AmbiKraf - Ubiquitous fabric display

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ABSTRACT

AmbiKraf is a novel non-emissive animated fabric technology that is fast, color changing, and robust. Here we combine thermochromic ink with semiconductor heating/cooling technologies, embedded in soft fabrics. By developing a technology that makes the fabric itself change the color we present it as a ubiquitous display technology. We present our results through a various range of animated fabric prototypes. Through the use of AmbiKraf's non emissive, subtle and calm color changing properties, we discuss its vision to develop a platform that allows the merging of complex technology into the rich traditions of textile arts and crafts to bring in a new meaning to such traditions.

Index Terms: K.6.1 [Management of Computing and Information Systems]: Project and People Management—Life Cycle; K.7.m [The Computing Profession]: Miscellaneous—Ethics

1 INTRODUCTION

Fabrics are a common form of material we interact with daily. Since its recorded uses from prehistoric times fabrics have become an integral part of our daily lives in the form of our clothes, home furnishing, architecture and other numerous range of uses. Besides its main use as a fashion statement, such uses of fabrics have become a medium for expression allowing arts and crafts to find its way into fabrics. With the advancement of technology and the introduction of new concepts and smart materials, researchers are able to embed more and more electronics into our fabrics paving way for a new era of fabric displays [3]. With this development, researchers have been looking into various forms of fabric displays that are mainly emissive, such as embedding LEDs [5], electroluminscent sheets and wires [4], complete LCD displays [1], etc. The unnatural and non subtle nature of these technologies present a rather obtrusive emissive displays, preventing their application in fabrics and traditional arts. Therefore there has been attention gaining towards non-emissive displays [6, 2]. However currently most of these non-emissive technologies are slow color changing.

With AmbiKraf, we present a robust, non-emissive fabric display technology with fast color change allowing us to present novel animations on fabrics. This technology uses a combination of thermochromic ink and peltier semiconductor elements to achieve these properties. By preserving the non-emissivity, we demonstrate how we can integrate this fabric technology into our clothes, decorative furniture, and further into traditional textile arts and crafts to bring in a new meaning of expression through fabrics. With this technology our main aim is to provide a platform that facilitates merging of complex technology into the arts and crafts of textiles making them a ubiquitous medium for interaction. The subtlety and the calmness of this technology would enable smooth merging into the textile traditions while preserving their values.

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2 THE TECHNOLOGY

The AmbiKraf system uses a combination of Peltier semiconductor modules and thermochromic leuco dye ink technologies to achieve a fast color changing display. These two technologies are combined together using a closed loop controller in order to accurately control the Peltier temperature and thereby control the color. The overall system is depicted in Figure 1

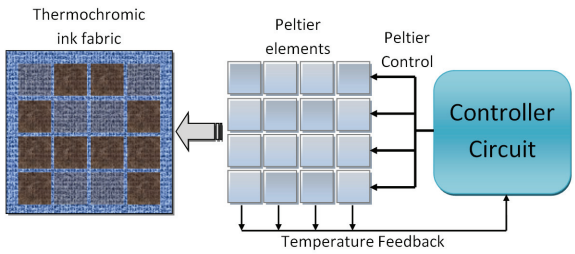

Figure 1: Overall system

2.1 Thermochromic ink

AmbiKraf uses thermochromic inks which when heated beyond its actuation temperature becomes colorless and when cooled returns to the original color. These inks can be customized to be of any color and any actuation temperature. In this version of AmbiKraf we use inks with an actuation temperature of 31^0C. These inks are then combined with textile binder and screen printed, making the fabrics more robust for regular use.

2.2 Peltier elements

AmbiKraf uses peltier semiconductor elements as its main thermal actuators. We used these semiconductors due to its ability to rapidly heat and cool across a wide range of temperature. Its capability to reverse its function from heating to cooling or vice versa by just reversing the power supply polarity makes it an ideal source to achieve fast bi-directional color change of thermochromic inks. As peltier elements are semiconductors, they can come in a variety of sizes. For our prototypes we use sizes as small as 3mm x 3mm up to 60mm x 60mm.

2.3 Integration

These two technologies of thermochromic inks and peltier semiconductors are combined together with a temperature controller which controls the temperature of each peltier and thereby control the color levels of the fabric. By rapidly changing the temperatures with the help of the peltier elements, we are able to change the color of the fabric depicting a non-emissive animated fabric display.

3 RESULTS

Figure 2 indicates the color transient response of the system. As observed, the rise time of the system is approximately 1.5s (to reach from ambient temperature of 25C to 32C). In addition, the fall time of the system too approximates to 1.5s which is an important characteristic. This ability of the system to rapidly cool down the fabric

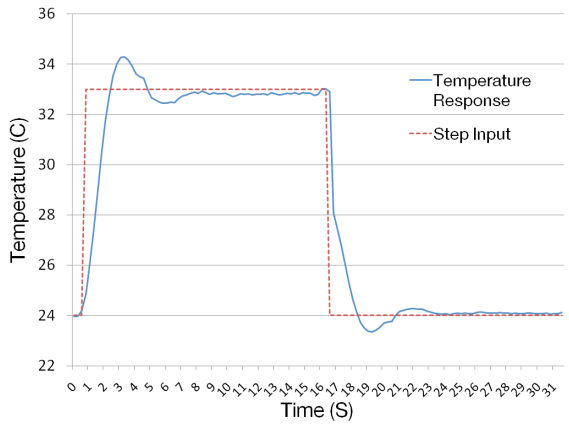

Figure 2: Transient response of the system

allows the thermochromic ink to rapidly regain the original color hence allow subtle bidirectional animations on fabric.

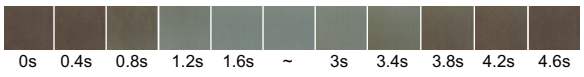

Figure 3: Integration of the system

With the current integration, the system is able to actuate the inks from color to colorless state in approximately 1s. The Figure 3 shows the color change of the system as a sequence of images. With this result, the system was able to animate the fabric at approximately 0.7 frames per second. With this rate, the initial prototypes focused integration as decorative furniture displays. Some of such implemented prototypes are depicted in Figure 4 and Figure 4 and Figure 5. Figure 4 depicts a wall hanging in which one bird appears and disappears in an animated form. Figure 5, is a table runner in which a sequence of birds are animated to give an impression of a bird flying across the table.

Figure 4: Integration of the system

In addition, AmbiKraf is focused towards integrating with the traditional textile arts and crafts. Many different countries, especially Asian countries still have rich traditional and cultural connections with textiles. With AmbiKraf we wish to develop a platform where such arts, cultures and traditions can meet the complexity of the modern technology. The ability of thermochromic inks to be used as a normal ink/paint is a great advantage for this platform. Its availability in multiple colors lends itself to artists and craftsmen to create their masterpieces with thermochromic inks and later be ”brought to life” with the capabilities of AmbiKraf system. Here, as a first step, we present an interactive Ambikraf byobu (Japanese room divider) that uses textile animation as a mode for interaction (Figure 6). Our work explores ways in which boundaries between physical and virtual, static and dynamic, material and immaterial can be blurred through everyday textile craft artifacts. With the

Figure 5: Integration of the system

use of Ambikraf one of the fundamental characteristics of textiles, unchanging and permanent patterns, can now be interactive and animated.

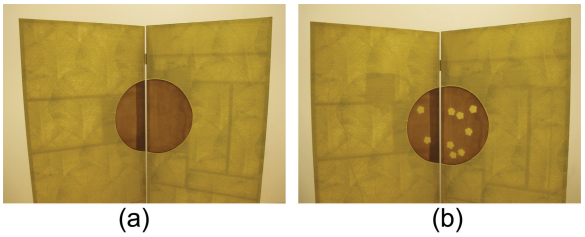

Figure 6: Interactive Byobu screen (a) Unactivated (b) Activated

4 Conclusion

AmbiKraf is a technology that redefines the role of textiles by allowing the fabric itself become a display medium. We innovate non-emissive display technologies which are completely embeddable into the fabric allowing subtle animations on the textiles. Due to the simplicity, subtly and the naturalness introduced by the non-emissivity of this technology, AmbiKraf provides a platform that lets textiles become a ubiquitous interactive display medium. As observed through the implemented prototypes, ranging from integration with cultural fabrics to smart furniture components, we envision that one day this technology would radically change ubiquitous display technologies.

Acknowledgements

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