The Nature of Biodesigned Systems: Directions for HCI

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Abstract
The nascent field of biodesign uses the biological affordances of organisms to address some user need. These can range from the development of novel materials, which the designer actively investigates, to applications of synthetic biology or the creation of bio-digital hybrid systems. Within biodesign there is a question for interaction design: what will interactive systems look like in a guided and grown environment, rather than a built environment? In this workshop, we will explore new technologies that rely on symbiotic relationships between the user and organisms that participate in interactive systems. The goal of this workshop is to engage the interaction design community in exploring new aspects of designing for living computational systems.

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Biodesign; Interaction Design; Interactive Systems; Bio-Digital Hybrids; Material Driven Design; Synthetic Biology

CCS Concepts

•**Human-centered computing** → **User centered design;** *Interaction design theory, concepts and paradigms;* •**Applied computing** → Life and medical sciences;

Introduction

There is potential for a shift in design thinking that arises from the new nature of biotechnology. Biodesign has roots in computational and synthetic biology and in human-centred design [12]. As it develops, the field of biodesign will not only be centred around the needs of the user, but also the needs of organisms which take part in these systems. This shift in thinking will influence the way in which designers view the designed system, the way in which users will need to act towards interactive devices, and the way that technology is conceptualised.

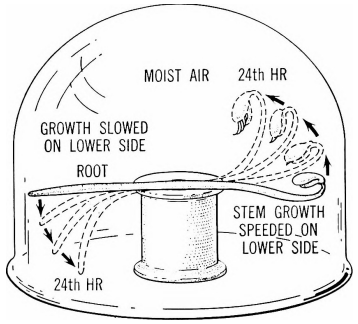

Figure 1: *Tropisms*, the natural responses to external stimuli, such as light, touch or water. The figure shows a diagram of a plant responding to gravity. Public Domain Image

Biodesign will see biotechnology developed based on cutting-edge life science research. Synthetic biology has already led to the design of computational circuits, which allow for living, rather than digital interactive systems [13, 8]. This requires a new approach to thinking about how technology is designed for users and the organisms that take part in our interactive systems.

In practice and research biodesign is applied through three main areas: interactive systems, material-driven design, and the combination of these. There is a growing body of literature that describes applications of biological processes, materials, forms and information (DNA) to create interactive systems, often enabled through intermediate digital systems, referred to as Bio-HCI [14]. These include three broad areas of application. The first area is bio-digital hybrids, technologies that create interactive systems that rely on tropisms of plants to create information displays [6, 10, 16, 9, 5, 15]. Designers have also created interactive materials using tropisms (see Figure 1), which do not require any intermediate digital system to mediate the interaction between the organism and the user [17, 8].

The second area of activity is Material-Driven Design. These methods allows designers actively explore new materials, rather than being passive recipients of novel materials [3, 7, 8, 1]. A third and future area of activity will cross both interactive systems and material design, where the designer may also use synthetic biology, applying the scientific research and collaborating with experts or members of the biohacker community to tailor the functions within living organisms, working at the seam between art, design and science [12, 11].

In these examples the natural forms, functions, processes and materials of the organism provides the opportunity to create interactive systems that designers create. However, these systems are different in nature to digitally computational systems, the components for which can be manufactured at scale, distributed around the world, and stored until ready for use. Biodesign is heading towards a new model: away from the paradigm of human-centred design and technology based on physics, towards designing for symbiosis and technology that is co-created with living organisms.

Workshop Description

Through this workshop, we wish to explore three themes of biodesign: *Design for Participating Organisms*, *Challenging User Behaviour* and *Steering Technology*.

Design for Participating Organisms

Biodesign is a field that will extend beyond human-centred design, to a form of human-organism symbiotic design. When components of an interactive system are living the designer will be required to co-create a product that allows the participating organism to thrive [3].

Challenging User Behaviour
Sustainability is a key issue driving biodesign. We will question whether a biological material can be more sustainable than a synthetic material when user behaviour is not challenged by the design, or disruptive design without the disruption [2, 4]. There is potential to shift unsustainable consumerism through design, which biodesign should be a part of, but this will need to go beyond the use of “drop-in” biodesigned materials [7].

Steering Technology
Synthetic biology and its applications may be climbing a peak of inflated expectations. The applications of novel composite materials developed by designers from natural sources are currently limited, and often speculative. The expectations designers and consumers have towards new technologies are biased towards a basis in physics, rather than biology. Rather than a risk to the future of biodesign, these may be an opportunity for biodesign to steer technology towards different kinds of technologies, which we have not yet imagined.

Topics of Interest from Participants
We invite the members of the DIS community to engage with the challenge of designing with living organisms as partners. Participants are invited to submit a positional statement or case study of their own biodesign practice, up to two pages. Participants will have a chance to give a short presentation of their paper as part of the workshop.

Workshop Goals
With this workshop we plan to strengthen the biodesign community within HCI. The one-day workshop is organised as a facilitated exploration focusing the topics of designing for participating organisms, challenging user behaviour, and steering technology. These discussions will help build a research agenda for biodesign and bring together experts in design and biodesign to critically reflect on potential of technologies based in biological sciences.

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