Expressive Surfaces: A Designerly Approach for Computational Objects

Heekyoung Jung (jung5@indiana.edu)
School of Informatics (HCI Design) at Indiana University

ABSTRACT
I propose the concept of expressive surfaces as a research theme to investigate and explore aesthetics of computational objects with its emphasis on forms and materials. In this proposal, I describe some of my preliminary studies to illustrate how the concept has been developed to my research theme. Then exploratory examples of expressive surfaces (the sound-sensitive lamp sculpture and the soft-spiky mouse) are introduced as attempts to specify the theme into a research agenda for computational objects in terms of concept development, prototyping and evaluation.

Author Keywords
Expressive surfaces, tangible/organic user interfaces, computational objects, aesthetics.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design

INTRODUCTION
Interactive computing technology is pervasive in everyday life. In particular, maturing technologies for tangible and organic interfaces are not only introducing novel computer interfaces, but also transforming the way we interact with inanimate physical objects into interactive computational activities. The context and meaning of interaction are diversified to include affective, embodied, and experiential values of digital objects. However, traditional HCI research based on scientific approaches, in many cases, struggles methodologically on issues such as the aesthetics and the subjective interpretations of digital artifacts in general [2]. In my PhD thesis, I aim to suggest a designerly approach to exploring and criticizing the aesthetics of computational objects enabled by interactive surface technologies.

In industrial design, surfaces have been a central part of research and practice agendas for decades. The surface is understood both to embody and to represent functional and symbolic values through its visual and material qualities: as in [3], “far from seeing surfaces as superficial, industrial designers engage in them intellectually and materially.”

However, this has not been the case in HCI, where the surface of early computers or electronics was basically to enclose inner electronic components. As electronic objects gained more interactive features, graphic layout and cognitive mapping of buttons and displays became critical design issues. Nowadays, surfaces of digital devices are becoming increasingly more dynamic both functionally and interactively (i.e., touch screen, tactile feedback, transitive materials). Moreover, with the simultaneous rise of everyday computational and sophisticated surface technologies (i.e., direct manipulation through tangible computing interface, flexible display through organic user interface [1]), interface design focused on surfaces is in demand in HCI. Bringing the trajectories for tangible and organic interfaces from design and HCI together, I suggest expressive surfaces as an important rising design theme for computational objects. This theme involves an effort to explore aesthetics—new types of forms, interactions, and functions—enabled by physically interactive surfaces.

EXPRESSIVE SURFACES AS A RESEARCH THEME
The concept of expressive surfaces entails unique design intentions represented through its dynamic surface-changing properties—such as motion or transformation of shapes or textures. The approach is not to apply expressive surfaces to a task-based computer interface, but rather to transform an inanimate object into an interactive one with smart tangible and organic surfaces. The intention is to actively intervene into certain user behaviors (functions) by providing awakening or persuasive messages (interactions) through dynamic surfaces of an object (forms).

Preliminary Studies
The concept of expressive surfaces has been developed through my preliminary studies. The first study was to match appropriate tactile feedbacks to different GUI widgets (i.e., buttons, keypad, sliders, pop-up menus) with an assumption that a flat touch screen could display varying affordances for different modes of interaction by switching its tactile feelings [Fig1]. The second study was to investigate how different types of interfaces (i.e., buttons, touch pad, sliders, knobs) affect user responses to the alarm clock radios that have the same shapes and functions [Fig2]. In those two studies, I learned that subtle variations in surface design properties could evoke different user responses (regardless of efficiency or ease of use) and there are more design potentials in representing different types of surfaces with advanced tangible/organic interface technologies. Another finding was that existing methods (i.e., heuristic evaluation, semantic differential, repertoire grid techniques)
are not appropriate to understand experiential qualities of such surface designs. The third approach has been tried out by transforming the function and meaning of an existing object—a plant pot—with additional computational features instead of applying interactive surfaces into task-oriented applications like in previous cases. Specifically, the ambient plant pot was designed to share awareness and support intimate communication between households through ambient displays from plant pot surfaces, which changed colors reflecting conditions of the plants [Fig3]. The in-situ user study was conducted to explore user responses to the new object. Initial user responses were favorable, but due to the indirect/ambiguous display of color changes and limited communication channels of low-fidelity prototype, it was hard to probe user responses through long-term engagement with the object.

Interesting research issues have emerged from my preliminary studies, which made me question about the process of design and evaluation in HCI research, especially regarding approaches for creating and investigating objects in everyday contexts—how we could know what user needs would be for new technologies, how computational objects could mediate those unknown needs, how to make interactive prototypes with not-yet-common technologies, and how to evaluate subjective aesthetic qualities.

Design Explorations Toward Expressive Surfaces

I suggest expressive surfaces as a research theme to explore such issues in designing and investigating computational objects. It takes an exploratory approach in discovering and even creating user needs by making artifacts through critical concept development and engagement with new materials and forms. Then, the functions of objects could be expanded from passive support for practical user goals to smart intervention in user behaviors with dynamic surface forms. Expressive surfaces reflect those unique design intentions considering the new possibilities of interactive surface design technologies. The theme will entail a research agenda that explores design implications of new material technologies as well as intellectual design strategies for computational objects. As initial attempts, several concepts and their prototypes were developed including the sound-sensitive lamp sculpture [Fig4] and the spiky mouse [Fig5] in a way to create meanings of surface-changing forms.

Specifically, the sound-sensitive lamp sculpture applies expressive surfaces to a lampshade by changing its surface textures according to the ambient sound level in a place. The lampshade with smooth surface patterns turns inside out as the sound level increases revealing its inner side of aggressive textures, for example, to influence people to behave appropriately by giving awareness of public atmospheres [2]. The soft-spiky mouse applies expressive surfaces to the mouse by changing its surface textures according to the amount of time that user works with the mouse. If the user works with the mouse too long, the mouse will display spiky textures to raise awareness to the passage of time and the need for refreshment. Beyond this functional aspect, diverse tactile properties of surfaces can introduce new experiential qualities and interaction with digital objects. In the symposium, I would like to present the details of concept development, prototype implementation and initial user studies of these two examples.

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REFERENCES