the Plant Radio serves as a materialization of the posthuman theories that form the backdrop of this project. In doing so, we expand on the design process of the artifact, specifically unfolding the discussions when deciding not to include a power button.

Authors Keywords

Physical computing, Design, Plant-human interaction, Posthumanism, Interaction design

INTRODUCTION

In this pictorial we present the Plant Radio, a device that enables a human to listen to a plant. It is a design experiment seeking to explore how to integrate posthuman theories and ideas in design practice. Concretely this exploration is materialized in a physical object (the radio) seeking to reconfigure the relationship

between humans and plants. Posthuman thinking is a move away from human exceptionalism and towards an understanding of the world as non-hierarchical. It is thus the aspiration of a posthumanist to understand humans as one lifeform amongst many equally important species and lifeforms. While theories of posthumanism are richly discussed in a wide range of disciplines [8], and its relevance is receiving growing attention in the field of design [1, 5, 9, 11, 16], it remains a challenge to apply these in actual design practice as also argued by Forlano [10].

The Plant Radio is part of the Growing Co-design research project that – through the use of sensing technology – explores how humans engage with and understand plants. Ultimately, the research project seeks to find ways that interaction design might engage with complex climate change discussions through sensitizing humans to a posthuman mindset. Materializing this thought through making the hidden activities in plants senseable to humans, the Plant Radio opens for new ways of understanding, thinking, and talking about plants, thus also seeking to materialize the often complex and abstract posthuman theories.

Most people will have experienced that plants are living matter: they move based on the sun's position, crawl along surfaces or forage water. While this could simply be understood as a primitive biological 'automata', recent findings suggest that plants are highly sentient beings [17] with the ability to process information and

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thereby learn, remember and apply knowledge [12]. Plants are also social beings who share information and nutrients with their neighboring plants either through mycorrhizal networks underground [19] or airborne chemical particles [18], thereby protecting and nourishing their kin. Some of these behaviors and activities can be expressed through changes in electrical signals, which can be measured with EMG sensors. In addition, plant behavior has long been an unappreciated phenomenon—a cognitive bias which has been coined ‘plant-blindness’. This inattention to plants is in part caused by cultural and historical factors, for instance that botany was valued primarily for its medicinal qualities, or that science and philosophy have been mostly focused on human beings [21].

Responding to this lack of recognition and interest in plants as beings, the Plant Radio was designed to shape new understandings about plants and to reconfigure the relationship between humans and plants. It re-conceptualizes plants from something passive, inanimate, non-intellectual, or utilizable into living, sentient beings that we can relate to, and consequently reigniting our curiosity towards plants. This materialization ultimately seeks to spark an awareness of an entangled and interdependent human-nature relation, reflecting our co-survival on a damaged planet.

The structure of this pictorial is as follows: first, we present the Plant Radio and the core features of the artifact. Following this, we present a use scenario of a day in the life with the plant radio as well as a visualization of the design inspirations. Then, we use posthumanism and postphenomenology to form the theoretical backdrop of the design, which is later used to discuss a design detail: the absence of a power button on the radio. Finally, this prompts a discussion on the dilemmas in thinking with posthumanism when engaging with design practice, which is most often human-centered. Throughout, pictures tell the stories of how relations between humans and plants might be reconfigured, if humans start tuning in to plants.



A person exploring how the plant responds to touch. When touching a plant, the electrical signals change and this is picked up by the EMG sensors. The Plant Radio responds by increasing the volume and pitch of the sound output. Similarly, the graph on the display shows the changing EMG data.

DESIGN OVERVIEW

As a device, the Plant Radio functions as a technological mediator between plants and humans by tapping into the plant's electrophysiological signals and outputting it in a running graph, pulsating lights, and sounds. The illustration gives a detailed look at the different parts of the Plant Radio.



LED panel with pulsating light in shifting colors based on data



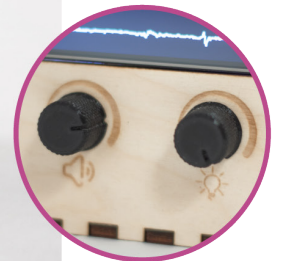
Leather strap for portability - made from recycled belts



EMG sensor pads that stick onto the plant's leaves



LCD screen displays the EMG data from plant



Turnknobs for adjusting sound volume (left) and light brightness (right)

Speaker that plays sounds based on data

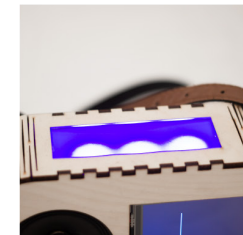
The sounds produced by the radio are quite 'true to data', as the data input produced by reading the plant's electrical signals undergoes minimal processing and interpretation. The incoming data is mapped onto the frequency and tempo of simple soundwaves, thus creating a soundscape of varying machinic sharp and electronic tones.



Left



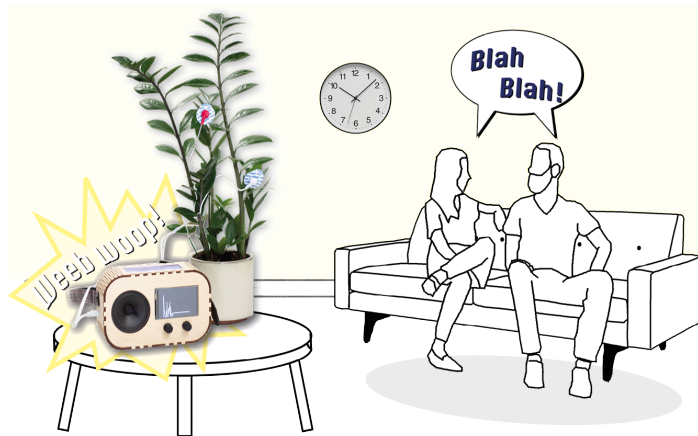
Right



Top

SCENARIO: A DAY IN THE LIFE OF A PLANT RADIO

The EMG sensors in the Plant Radio measure the electrical currents in the leaves of a plant. By measuring the electrical difference between several points around the plant, the sensor is able to register sudden changes in the plant caused by its immediate surroundings. This means that different plants will react differently, depending on the plant's physiology, time of day, if and how it is being touched, odors and sounds in the immediate environment, and many other factors.



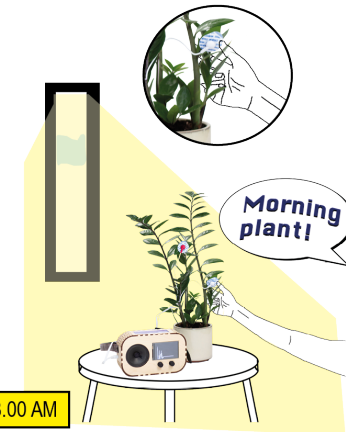
10.00 PM

The atmosphere in the living room is buzzing with life. On the couch two humans are conversing. On the table a plant is trying to participate in the conversation, and its sounds fills the room through the Plant Radio.



03.00 AM

The human has gone to sleep, but is kept awake by the sounds and lights from the Plant Radio, because this plant is nocturnal.



08.00 AM

The human stroke the plant's leaves, and the plant reacts briefly.



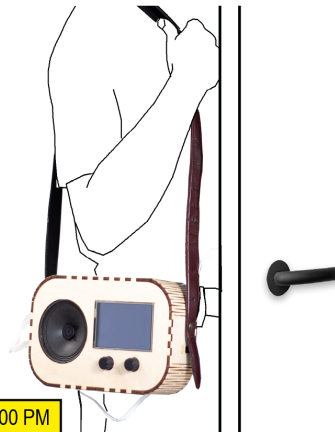
09.00 AM

The Plant Radio is out of battery.



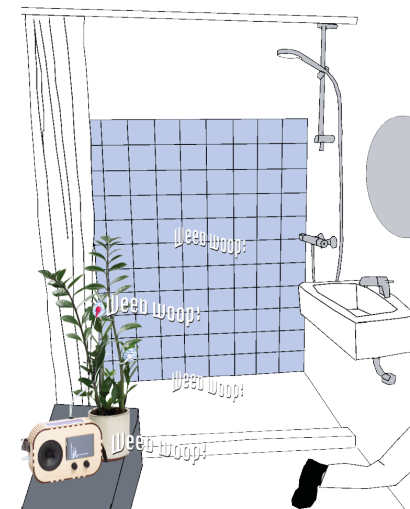
10.00 AM

While the Plant Radio's battery is charging, the radio is disconnected from the plant.



04.00 PM

The Plant Radio is charged, and the human has decided to move the plant to a different room to reduce the disturbance of the plant.



04.10 PM

The plant is connected to the Plant Radio again. As the human leaves, the bathroom is filled with sounds and light from the plant, which is making sense of its new environment.

DESIGN PROCESS

Designing the Plant Radio was primarily a process influenced by theory readings, conceptual ideas, and material inspirations as illustrated below. In that sense it was a designer-oriented process rather than a user-centered process, in which we used theoretical concepts, inspirations and metaphors to drive ideations, prototyping, coding, and design decisions.

This was framed by the purpose of the Growing Codesign

project—in which the Plant Radio is situated—seeking to investigate how to think of design as codesigning with non-human entities like plants. In this part of the project, we wanted to design an object that would allow us to explore the type of conversations an object would spark if it allowed for people to tune-in to plants. The final Plant Radio objects have met the world through workshops, brief deployments in people’s homes, and through exhibitions. Insights from these encounterings will be the subject of a future paper.

DESIGN INSPIRATIONS AND METAPHORS

Throughout the design process our design decisions have been inspired by different objects and attributes from the world around us. The illustration below gives a detailed look at some of the inspirations for the final design of the Plant Radio. These have ended up being physically manifested in the final design, and/or have guided the process of exploring a post humanist design practice.



EMG: By measuring difference in voltage, ExG sensors listen to internal signals within a specific bandwidth that would otherwise be hidden. ExG sensors are used to communicate different internal statuses of the human, such as heart (ECG), muscle (EMG), or brain activity (EEG). EMG sensors can also be used to measure electrical signals in plants.



Material: The wooden material gives a warm, welcoming feeling, while also possessing a prototype makerspace aesthetic. Choosing wood over transparent acrylic, materials often used for laser cutting, hides the technical components and creates a visual link to the broadcast receiver look.



Radio: Aesthetically the Plant Radio draws on the metaphor of the radio broadcast receiver that allows the user to tune in on intangible radio signals sent through the air. Operating the volume button mimics that of tuning into a foreign radio station: the semantic meaning is hidden, but you can tune into the prosody of the plant language with its own rhythm and tone.



Leather strap: since plants do not only reside in our homes but largely exist outdoors, a strap enables portability. Taking the Plant Radio outside can furthermore point the user towards the bigger theme of climate crisis, which is the backdrop of the project.



Power button: The Plant Radio is powered by battery or through a charger, yet has no power button. To turn off the radio, the user must either let the battery run dry or kill the plant. This decision was both a technical and a conceptual decision, which is elaborated on later in this pictorial.



Sounds: The rapid speed at which the frequencies change gives the soundscape almost language-like qualities. Furthermore, added envelopes to the data result in sound qualities similar to changing vowels mimicking the motion of a human throat and mouth.

THEORY: MEDIATED POSTHUMAN PLANTS

The Plant Radio is part of a research project seeking to explore how we might design with the environment in practice, and how we might use design to develop the necessary sets of sensibilities and methods to think of the world as more-than-human. In this context, we designed the Plant Radio as a way to address ‘plant-blindness’, that humans largely seem indifferent and insensitive to the nuances of plant beings: In giving plants a voice, we sought to spark curiosity in humans as well as an awareness of plants as complex living beings with their own rhythms and temperaments.

In conceptualizing the design, and throughout the design process, two theoretical mindsets have been key, and we see them materialized in the Plant Radio artifact: posthumanist thinking and postphenomenology. The first is concerned with putting nonhumans as equal entities as humans, while the latter is concerned with how humans make sense of the world through technology and with relation-building. Although a bit contradictory, because postphenomenology and posthumanism are not very compatible from a theory standpoint, we think of the Plant Radio as a design built on the post-phenomenological concept of mediation: the radio is a mediation device that makes posthuman matters tangible and sensible to a human. In this way, postphenomenological mediation theory becomes a kind of method with which we design with the posthuman idea of connectedness.

Posthumanism

The posthumanist perspective forms an important theoretical backdrop of the Plant Radio. A considerable amount of academic discourse has in recent years been centered on notions of the nonhuman or more-than-human and object-oriented ontologies, such as actor-network theory, especially within the humanities [2, 4, 6, 7, 14, 15]. Under the common term *Posthumanism* these theories reject dualisms in general, most notably the mind-body and the culture-nature dualisms. In this way, an array of fundamental breaks with Western thinking are put forward, when posthumanism seeks to understand the human subject and its relationship to the natural and

artificial worlds in a non-anthropocentric light.

One way of working with posthumanist ontology is to de-center humans and instead take seriously the experiences, perspectives, and agencies of non-humans, in ways that are situated, embodied, and non-homogenizing [3]. As a human designer, this means being willing to listen to that which has long been excluded from dominant knowledge making processes – for instance through developing methods and objects that engage with the relations between all kinds of actors, amongst others those of humans and non-humans.

With a focus on plants and the *beings* of plants, our posthumanist agenda is to highlight the sentience in the non-human plants. To do this, we chose a design approach that centers the plants with respect to their traits, uniquenesses, and otherness from humans, both during the design process and through the designed object itself. This approach resulted in exposing the hidden life of plants through the Plant Radio, which paves the way for people to start conversations about the abstract relations that exist between humans and plants, and reflections on how these relations could be configured differently.

Postphenomenology

Concretely, the Plant Radio gives access to an aspect of the world that humans are unable to sense, and in this way it mediates relation building. Metaphorically, through mediating the life of the plant, the radio serves as a kind of tool for humans, thus seeking to reconfigure the posthuman relationship between human and plant. In mediation theory, as laid out by philosopher Peter-Paul Verbeek in continuation of Don Ihde’s conceptualisations of the *phenomenology of technics*, technologies mediate (i.e. create and form) relations between humans and the surrounding world, and they do so in various ways.

In general, in mediating a plant’s agency or actions, the Plant Radio becomes a *technological mediation*: it is an object that inserts itself into a relation as a mediator. In Verbeek’s understanding, a technology mediates the relationship between human and world



but this mediation also changes that relationship when it “[...] shape[s] the way in which human beings are involved with their world and interpret it.” [20, p. 235]. In this case, the action of experiencing the plant through technology also shapes our relation with the plant as well as our understanding of the world. This mediated relation is created in the following three ways.

First, like other instrument panels, the Plant Radio offers a *hermeneutic relation* to the plant through reading, recording, and interpreting the signals into data that humans are able to sense. In hermeneutic relations, the purpose of a design/technology is to display and interpret the world—making it cognitively accessible to humans. With the Plant Radio, the graph on the display

is a direct data representation while the lights on top of the radio require an extra layer of interpretation from the human user when figuring out the patterns and meanings of colors and pulsations. In the design process, we discussed these hermeneutic relations whenever we made design choices regarding the *output* of the Plant Radio.

Second, the Plant Radio seeks to enable human understanding of plants as *quasi-others*, an additional and actual living being in the household, thus mediating an *alterity relation* to the plant. We deployed a few Plant Radios in the homes of plant enthusiasts for a couple of weeks and in our interviews with them, we for instance heard how one plant always responds when people pass by; how another plant turned out to be nocturnal and

thus became a spooky encounter for humans going to the bathroom during the night; how a third plant had a clear reaction to onions; and how a fourth plant was ‘comforting’ a person during a night of sickness. All of these little glimpses into people’s everyday lives shows that in living with the Plant Radio, the design supports the idea of seeing plants as co-inhabitants (i.e. room-mates or roomies) thus acknowledging them as sentient beings.

Finally, we also worked with *background relations*, as we specifically wished to make the houseplant noticed in an environment primarily controlled by and designed for humans. In this type of mediation, technology which falls into the background is taken for granted, and is unattended to unless there is a breakdown. In well-



The Plant Radio is exhibited at a Maker Faire, showing how the audience is confronted with the plant’s signals in a hermeneutic relation when they interpret the graph on the radio display as well as the sound; both enable the plant to draw attention to itself and prevent it from falling into the background.



The plant is deployed in the home of a plant enthusiast who actively engages with the plant. In this case, the combination of the radio and the plant establishes an alterity relation, emphasizing the plant’s role as a quasi other co-living in the home.



infrastructured urban environments common examples are electricity and lights, thermostats and heaters, and wireless internet access. In trying to *avoid* that the Plant Radio pushes the plant into the background, we designed sounds that are piercing and alienating, rather than ambient and atmospheric.

DESIGN DETAIL: THE ABSENT POWER BUTTON

A central discussion in the design process of the Plant Radio addressed the question of whether to include a power button. In the early phases of the design process, the power button was an established element of the final vision, but as the development of the radio went on, the inclusion of the power button became a recurring subject in our design discussions. The discussion revolved around three key design positions with each an argument: a technical, a practical and a conceptual.

Can you turn off a plant? Three design positions

From the technical position, two key arguments revolving around saving power and software constraints emerged. An argument *for* adding a power button was that it would be possible to preserve power whilst traveling to outside places and plants. An argument *against* adding such a button is that we would have to build a procedure into the Raspberry PI software to ensure that the device wouldn't be forced to turn off without going through the intended shut-down procedure.

From a practical position, an argument *for* adding a power button was that it would increase the user friendliness of the design, since the human user would be able to turn off the radio, and bring it with them into the world without disturbing other people, essentially promoting the remote capabilities of the device.

The conceptual argument *for* including a power button on the Plant Radio is derived from the initial design metaphor of a radio broadcast receiver. The argument was that if we wanted to follow the design of a radio, it would be conceptually reasonable for us to include a power button, as it is expected that radios employ this kind of interaction system. Arguably, we not only expect to find power buttons on radios, but on most

technological devices we interact with, to a point where we almost take our ability to turn off a device for granted.

The conceptual argument *against* the inclusion of a power button is derived from the posthumanist standpoint. By not including a power button on the radio, the human would not have the power to turn off the plant, thus establishing more balance in the relation between human and plant. Following this notion, the conceptual argument against the power button comes from perceiving the plant as a non-human actor with equal part in the world as the human user who operates the radio.

The position we designed from

Firstly, the discussion of the power button was influenced by the technical and practical needs and constraints of the hardware and software. Secondly, we saw a conceptual dilemma of following through with the posthuman agenda of the project versus making a radio that favored a human's needs. Ultimately, we decided to not include a power button in respect for the plant's being. You can dial it down but not turn it off.

DESIGNING FOR POSTHUMAN RELATIONS

The discussion of whether to include a power button on the Plant Radio also relates to the two theoretical positions influencing this paper; postphenomenology and posthumanism.

From a *postphenomenological perspective*, the omission of the power button illustrates how the radio and plant are pulled away from the background relation to the user, as discussed earlier. Instead, the user is actively confronted with the state of their plants. Following this, we saw how the plant and radio together take the form of a roomie living with the user, a quasi-other. This idea is enhanced by the omission of the power button as humans likewise don't have power buttons. Instead, humans have developed sophisticated, socially situated ways of managing co-inhabitants, for example by adjusting and realigning our behavior based on spoken and unspoken social cues. Arguably, for humans to gain a closer understanding of their plants, they must similarly learn

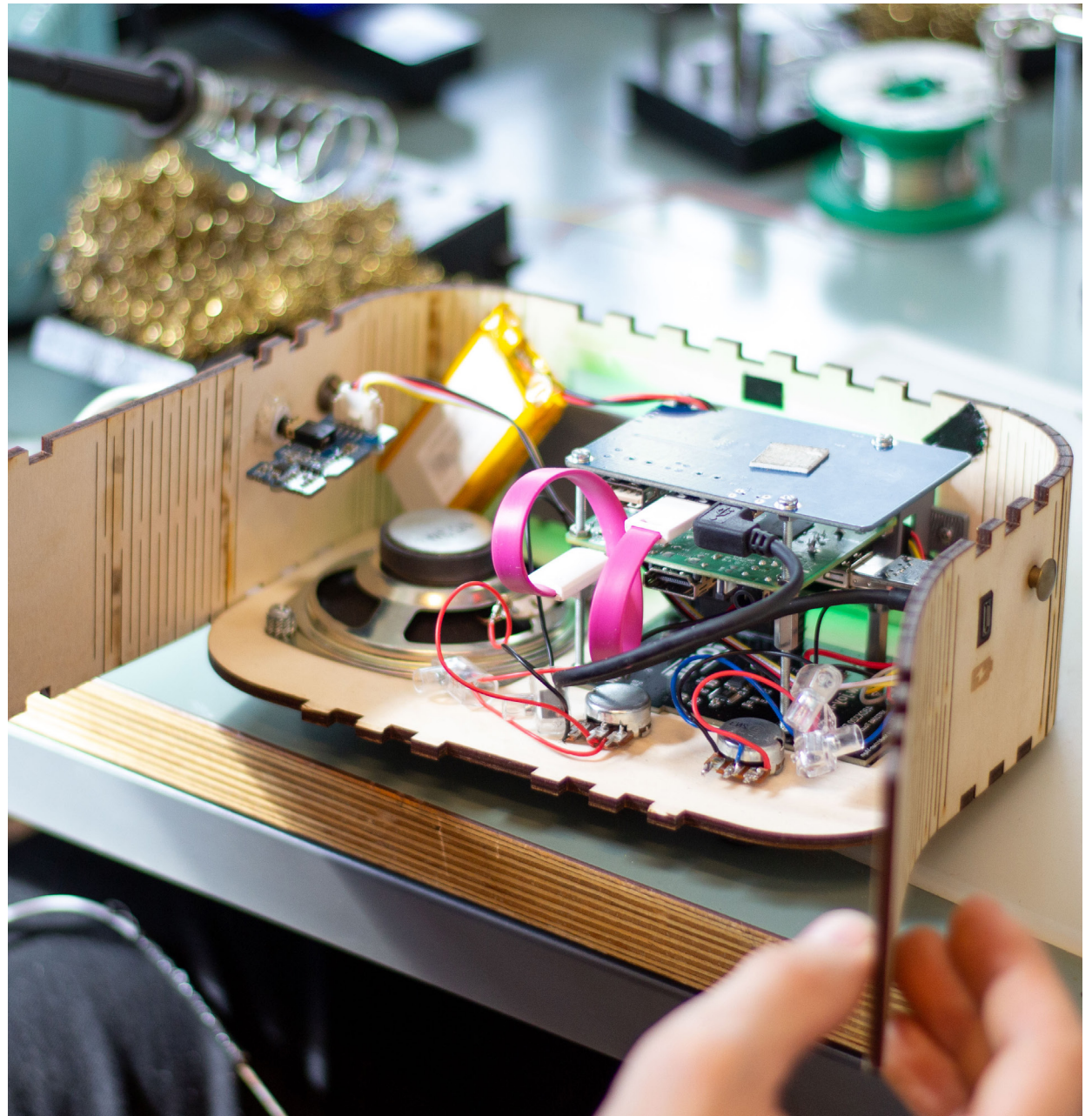
the unspoken and hidden cues from the plants around them. We approach this by creating a hermeneutic relation to the plant through the data presented by the radio. By omitting the power button, the plant is in a way on the same playing field as humans, where information of their state is flowing unhindered.

This point leads to perceiving the power button through posthuman lenses. From a *posthumanist perspective*, the omission of the power button allows the plant to express itself unhindered via the Plant Radio. In processes like co-design, participatory design, and human-centered design, the human is often the primary focus, relying on a deep understanding of the needs, capabilities, and behavior of the user. On the one hand, it could be argued that the design of the Plant Radio contradicts these approaches as the exclusion of the power button is an almost anti-human design decision, demanding that users are confronted with the state of their plant without them necessarily wanting to. On the other hand, perhaps the insights from the Plant Radio suggest similarities to the aforementioned design conventions. To conduct posthumanist design, the designer must gain a deep understanding of the needs, capabilities, and the contextual behavior of the posthumanist subject in question, which in the case of this pictorial is the plant. In some cases, it could be when making specific design decisions that empower plants, like omitting the power button, while in other cases it could be designing exclusively for posthuman entities, without including human actors in the interaction.

As such, the omission of the power button is not necessarily an anti-human decision, but a pro plant decision enhancing the expression of the plant. More broadly speaking, the consequence of using posthuman theories in design practice is to continuously consider how the design materializes hierarchies and relations, and how the design changes these.

The Paradox of Posthuman Design

As explored above in the discussion of the (un)design of the power button, the design choices that we faced



An early prototype in cardboard and with components



with the Plant Radio with regards to agency are not insignificant: whom do we design for, who has agency, when is agency given, and how does the Plant Radio transfer or support relation building between human and non-human actors. Omitting the power button was a design decision made from the perspective of plants, however by and for humans. Just as the Plant Radio is ultimately designed by and for humans. It's difficult not to see the irony situated in between vision, design, and usage: It is paradoxical to design a human-centered artifact that seeks to decenter humans. From a Harawayian perspective, these anthropocentric design decisions will always make the plants unable to escape being seen in a humanistic light [13].

When perceiving and interacting with the plant radio, it is the human user who senses, analyzes, and reflects on the signals conveyed by the plant. As designers we are hoping to have planted an initial seed that makes human users engage with the idea that plants are sentient beings too, worthy of recognition and extended care. Ultimately, however, it is the human user who must form a meaningful realization from their interaction with the plant: the plant probably doesn't care.

In this way, moving towards establishing a posthuman design practice has to include a continued balancing in the design process between, on the one side, human-centered theories such as the post-phenomenological mediation theory, and on the other side, a decentering of the human from the posthumanist approach. In so doing, a human-centered design principle becomes a tool with which we might move towards reconfiguring the relation between humans and non-humans.

CONCLUSION

In this pictorial we have presented the Plant Radio, its usage and design, including a discussion of whether or not to give the device a power button. The device enables a human to listen to a plant and explores how posthuman theories and ideas might be materialized in a physical object. Concretely, it is designed to function as a technological mediator between plants and humans by

measuring the electrical currents in the leaves of a plant, thus enabling the radio to register and show changes in the plant caused by its immediate surroundings. Through this we exemplify how mediation theory, which initially came from a human-centered foundation, can be applied to a posthuman project, to illustrate how designs for humans can lead to posthuman realizations. Instead of a paradox of impossible contradictions between human-centered design and posthuman ideals, we argue that it might be perceived as a field of tension, which must be thoughtfully navigated to effectively convey the designer's underlying ideas. The point is not to completely reject the human perspective in favor of the non-human, far from it. This approach could lead to designs that humans can't or won't interact with. Instead, the point is to keep a nuanced and balanced perspective through the design process. The design itself may have been made with elements of human-centered qualities, but the reflections it sets in motion for the human user can shift towards a more posthuman outlook on the world.

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