BOTANICUS INTERACTICUS: Interactive Plants Technology

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1. Introduction

Botanicus Interacticus is a technology for designing highly expressive interactive plants, both *living* and *artificial*. We are motivated by the rapid fusion of computing and our dwelling spaces, as well as the increasingly tactile and gestural nature of our interactions with digital devices. Today, however, this interaction happens either on the touch screens of tablet computers and smart phones, or in free air, captured by camera-based devices, such as the Kinect. What if, instead of this limited range of devices, a broad variety of objects in living, social and working spaces become aware and responsive to human presence, touch and gesture?

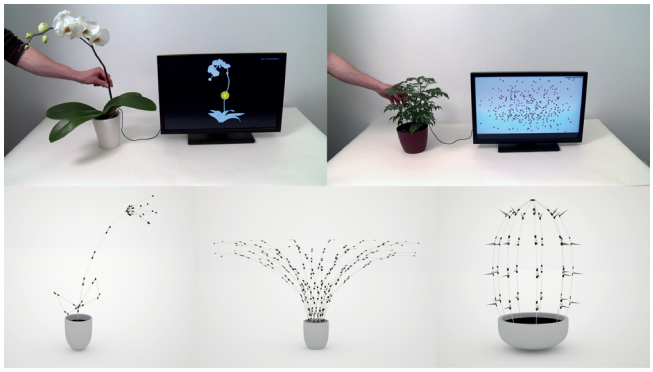

***Figure 1**. Top: Precise and playful interaction with living plants; Bottom: Design of biologically inspired artificial plants.*

2. Interactive Plants, Living and Artificial

Botanicus Interacticus is an interactive plants technology. A number of unique properties set it apart from previous projects [1, 2].

Simple and ad-hoc instrumentation. Enhancing plants with interactivity is simple, non-invasive and does not damage the plants – all that is needed is a single wire placed anywhere in the plant soil. Furthermore, the technology does not require instrumenting either the environment, or the users, which allows creating truly ad-hoc plant-based user interfaces

Rich set of gestures on plants. Plants instrumented with our technology respond to a rich set of gestures, e.g. *sliding* fingers on a stem, *discriminating* touched leaves, determining level of the user *proximity* and the *amount* of touch. This large range of gestures makes many applications possible with *Botanicus Interacticus*.

Precise recognition. We use machine-learning techniques for precise and unambiguous recognition of gestures on plants. Therefore, plants can be used to issue commands, such as play a musical note, select a date on the calendar, or flip channels on TV.

Unique interactive character. Structure and physical properties of each plant species exhibit unique interaction constraints and affordances. In other words, for each type of plant certain gestures are more natural then others, e.g. an orchid invites users to slide fingers along it's stem, while a gardenia suggests unstructured, playful interaction (Figure 1). These physical, tangible properties of plants map naturally into the control variables that we capture using our sensing technology. Thus, each kind of plant species has a unique and specific interactive character.

Real and artificial plants. The sensing approach used in our technology treats plants as an electrical circuit that can be modeled and replicated with standard electrical components. This allows us to design a broad variety of biologically inspired artificial plants that would behave nearly exactly same as their biological counterparts. From the point of view of our sensor there would be no difference between real and artificial plants: they would all represent the same plant specie: *Botanicus Interacticus*. A possibility to create both real and artificial interactive plants using the same technology allows to designing environments where artificial plants can be used where real plants are not be appropriate, without changes to sensing technology, infrastructure, interfaces or applications.

3. Sensing Technology.

Botanicus Interacticus uses the recently developed Swept Frequency Capacitive Sensing technology [3]. Previous capacitive sensing techniques measure response to touch by exciting the target objects with an electrical signal at a *single* frequency. We excite plants at multiple frequencies, by sweeping them through a range between 0.1 and 3 Mhz. Because the path of the electrical signal inside the plant varies with frequency, we can estimate touch locations by observing the frequencies at which the signal was affected by user touch. Since the plant has a complex and dynamic electrical structure, we use machine-learning techniques to recognize gestures on plants reliably and with high precision.

4. Applications of Interactive Plants Technology

Although there are many applications of interactive plants technology, we are currently focusing on experiential, entertainment and aesthetic uses. We are particularly interested in technologies that would encourage children and adults to move and engage with surrounding physical environments and each other, rather than with personal digital devices such as smart phones. This can be achieved by enhancing living, working and social spaces to make them responsive, intelligent and adaptive.

Plants represent a natural platform for such enhancement. Indeed, they already have a special place in our dwelling, serving as a decoration and living companions that we nurture and care for. Giving plants a voice, a possibility to respond and engage us would lead to new forms of entertainment, enhance our lifestyles and form a new environmental computational platform that can be used both for education and entertainment.

5. Siggraph Demonstration

At the SIGGRAPH Emerging Technology we will demonstrate a garden composed of real and artificial interactive plants. Visitors will be interacting with them by touch and observing their visual and audio responses (Figure 2). Each plant would recognize a unique set of gestures and, similarly to popular virtual pet computer games, the more visitors engage with plants – the more complex and rich visuals and audio would become. Engaging with more painful plants, such as cactuses, would provide far more rewarding experiences. The visitors will be encouraged to go through all levels of plants responses and the entire experience would take between 2 to 3 minutes for each visitor.

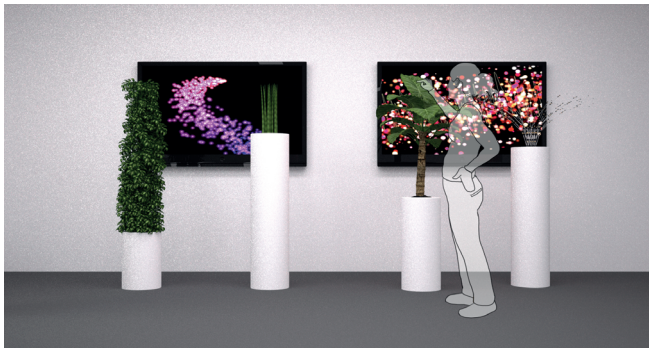

***Figure 2**. Botanicus Interacticus SIGGRAPH exhibition.*

5. References

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