Eek! A Mouse! Organic User Interfaces: Tangible, Transitive Materials and Programmable Reality

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Abstract
In this panel, we explore the role emerging transitive materials, like flexible thin-film displays, multi-touch input skins, e-textiles, micro-actuators and Claytronics might play in re-defining the human interface towards a programmable form of reality. Panelist will extrapolate historical trends from Tangibles to new developments in organic user interfaces, trying to identify a future in which interfaces will no longer be predominantly flat, but instead have any possible shape or form: from skins that are foldable, flexible and physical to three-dimensional products that are fully kinetic.

Keywords
Organic User Interface, Transitive Materials, Tangible User Interface, Programming Reality.

ACM Classification Keywords
H5.m. Information interfaces and presentation

Introduction
Over the past few years, a quiet revolution has been taking place in some of the fundamental computing technologies. Advances in light-emitting polymers and E-ink displays have resulted in displays so thin and flexible, they are beginning to resemble paper. On the input side, advances in sensor technologies allow us to track the position of multiple fingers, twists and pressure on

surfaces of any shape. New actuating devices allow for "Claytronic" displays that can actively re-shape themselves. These and other developments not only open up unprecedented opportunities for user interface innovation, but also require us to re-examine some of the basic principles of modern user interfaces, which were designed for traditional rectangular, planar and static display devices. Organic User Interfaces [1] is an emerging vision for future user interfaces that attempts to map out a future where these technologies are commonplace. It is based on an understanding that future technologies will make the *physical shape* of computing devices an important design variable.

The proposed topics of discussion for the panel will include, but not be limited to:

- *Transitive Materials: embedded displays, e-textiles, actuators, smart materials and sensor technologies in everyday structures.* Recent advances in materials engineering have resulted in e-textile displays, actuators, and sensor technologies that allow us to capture interactions in any conceivable structure or fabric. We will provide an overview of transitive materials [2], and discuss their potential implications for the design of everyday things.
- *Evolution of Organic Tangible User Interfaces.* We will discuss a historical perspective on trends in user interface research from DigitalDesk to Tangible User Interfaces. Can we identify a new category of interfaces in which malleable atoms and tangible bits are substantially more aligned?
- *Digital Paper*. Flexible E-Ink and OLED displays will allow for paper-like user interfaces. How will we navigate such future foldable interfaces? Are we reinventing the book in electronic paper form, and if so, do users need physical interactions with multi-page designs, and is the mouse a goner?
- *Industrial Design of Freeform Displays*. Emerging technologies allow us to create displays that can take *any shape*, i.e. spherical, or triangular, or any other form. How would we design interfaces for such displays? What will this mean for industrial design?
- *Skin as a Metaphor for Input*. When computing devices can take on a complex shape, point and click interaction techniques break down. New multi-touch, gestural and multimodal input techniques are required. What might our design guidelines be?
- *Shape-shifting devices, claytronics, and kinetic interactions.* Augmented with new actuating devices and materials, future computing devices will be able to actively alter shape: the entire device is able to dynamically reconfigure, move or transform itself to reflect underlying data though programmable reality. How can physical motion be used for communication?
- *Dynamic Art Forms and Sculptures*. New interface technologies make possible the merging of computing fabrics with real world structures. What are the implications for the media arts, fashion and architectural design? Will this aligning computing, artistic and materials engineering efforts?
- *Dynamic environments and architecture*. Future living environment and buildings will exhibit real-time behaviors, like adjustments in shape in response to changing environmental conditions, such as wind direction, or to individuals living in them. How will we we design such environments to be usable? What will they respond to, and what implications could this have for individuals or communities living in them?

- *Definitions and philosophical implications.* Current definitions of Tangible User Interfaces (TUI), Organic User Interfaces, Transitive Materials and Programmable Reality have many things in common. How can we come to a unified definition?

Panel Format

Opening and Panel Overview. Moderators Vertegaal and Poupyrev will begin the session with an outline of new materials technologies and working definitions for Organic User Interfaces, Transitive Materials and Programmable Reality. They will pose some questions associated with these emerging fields of user interface research, and introduce the panelists and moderators.

Panelists, Questions and Responses. After introductions, each panelist will have 5 minutes to discuss one piece of research in this area of user interface design that they believe highlights an important issue or question in organic user interface design. During switching, one of the panelists will be allowed to respond critically to the question posed by the presenter, with a discussion time of 2 minutes per presentation. Discussions will be moderated by Vertegaal and Poupyrev.

Discussion and Audience Interaction. After all panelists have completed their presentation, the floor will be opened for debate. Moderators will have some time to continue debate amongst panelists, and discussing the topics listed on the previous page. The floor will be opened to the audience, asking questions during the last half hour of the panel.

Panelists

Below panelists will participate:

Nimish Biloria is an Architect and Assistant Professor at Hyperbody, TU Delft, The Netherlands. After investigating the interrelation of Media and Architecture at CEPT, Ahmedabad, India, he specialized at the Architectural Association, London, in the field of Emergent Technologies and Design. His Doctorate at the TU Delft, Netherlands, focused on developing real time responsive/adaptive corporate office environments.

Dr. Biloria will be discussing how contemporary actuation, sensing and control system based technologies have allowed him and Dutch architect Kas Oosterhuis to design flexible and performative interfaces at the scale of buildings that are fully interactive, able to reshape themselves intelligently in response to human behavior and environmental stimuli such as wind and rain.

Seth Goldstein is a Professor at Carnegie Mellon's Computer Science Department. His research focuses on understanding nano-technology computing systems. Among his research efforts are three research projects: the Phoenix project, the Claytronics project, and Brain in a bottle. The common theme among these projects is to understand how to design, manufacture, program, and use robust reconfigurable systems built with massive numbers of similar, and often unreliable, programmable units. Dr. Goldstein joined the faculty at Carnegie Mellon University in 1997. He received his Masters and Ph.D. in Computer Science at the University of California at Berkeley.

At the panel, Dr. Goldstein will present his vision for Programmable Matter, which is any substance that can be programmed to effect a change in one or more of its physical characteristics. In Claytronics, the interactive substance is a collection of individual units, each of which can sense, compute, communicate, and actuate. The long-range goal for Claytronics is for the collection to behave as

a coherent mass and mimic, with high fidelity and in 3D solid form, the look, feel, and motion of interactive objects.

Hiroshi Ishii is Muriel R. Cooper Professor of Media Arts and Sciences at the MIT Media Lab, where he heads the Tangible Media Group and co-directs the Things That Think (TTT) consortium. Prof. Ishii's research focuses upon the design of seamless interfaces between humans, digital information, and the physical environment. Prof. Ishii received his BE degree in electronic engineering, and ME and PhD degrees in computer engineering, from Hokkaido University, Japan. In 2006, ACM SIGCHI elected Prof. Ishii to the CHI Academy.

Prof. Ishii will be speaking on the problems of synchronizing bits and atoms, and on the evolution of TUIs into fully malleable, dynamic, and organic interfaces that seamlessly integrate sensing and display into soft and hard digital/physical material.

Sachiko Kodama is a Media Artist and Associate Professor at the University of Electro-Communications in Tokyo, Japan. She studied Computer and Holographic Art and Plastic Art and Mixed Media at the University of Tsukuba. Her work has been exhibited at Ars Electronica Center/Linz, National Taiwan Museum of Fine Arts, Tokyo Metropolitan Museum of Photography, Wexner Center for the Arts/Columbus, Skirball Cultural Center /Los Angeles, Science Museum/ Tokyo, The National Art Center/ Tokyo. She received the Grand Prize at the 5th Media Arts Festival, Agency for Cultural Affairs, Japan.

Prof. Kodama will be discussing implications of her ferromagnetic fluid sculptural work, which allows computer displays to take on programmable forms, on ui design.

Pattie Maes is an Associate Professor in MIT's Program in Media Arts and Sciences and Associate Head of the Program in Media Arts and Sciences. She holds Bachelor's and PhD degrees in Computer Science from the Vrije Universiteit Brussel in Belgium. TIME Digital named her one of the top 50 technological pioneers of the high-tech world; and in 2000 she was recognized with the "Lifetime Achievement Award" by the Massachusetts Interactive Media Council.

Prof. Maes will be discussing research on computation and design, and how we might use responsive materials as a physical and computational bridge between form and function, structures and membranes. She seeks to define the integration of novel "transitive materials" that blur the gap between computation and structure, and between disciplines that have traditionally stood apart [2].

Jun Rekimoto is a Professor of the Interfaculty Initiative in Information Studies at The University of Tokyo and director of Interaction Laboratory at Sony Computer Science Laboratories, Inc in Japan. He received his B.A.Sc., M.Sc., and Ph.D. in Information Science from Tokyo Institute of Technology. His research interests include real-world user interfaces, novel input devices, and large-scale sensing systems. In 2007, he was elected to ACM CHI Academy.

Prof. Rekimoto will be discussing his work in skin-based interaction techniques, smart capacitive fabrics and computer vision surfaces that allow multi-hand, multi-finger physical input on objects and surfaces of arbitrary shape. He believes metaphors for Organic User Interfaces should be skin-based, not tool-based.

References

1. Vertegaal, R. and Poupyrev, I. (Eds). Special Issue of Communications of the ACM June 2008. *www.organicui.org*

2. Coelho, M, et al. Transitive Materials, 2008 *ambient.media.mit.edu/transitive/*