

# Emotional Smart Materials

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**Abstract.** To build affective and emotional interaction, we pay attention to materials of interface. We introduce two non-emissive displays as examples showing our concept. Fabcell is a fabric pixel that changes its color with non-emissive manner. Matrix arrangement of Fabcell enables information display with fabric texture. Jello Display is composed of gel blocks with moisture, coldness and softness. The unique look and feel enables organic information display. These kinds of haptic and organic information displays have ability adding rich affectivity to the artifacts used in our everyday life.

**Keywords:** smart material, affective computing, ubiquitous computing, tangible interface.

## 1 Introduction

Recently, applications of ubicomp and tangible UI are keep expanding its domain and a variety of smart objects are created. The interaction accomplished by these kind of smart objects will cover not only generalized cold functions but also affective warm functions. Thus, human computer interactions keep evolving from dry to wet manner.

To fulfill this requirement, huge numbers of sensors are developed and distributed on the market as readily-available electric parts. Moreover, easy-to-use physical computing toolkit, for example Gainer [1], Arduino[2] and Wiring[3] are developed. These rapid-prototyping environment enables creators of digital contents to change fields of creation from cyber world to physical world.

Sensors can transfer many physical phenomena to electric signals. For example, light, pressure, sound, temperature, acceleration, tactile, proximity, and so on. The combination of sensor fusion and artificial intelligence technique will be applicable for the use of recognizing and interpreting human emotion [4]. On the other hand, there exist limited number of actuators. Compared with sensors, there is really few output physical phenomena, for example light, movement, temperature and so on.

This is one of the problems why it is difficult to accomplish rich and emotional communication by using computer embedded artifacts. Expressiveness of actuators is not enough to strike users chords. To address this problem, we pay attention to materials of actuators. Building calm and embodied interface is expected by utilizing mentally-and-physically soft and worm materials.

## 2 Emissive and Non-emissive

As mentioned the above sentences, most of works use emissive materials, i.e. LED and projection images, for output signals. As a consequence, styles of interaction are biased because these works tend to push information to users as a stimulus.

We have to discuss natural inclination of emissive and non-emissive materials. Generally, emissive materials are suitable for showing the urgency or degrees of risk, and are not suitable for showing emotions or hospitality. For instance, hospital emergency rooms are compatible with emissive materials because those push information in high frequency and directly. On the other hand, rooms of obstetrics and gynecology are compatible with non-emissive materials. Pushing through blinking light or high lumen display are not appropriate for the spaces in which high hospitality is required.

Let us think about the relationship between scale and light emission. Large scaled objects such as cities and vehicles contain many emissive functions. Street lamps and billboards are glittering in the night. Automobile seems like a composition of pushing functions for example headlight illumination, noise and horn. On the other hand, small scale objects such as house interiors and clothing contains many non-emissive functions. Wallpaper of the room, bed, sofa, underwear, and so on. The closer artifacts are used to our bodies, the more non-emissiveness is required. It is also observed that the closer to our bodies, the softer material becomes both physically and mentally.

We human have not acquired the culture to put on emissive materials in our everyday life. Cell-phone maybe the first artifact in our history. Hence, it will take a long time to overcome social, cultural and psychological problem of emissive artifacts.

## 3 Emotional Displays

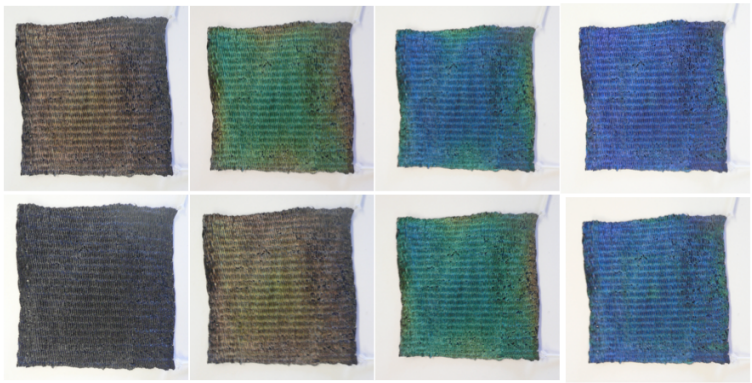
### 3.1 Fabcell – A Fabric Pixel

Based on the above-mentioned ideas, we are developing material-oriented smart actuators for emotive interactions. The first example is Fabcell [5], a kind of fabric pixel.

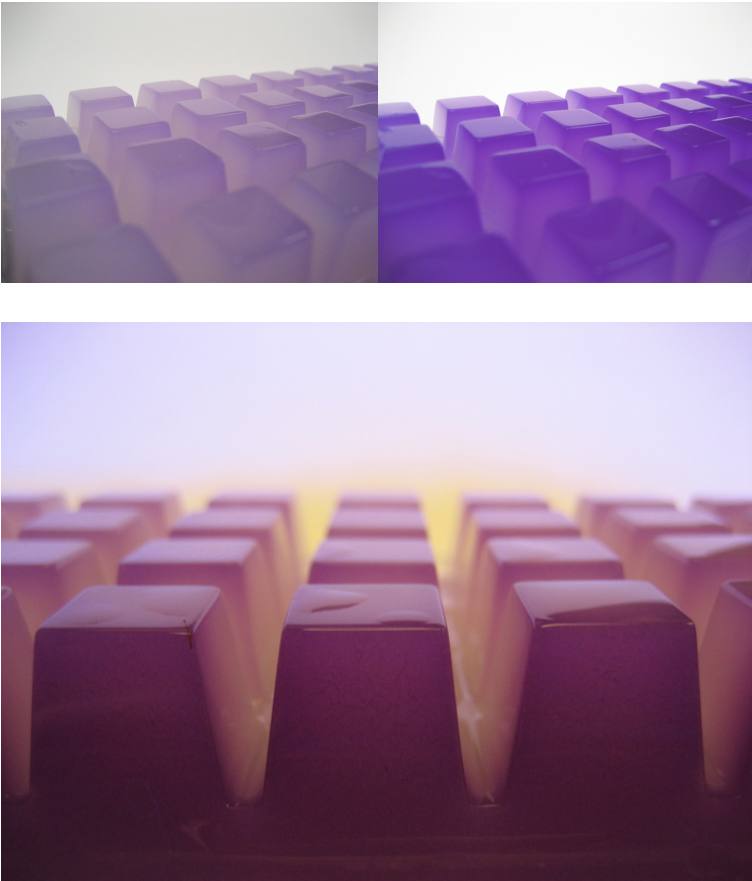
A fabcell consist of conductive yarns and heat sensitive ink. The surface temperature of the textile will change by energizing conductive yarns. A unique color correspond to each temperature will emerge on the surface of fabcell. The color will change from red, green, to blue. Digital images can be displayed by arranging fabcell in matrix state.

Digital images and animations on fabric texture are quite unique and warm expression.

By utilizing fabcells, any kind of artifact made by fabric can be changed interactive media showing rich and warm information.



**Fig. 1.** Fabcell – A Farbric Pixel. Colors change form red, green to blue



**Fig. 2.** Jello Display / Keyboard

### 3.2 Jello Display and Keyboard

The second example is Jello Display made of gelled pixels. Each gelled pixel consist of japan agar block and photochromic ink. A ultra-violet LED is attached at the back of gelled pixel and is turned on and off, enabling photochromic ink to emerge its predefined color. Jello Display has unique look and feel, shaking like a jelly and giving of a semi-transparent brilliance. It shows not only digital image but also qualitative code through its unique texture. If a ager block is resembled as a key block and a touch sensor is attached at the bottom, it becomes keyboard with moisture, coldness and softness. By utilizing Jello Display, wet and organic interaction may be realized.

## 4 Calm and Embodied

Mark Weiser used two impressive keywords to explain the vision of ubicomp, those are "calm technology" and "embodied interaction"[6]. The former means that existence of computers becomes invisible in our living space, and unfortunately most of applications of ubicomp and TUI still use emissive materials such as LED and LCD. This situation also makes our living space extraordinary venue, and disturbing affective and emotional ambient atmosphere. The latter means that computers connected to the network become smaller and are embedded to any object in our living space. However modern manufacturing process utilizes rigid and solid materials such as plastics and metals, soft materials such as gels and textiles remains untouched by ubicomp and TUI. Because those kind of materials are really suited for affective and emotional information display, cultivating the edge of unused materials contains many potentials.

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