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Programming Reality: From Transitive Materials to Organic User Interfaces

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Abstract

Over the past few years, a quiet revolution has been redefining our fundamental computing technologies. Flexible E-Ink, OLED displays, shape-changing materials, parametric design, e-textiles, sensor networks, and intelligent interfaces promise to spawn entirely new user experiences that will redefine our relationship with technology. This workshop invites researchers and practitioners to imagine and debate this future, exploring two converging themes. *Transitive Materials* focuses on how emerging materials and computationally-driven behaviors can operate in unison blurring the boundaries between form and function, human body and environment, structures and membranes. *Organic User Interfaces* (OUI) explores future interactive designs and applications as these materials become commonplace.

Keywords

Interaction design, architecture, smart materials, tangible UI, ubiquitous computing, organic UI, physical interaction, transitive materials, shape change, flexible computers, interactive textiles.

ACM Classification Keywords

H.5.2 User Interfaces — Theory and methods

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figure 1. Re-configurable architectural spaces [4].

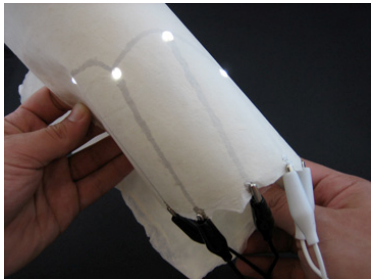


figure 2. Composite combining natural paper and electronic components [2].

Introduction

Over the past few years, a quiet revolution has been redefining our fundamental computing technologies. Flexible E-Ink, OLED displays, shape-changing materials, parametric design, e-textiles, sensor networks, and intelligent interfaces promise to spawn entirely new user experiences that will redefine our relationship with technology. In one example, future displays will allow us to design devices that are completely flexible and can curve around everyday objects and our bodies. New actuating technologies will also allow for “claytronic”-type devices and materials that can actively re-shape themselves on multiple scales: from hand-held gadgets to entire buildings (Figure 1). On the input side, new sensor technologies allow us to track the position of multiple fingers, twists and pressure on surfaces of any shape. These and other developments are opening up unprecedented opportunities for innovation and require us to re-examine and re-evaluate some of the most basic user interface design principles. In this workshop we will explore two converging themes related to these developments: *Transitive Materials* and *Organic User Interfaces*.

Transitive Materials

Transitive Materials investigate how emerging materials and computationally-driven behaviors can operate in unison. Computation today still remains an entity of information which is overlaid on top of the passive physical world, with little regard for how material and computationally-driven behaviors can operate together. Transitive materials attempt to blur such boundaries by supporting the design of integrated structures that are themselves capable of input/output, computation, and ultimately of interactivity and personalization.

Smart materials, for instance, can significantly alter their physical properties or realize energy exchanges in response to a controlled stimulus. Composite materials, on the other hand, interleave distinct materials to achieve properties unavailable in their constituents, leading to high performance or esoteric applications where specific material properties are required [8] [2] (Figure 2). Lastly, computationally-enabled materials change their properties in response to input, but use computation to determine the output rather than responding blindly [7]. The differentiating factor between these material approaches is their intrinsic capability for behaviors, allowing for great granularity of control and interactivity. Transitive materials combine the transient qualities of smart, composite, and computational materials, and encapsulate the ability to function as frame, skeleton, sensor, actuator and/or processor. The multifaceted nature of transitive materials provides a link between computational devices and physical material elements.

Organic User Interfaces

Organic User Interfaces (OUI) explore future interactive designs as computationally controlled materials become commonplace. The OUI vision is based on an understanding that physical shape of display devices will become non-flat, potentially arbitrary and even fluid or computationally controlled. This allows display devices and entire environments to take on shapes that are flexible, dynamic, modifiable by users or self-actuated. This leads to at least three broad venues of exploration and innovation.

When displays can take on any form. What would happen, when any object, no matter how complex, dynamic or flexible will be wrapped with high

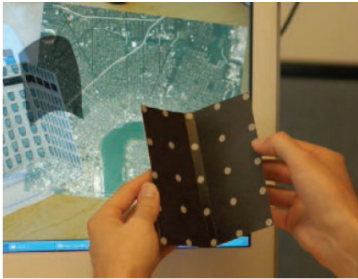


figure 3. Exploring possible shapes and embodiment for paper computers [5].



figure 4. Shape changing textile surface for environmental control and communication [1].

resolution, full-color, interactive graphics? There are few early projects that explored these possibilities [5] suggesting that the design of interface elements and mappings should follow the 3D physical shape of the display itself: *form of the display equals its function*.

When displays can change their shape. In the future, the physical shape of computing devices will no longer necessarily be static. On the one hand, we will be able to bend, twist, pull and fold digital devices just like origami [3] (Figure 3). On the other hand, future computing devices will be also able to dynamically alter their shape. Hence, *the physical shape of future device and displays will follow the flow of user interactions*.

When the display is the input device. How will we interact with displays that come in any shape imaginable? One thing is clear: current point-and-click interfaces will not be sufficient anymore. Rather, multi touch gestures and 3D surface deformations that are performed directly on and with the display surface itself [6] [1] (Figure 4).

The above three directions in future digital computing devices form the umbrella that we refer to as *Organic User Interfaces* [9].

Topics

The proposed topics for the workshop include but are not limited to the following:

- Possibilities and needs served by emerging transitive materials
- Biomimetic, biologically-inspired and biological materials and interfaces
- Flexible digital paper, OLED and E-Ink computers

- Electronic textiles
- Interactive spaces and architectural applications for transitive materials
- Advanced actuators and haptics
- Shape-shifting and physically actuated devices
- Physically reconfigurable computers
- Parametric design and fabrication technologies
- Sensors and techniques for multi-touch and full-body interaction
- Effects of materials and form on design and affordances
- Interaction techniques for non-flat and curved display surfaces
- Tangible and embodied interfaces
- Soft mechanics
- Methodologies for interaction design using transitive materials
- Personalization of shape changing and transitive material interfaces
- End-user customization of the massively-interactive environment
- Value and role of craft, collaborative development, and community knowledge

Workshop Goals

The guiding goal of the workshop is to bring together interface experts, architects, designers, engineers and scientists to:

- (1) Survey and discuss the current state of user interface research in order to identify new research directions and reveal unsolved problems.

(2) Debate the scope and mission of transitive materials and organic user interface research and its connection to other research fields, such as Tangibles and Ubiquitous Computing.

(3) Foster creativity and imagine the underlying technological changes that will take place in the next 10-20 years.

(4) Develop a strategy for building a community of researchers and practitioners, and bring to the forefront overlapping research problems.

(5) Create new opportunities and set the ground for future collaboration between participants, generating insights that can be carried forward into future work.

Concluding remarks

In the future, we will observe increasing integration of computation and the physical environment to the point where basic material properties will be computationally controlled. In this brave new world, we will be programming not only computers or devices, but the fabric of reality itself. We invite everyone to join us in discussing, inventing and prototyping this exciting future.

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