
Growth, Change and Decay: Plants and Interaction Possibilities

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Abstract

Our work explores using plants as an interaction material to extend and disrupt existing notions of HCI. We focus in particular on how the affordances and properties of plants can be utilised for enhanced physical and emotional interaction between people and computers, with our core motive being to find methods of enriching user engagement. Moreover, we investigate whether plants could offer a new dimension of interaction and emotional attachment to computer interfaces. We conducted a study to observe people's interactions with prototype plant-based systems, and also interviewed them about future usage of plants in HCI. Our early findings indicate that using a plant-based interface triggered emotive connections, making interactions more enjoyable. In this work-in-progress, we discuss the results of this study, and consider the future potential for using plants as an interaction medium.

Author Keywords

Plants; biophilia; organic; emotion; interface; interaction;

ACM Classification Keywords

H.5.2 [User Interfaces]: Haptic I/O; Input devices and strategies

Introduction

As ubiquitous computing becomes commonplace [3], we argue it is timely to explore using new materials for interaction outside the realm of smartphones, tablets and laptops. Current materials used to interact with computer systems support minimal physical manipulation and no organic change. Touch screens, mice and keyboards dominate our everyday interactions, but they offer little in the way of tactile feeling, or a sense of human engagement and attachment [10]. We believe that plants can offer unique and fun experiences outside of the digital world to create more engaging digital systems. Plants are in abundance in everyday environments, so we sought to explore which of their properties and affordances might be used to create unique experiences.

We conducted a user study to explore how people perceive and interact with plants, helping us to imagine how they could be integrated into future computer interactions and how they might influence new forms of engagement with digital devices. We used a variety of sensing techniques to pick up peoples' interactions using plants, creating several technology probes and inviting participants to both interact with the plants and reflect on their experiences and perceived future uses for the technology.

Related Work

Previous work has explored plant-based interaction with digital devices. Disney's project *Botanicus Interacticus* [9], for example, used capacitive touch sensing to pick up an array of gestures on a variety of plants, and demonstrated how certain gestures are more natural on particular types of plants. The work was exhibited where visitors could interact with

plants that gave both visual and audio responses. Another study—*My Green Pet*—addressed the difficulty that children have in perceiving plants as living [6]. The system recognised touch gestures with which the plant would respond with humanoid reactions. *Babbage Cabbage* used colour change in cabbages to represent social or ecological information triggered by changing pH levels [2]. Other research used plants to present information as a natural ambience, rather than for direct interaction [1, 5, 8]. In general, previous research in this area has shown the use of plants to be appealing to humans, as it can give a sense of emotion via organic change.

The *biophilia* hypothesis suggests a natural connection between humans and living systems [7]. A recent survey further strengthened the hypothesis' merit, considering how visual contact with nature impacts health, evaluated via fifty relevant studies [4]. We motivate our work with a notion that a natural connection to a digital interface could improve the psychological and emotional feeling beyond current digital devices. We have previously seen how children responded positively to *My Green Pet*, with examples of behaviour that suggest empathy, along with increased interest in the interactive plant [6]. *Babbage Cabbage* also supports the biophilia hypothesis, concluding that colour change through natural media offered a calming effect [2], and suggesting that living interfaces could have a positive effect.

Prior work has focused on plants as a visual interface (e.g., [1, 2, 5, 8]), and where physical interactions were studied (e.g., [6, 9]) little has been reported on user experience, or focused only on children. In this work we directly observed adults' interactions, and



(a) Aloe Vera



(b) Dragon Tree



(c) Hosta

prompted discussion about their experiences, aiding us in understanding how plant interfaces affect users' experiences, and the benefits they can offer new media in contrast to digital input methods. Our objective is to understand how biophilia affects using plants in an HCI context, potentially increasing support for designing emotional and physical contact with computers in an increasingly digital-focused world.

Plants as Interactive Objects

Interfaces

We developed three plant-based interfaces to explore the potential for interaction by utilising the different physical properties of different plant species. We used an Aloe Vera plant, with strong leaves and small approachable size. The Dragon Tree was chosen due to it being large, flexible, with floppy leaves and interesting textures. Finally the Hosta was withered and more fragile in contrast to the others plants (See Fig. 1). We also presented a digital interface (using mouse and keyboard) as a comparison. Unlike previous studies that have used capacitive touch (e.g., [6, 9]), we used accelerometers to detect movement. We also attached conductive thread to the plants, using a MaKey MaKey¹ to map functions.

Systems

We developed three interactive systems that each interface could be used with. Each was developed as fun and open-ended to encourage exploration.

System 1 gave visual feedback by generating bouncing coloured balls on a monitor (See Fig. 2a). When using each plant, the more the user touched, shook or moved it, the more balls were generated. As the

plant stabilised, the number of balls reduced. Using the digital interface, the visuals were based on mouse movement in the same manner.

System 2 involved controlling a rain cloud, which watered virtual plants on a monitor. If rainfall hits a plant, a blue bar grows until turning green to indicate full. If the plant is not being watered, the blue bar drops (See Fig. 2b). When using a plant interface, moving the plant controls the cloud. Using the digital interface, arrows on the keyboard control the cloud.

System 3 involved activating interesting facts on a monitor (See Fig. 2c). To activate these facts using a plant, participants must touch near or on its conductive thread. When interacting with the digital interface, facts were mapped to random keys on the keyboard. The aim of this system was to explore how plants could present ephemeral traits. For example, if a leaf is removed, so is access to the fact it triggers.

User Study

The objective of our study was to explore perceptions of plants as tangible interfaces, observing interactions and interviewing users about their experiences.

Procedure

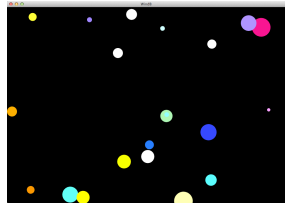
After signing an ethically approved consent form, participants interacted with each system using each interface. A post-hoc interview explored their experiences, with open questions discussing future usage.

Participants

Sixteen people took part (8F, 8M; ages 18–44). Participants attended the 40 min session individually to interact with the four interface types, using each of the three systems, compensated with a £5 voucher.

¹MaKey MaKey toolkit. makeymakey.com

Figure 1: Plant interfaces



(a) System 1



(b) System 2



(c) System 3

Figure 2: Screen captures of the systems used

Task

Participants used each of the Aloe Vera, Dragon Tree, Hosta and Digital interfaces to interact with System 1. They then used System 2 and System 3 with the interfaces in the same order. Participants used the interfaces in a Latin Square order, to minimise learning effects and avoid influencing results. They were told that none of the tasks were a test, and that we simply wanted to find out how they might use the interfaces. A brief was given before each system, but users were not told how to use the interface; instead they were prompted to explore and play.

Results

Participant Observations

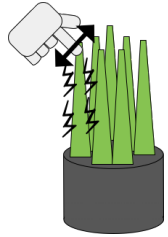
From observing the participants, we saw that different plants attracted certain interactions. Participants interacting with the Aloe Vera were highly likely to pluck the stem tips, causing the stems to wobble due to their elasticity (See Figure 3a). Two participants proceeded to interact by means of snapping a stem off the Aloe Vera plant. One of these participant said "sorry little plant" as they snapped off a stem, and rubbed the juices on their skin. The other did this to be able to smell the stronger scent. Participants interacting with the Dragon Tree commonly brushed their hands through the hanging leaves (See Figure 3b) or tilted hanging branches. One proceeded to "tidy" the plant, moving leaves that were wrapped around branches. When using the Hosta, participants were always drawn to rubbing or touching the leaves, most likely to touch the greener, healthier leaves.

Switching systems did not seem to change the array of gestures participants tried; instead, they tended to cycle through previously tried gestures until they

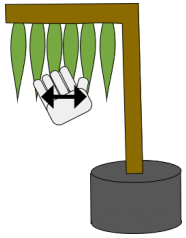
were happy they found a form of interaction that satisfied. When interacting with System 2, all participants tried tilted the plants after discovering this method gave most control over the cloud (See Figure 3c). One participant went against this trend when interacting with the Hosta, choosing to pull the leaves in the direction they wanted to move the cloud, still achieving the same level of control.

Interviews

When asked how the plant interfaces being living affected interactions, participants mainly gave comments relating to being careful; they worried about the plants' durability. One stated, "it's not like a keyboard where you hit it when it doesn't work." Participants made a point of explaining how they were particularly careful with the Hosta as it was more fragile than the other plants. After voicing these thoughts, many participants went on to explain how the living aspect added to the experience. One explained what they saw as "a collaborative relationship with the plant" and another said "it made the interactions more fun and a very different approach to using computers." When talking about enjoyment, most spoke about how returning to the digital interface after using plants was less fun, and that sometimes the lower level of control added challenge and exploration. Participants used adjectives such as, "playful", "therapeutic", and "personal" to describe their experiences with plants. One said "the Aloe Vera plant was really smooth, I just wanted to touch it." They spoke about how the sense of touch and texture played a big part in their enjoyment, going on to say "I did not like returning to the keyboard". Another explained how they wanted to use a different plant, more personal to them, from their home country.



(a) Stem Plucking



(b) Leaf Brushing



(c) Tilting stems

Figure 3: Common gestures

When we asked about ideas for the future, participants were very engaged. Four were particularly keen on the idea for children, especially in an education context, independently describing a system where children touched parts of plants to receive information about each part. Others gave ideas relating to ubiquitous interactions, such as turning a light on or controlling a TV, seeing this as more aesthetically pleasing in contrast to switches and buttons.

One participant was keen to use the ubiquitous nature of plants for tricks and pranks, while another thought it would aid their graphic design work. They explained how *"the texture is playful and creative; the mouse and keyboard creates barriers"* and how the connection to the interface could lead to more creative experiences. None of the participants raised ethical concerns, and as long as the plant is still being cared for they saw no issues with using them in this way.

In a discussion about favourite and least favourite interfaces, several participants compared both the Hosta's stem and the stems of the Aloe Vera plant to joysticks. Two of these participants went on to explain that they liked this feature because it offered good control. One participant believed this limited interactions, and preferred more variety and exploration as it offered lots of different interactions. Others also enjoyed the dimensions of interactions – describing the traits of the Dragon Tree, one participant said *"it's my size, I can reach out and give it hug"*. When asked if their opinion of interaction with plants for computer-based tasks had changed after their experience in the study, 13 out of 16 of stated a clear positive change. All participants came in with no idea what to expect, but these 13 left positive and excited

for the future of the idea, explaining how they enjoyed the time interacting with the plants. Three participants questioned the technique's usefulness, and said that interacting with plants was either too *"odd"* or too *"complex"*, explaining how they like the precision mice and keyboards offer.

Discussion

In this paper we have demonstrated that plants can offer an engaging experience. Participants enjoyed the new textures and developed interesting interactions such as brushing hanging leaves or plucking and bending rubbery stems. From taking simple existing sensors, we can enhance our engagement with plants that exist in our environments. We observed how plants can enrich the way we think about interfaces, and provide merit for future applications. This idea is further supported by answers in interviews we conducted, stating that exploration and working with an interface rather than using it as a tool were clearly compelling features to most participants.

We should also be mindful of people's concerns relating to about the durability of the plants. The Hosta raised most concerns due to its delicate nature. Many plants have similar properties to those of a Hosta, and if people are not comfortable using them in this way, this will be an important consideration for future work. There is also the issue of decay. From the start of the study, the Hosta was very withered, and as mentioned participants were more drawn to healthier leaves. This presents a question around changes in plants (e.g., growth, death, seasonal changes), and the effects on users' interaction possibilities. Participants spoke highly of the Aloe Vera plant due to its rubbery strong stems, often stating it offered

more control and felt more durable. People never felt the Aloe Vera was unbreakable, but it was alluded to that stronger plants made the users more comfortable and likely to explore. People throughout the study were mindful of the plants as living entities. We think it's important to maintain this perception. The idea of a living interface enhances the experience – we see people caring for the well-being of plants, finding them to be “personal interfaces” degrading this could affect the benefits of the material.

Future Work

Our study has shown early merits of plant-based interaction, and we hope to develop this knowledge in future work. We think plants offer opportunities for interfaces in public places, encouraging interaction away from individual experiences on personal devices, alongside enriching engagement of the setting. Based on our interview results, we see use in both games and education. We intend to explore how interactions are effected through growth, change, and decay, exploring how the interactions observed are effected by these changes and what influence this has on the user. Due to the naturally changing properties of plants, gestures interactions and user perceptions will no-doubt change over time. This could offer slower digestion of information and organic control over content, with each new leaf grown new media can be accessed. For example, a parent with a series of pictures of their child from various stages in their life, using the plant could “grow access” to the photos revisiting memories again in a more organic and reflective medium. We also want to further explore the participant suggested idea of using plants to enhance user creativity, for work such as graphic design. With the different textures and

new gesture sets plant could afford new creativity possibilities, and more natural mediums for people to express themselves.

References

- [1] Easterly, D. Bio-fi: Inverse biotelemetry projects. In *Proc. MULTIMEDIA '04*, ACM (2004), 182–183.
- [2] Fernando, O., Cheok, A., Merritt, T., Peiris, R., Fernando, C., Ranashinge, N., Wickrama, I., and Karunanayaka, K. *Babbage cabbage: Biological empathetic media*. Proc. of VRIC Laval Virtual, 2009.
- [3] Greenfield, A. *Everyware: The Dawning Age of Ubiquitous Computing*. Peachpit Press, 2006.
- [4] Grinde, B., and Patil, G. G. Biophilia: Does visual contact with nature impact on health and well-being? *Int. J. Environ. Res. Publ. Health*. 6, 9 (2009), 2332–2343.
- [5] Holstius, D., Kembel, J., Hurst, A., Wan, P.-H., and Forlizzi, J. Infotropism: Living and robotic plants as interactive displays. In *Proc. DIS '04*, ACM (2004), 215–221.
- [6] Hwang, S., Lee, K., and Yeo, W. My green pet: A current-based interactive plant for children. In *Proc. IDC '10*, ACM (2010), 210–213.
- [7] Kellert, S., and Wilson, E. *The Biophilia Hypothesis*. Shearwater books. Island Press, 1995.
- [8] Kuribayashi, S., and Wakita, A. PlantDisplay: Turning houseplants into ambient display. In *Proc. ACE '06*, ACM (2006).
- [9] Poupyrev, I., Schoessler, P., Loh, J., and Sato, M. Botanicus interacticus: Interactive plants technology. In *SIGGRAPH '12 ET*, ACM (2012).
- [10] Victor, B. A brief rant on the future of interaction design. <http://goo.gl/3atgtS>, 2011.