Smart Material Interfaces: "A Material Step to the Future"

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ABSTRACT

Over the past years the technology push and the creation of new technological materials made available on the market many new smart materials. Smart Material Interfaces (SMIs) want to take advantage of these materials to overcome traditional patterns of interaction, leaving behind the "digital feeling" by a more continuous space of interaction, tightly coupling digital and physical world by means of the smart materials' properties. With this workshop about SMIs, we want to draw attention to the emerging field, stimulating research and development in interfaces that make use of smart materials and encourage new and different modalities of interaction.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces - Interaction styles

General Terms

Design.

Keywords

Smart material interface, Reality-based interface, Tangible interface, Organic interface

1. INTRODUCTION

Every day we are getting closer to Mark Weiser's [14] vision of Ubiquitous Computing that motivated researchers to augment everyday objects and environments with computing capabilities to provide Tangible User Interfaces (TUIs) [4], organic interfaces [11] and reality-based [5] interaction possibilities. That is, HCI researchers are developing a wide range of new interfaces that tend to separate from the "window, icon, menu, pointing device" (WIMP).

We can find many different examples of these post-WIMP interaction styles such as: mixed and augmented reality, tangible interaction, ubiquitous and pervasive computing, handheld and mobile interaction, perceptual and affective computing etc. [5]. As mentioned in [5], many of these interaction styles seem to proceed in different and unrelated ways, but they share a common important knowledge. All of these interaction styles try to take advantage on users' preexisting knowledge of everyday life. They employ themes of reality such as users' understanding of naïve physics, their own bodies, the surrounding environment, and other people trying to mimic the real world for making the users more comfortable, creating an interaction more close to what they are used to do already.

To foster and experiment new kinds of interfaces and interaction styles, a vision called Smart Material Interfaces (SMIs) (see e.g. [8]) has been introduced. This vision takes advantage of the latest generation of engineered materials that has special properties defined "smart". Partly introduced to provide an answer to the limitations present in common TUIs, SMIs try to overcome traditional patterns of interaction and leave behind the "digital feeling" by a more analogical and continuous space of interaction, tightly coupling digital and physical world by means of the materials' properties. And not just to copy reality-based patterns, but also to create new possible ways to reach the users' needs and satisfaction.

The main focus of a SMI is being able to make changes in the physical and material properties, creating channels for new input/output modalities. SMI proposes the use of materials that have inherent or "self-augmented" capabilities of changing physical properties such as color, shape and texture, under the control of some external stimulus such as, among other things, electricity, magnetism, light, pressure or temperature.

2. EXAMPLES OF SMI

Considerable efforts have been made to explore the possibilities of applying smart materials in interfaces. For example, Surflex [1] consists of a foam with coiled nitinol muscle wires embedded. The muscle wires can be used to reshape the foam into different shapes. This principle has been applied as a way to use SpeakCup [3], a device used to record and replay messages by physically manipulating its shape (shape-changing interfaces [3]). Parkes and Ishii [9] presented a design tool for motion prototyping and form finding,

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named Bosu. Bosu consists of a number of flexible modules that can be physically manipulated (e.g. bending, twisting). The physical manipulations can then be played back thanks to nitinol muscle wires embedded in the modules. Smart materials have been used in the creation of novel ambient displays. Shutters [2]) is a curtain with a grid of shutters that are actuated by nitinol wires. Shutters can be used to regulate the amount of light and air flow that enters a room, as well as serves as an ambient display by creating patterns using the grid of shutters. An ambient display that aims for a more tangible experience is Lumen [10]. A grid of cylindrical physical pixels is actuated to move up and down, using nitinol wires. The physical pixels contain LED's that allow Lumen to display animations both visually, and physically. While nitinol is by far the most widely applied smart material, others have used ferrofluids to create physical ambient interfaces as well as thermo-chromic materials. WeMe [7] for example, is an ambient display that visualizes the presence of members of remote families represented by bubbles of ferrofluid. Another display that makes use of magnetic fluids is Programmables Blobs [12] by Wakita, that try to force the blobs to change shape using electromagnets. Wakita [13] also notes how in design the materials and colors are felt as part of the emotional communication of the interface. Using the property (in this case colors) of the material directly, their aim is to communicate mood by changing the color of Jello Display-Keyboard using IR-chromic material. Several other examples can be found in arts and design installations, as for example Kodama's artwork with ferrofluid [6].

3. WORKSHOP THEMES AND TOPICS

We invited original contributions in a variety of areas related to Interaction design and development of interfaces that make use of SMART MATERIALS. Main topic of interest was the application of smart materials in designing and building interfaces of everyday life. Interfaces that communicate information to the user or allow the user to manipulate information, using different modalities provided by the material's properties. Such as deforming or changing shape of the interface, ambient modifications or interactive textiles. The proposed topics for the workshop included but were not limited to the following: *reality-based interfaces, tangible Interfaces, organic user interfaces, programmable matter, electronic textiles, computational textiles, smart textiles robotics.*

4. WORKSHOP FOCUS

The workshop discussion focuses on three categories about how SMIs can change our environment, i.e., by using shape, color or interactive textiles. The design of Everyday Computational Things allows new materials to enter in our daily life.

For example, SMIs can change shape through movement to suggest information at the right moment or change shape to create interaction or better comfort in everyday condition. Or SMIs can make houses more energy efficient by changing the thermal transmittance of surfaces (windows, facades, etc...). In this way the material change influences both the appearance and the impact of sunlight. SMIs can also enhance experience on embodied interaction using smart textiles.

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