Experimental Application of Dual Environmental Sensitivity on Interactive Textile Design

Haze NG, Gloria WONG and Kinor JIANG

Institute of Textiles & Clothing, The Hong Kong Polytechnic University, Hong Kong

haze.khng@gmail.com

ABSTRACT: This paper presents part of the development of an ongoing textile design research project titled The Creation of Interactive Textiles with Adoption of Environmental Sensitivity. The research attempts to integrate textile design creativity, interactive concepts, human perception theories and textile craftsmanship to create high value contemporary textiles. This paper showcases the process of the experimental trials combining thermo- and photo- sensitivities. The textile works with hybrid reactive property are capable to function as an interactive platform. With reference to the textile pieces created, a more in-depth investigation is proposed as the paper conclusion.

KEYWORDS: Environmental Sensitivity; Environmental Sensitive Textiles; Interactive Textiles; Textile Design

1. INTRODUCTION

This paper showcases part of the experimental development of the aforementioned interactive textile design project. At the early explorative stage of the whole research, three parallel development threads focusing on the investigation of reactive medium, the development of interactive yarns and textiles, and the exploration of potential textile craftsmanship have been conducted in a divergent manner. This paper presents the initial part of the cross-thread phrasal achievements.

A number of environmental responsive properties including, photo-, thermo-, hydro-, sonic-, kinetic-reactive qualities, etc, are being explored by textile practitioners. In a significant portion of previous projects, the responsive properties were introduced to the textile pieces with assistance of external electronic devices and computerised systems. For examples, Bubelle by Philips Design and Scentsory Design by Jenny Tillotson (Quinn, 2010). Facilitated by advanced technologies, a single creation is able to provide multiple responses to ambient environment. However, the reactive behaviours are significantly dependent on the outboard systems instead of the textile substrate itself.

On the other hand, some projects investigate on the integration of responsive properties into textile substrata. Applying responsive medium on textile material is one of the major scopes being cultivated by the related research projects. For examples, Woven Light series by Kathy Schicker, Constellation Wallpaper by Aurélie Mossé, Swamp Stools by Erin Hayne and Nuno Goncalves, and Motion Response Sportswear by Kerri Wallace (Quinn, 2013). By introducing smart material to textile process, the fabric itself is able to react to external stimuli without additional electronic mechanism. However, most of the realised projects in this approach cultivate only on a single reactive property. The creation of multi-reactive textile substratum has not been very significantly investigated. Therefore, in order to fill the research niche, this study targets to combine different environmental sensitivities to create hybrid textiles which are capable to perform multiple responsive behaviours, and hence function as an interactive platform, without outboard electronic system.

2. OBJECTIVES

The aim of this design development phrase is to try and test the possibilities of combining photo- and thermo- sensitive properties with eligible textile design techniques. The specific objectives of the phrase are as follows:

- To investigate the possibility of applying dual environmental sensitivities in interactive textiles design;
- To inject the dual properties at the pre-fabric-formation stage;
- To inject the dual properties at the post-fabric-formation stage.

With assistance of the theoretical design process model constructed for the ongoing design research, the textile works created in this paper are expected to perform as the supportive phrasal achievements for the whole study.

3. EXPERIMENTAL TRIALS

The initial experimental application was divided into two parts according to the process whereby the two environmental sensitivities were injected to the textiles. Since the application base substrates are different in nature, different design possibilities can be developed.

3.1. Pre-fabric-formation application

The first part of the experimental application incepted the integration at the pre-fabric-formation stage on yarn level. Five yarns were developed with different properties. Figure 1 shows the five developed yarn.

Figure 1: Yarn A, B, C, D & E

Yarn A, B and C were created in the primary yarn development. Yarn A and B were injected with single reactive property responding to ambient temperature and light respectively, while Yarn C possesses both of the properties. The three yarns were then brought to the secondary development to create hybrid Yarn D and E. Yarn D was created by plaiting two plies of Yarn A with one ply of Yarn B while Yarn E was obtained by plaiting two plies of Yarn A with one ply of Yarn C. Table 1 summarises the observable reactive behaviours of the yarns developed.

Table 1: Reactive Behaviours of the Developed Yarns

Yarn	Reactive Behaviour
A	Colour changes from pink to white in contact with heat around 30°C and above.
B	Partial colour changes from spray dyed copper to illuminating green in contact with ultraviolet light.
C	Colour changes from azure to white in contact with heat around 30°C and above; partial colour changes to illuminating green in contact with ultraviolet light.
D	Colour changes from pink-copper mélange to white-copper mélange in contact with heat around 30°C and above; colour changes to pink/white-illuminating green mélange in contact with ultraviolet light.
E	Colour changes from pink-azure mélange to white in contact with heat around 30°C and above; colour changes to pink/white-illuminating green mélange in contact with ultraviolet light

Experimental swatches were then created to bring the developed yarns to real practices. Two swatches have been composed with plain weave on handloom. Swatch A was woven with Yarn A and E , while Swatch B was composed with Yarn A, D and E. Both swatches are capable to respond to external stimuli and display different visual appearances as shown in Figure 2 - 4. Table 2 summarises the observable reactive behaviours of the swatches developed.

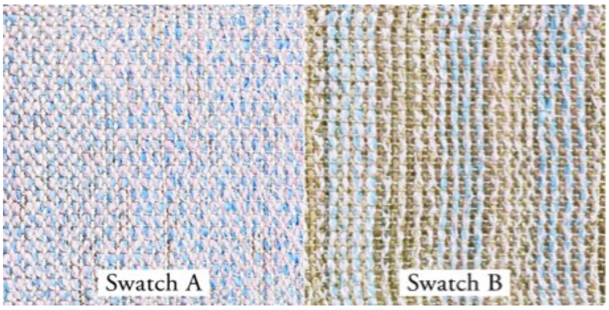

Figure 2: Swatch A & B

Figure 3: Swatch A & B in contact with heat

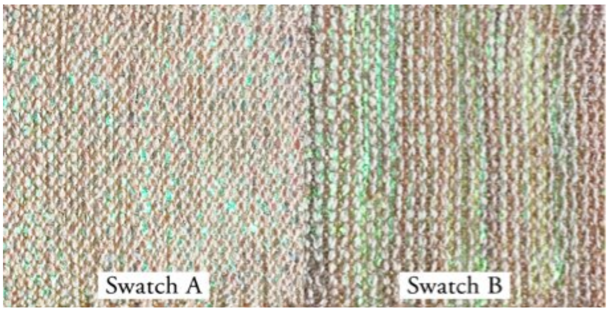

Figure 3: Swatch A & B after exposed to UV light

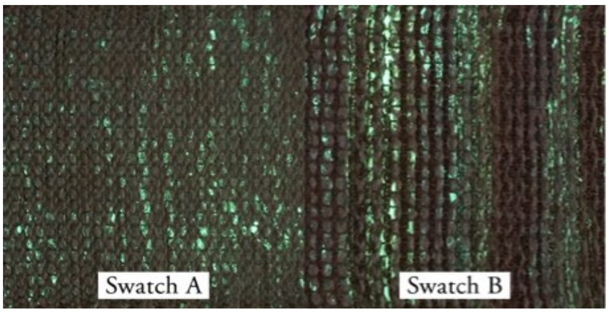

Figure 4: Swatch A & B in dark

Table 2: Reactive Behaviours of the Developed Swatches

Swatch	Reactive Behaviour
A	Colour changes from pink-azure mélange to white in contact with heat around 30°C and above. Illuminating green mélange effect reveals after exposing to ultraviolet light and glows in dark.

B	Stripe pattern colour changes from azure-copper mélange to white-copper mélange in contact with heat around 30°C and above. Illuminating green mélange effect reveals after exposing to ultraviolet light and glows in dark.

3.2. Post-fabric-formation application

The second part of the experimental application integrated the dual properties at the post-fabric-formation stage on fabric level. With reference to the traditional Japanese textile craftsmanship, Nui Shibori, Swatch C (Figure 5) was artfully created.

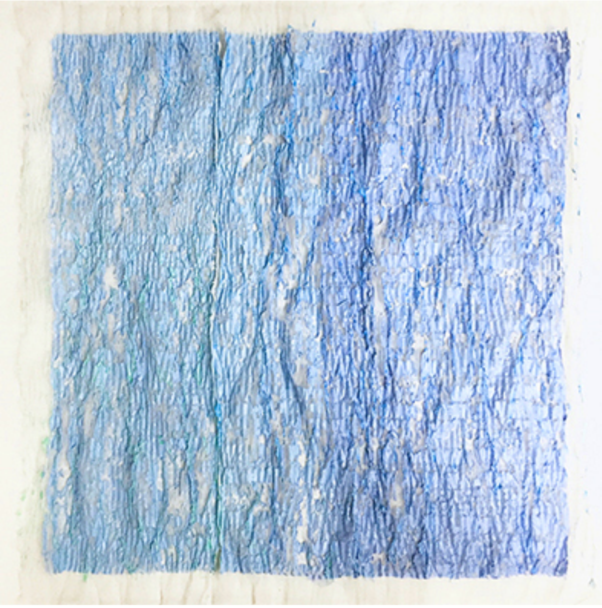

Figure 5: Swatch C

Firstly, the transparent polyester organza was coated with transparent-green luminescent coating on one side with thermochromic pigments on the other. Figure 6 shows the thermo-reactive property of the fabric surface.

Figure 6: Thermo-reactive property of the coating

Figure 7: Gathering the coated fabric

Secondly, the dried fabric was gathered and secured by hand stitched drawing threads (Figure 7). A layer of transparent-azure luminescent coating was then applied to the gathered panel on top of the thermochromic coating.

The panel was then spread after the coating is dried. Since the viscosity of the luminescent coating is higher than that of the thermochromic pigments, cracks were created along the gathers. The transparent-green luminescent coating on the back side of the fabric is then exposed to the front side through the transparent organza.

The fabric developed reacts to thermo- and photo-stimuli and exhibits multiple visual effects. The surface colour changes from different shades of azure to light bluish grey in contact with heat around 40°C and above. Furthermore, it glows in luminescent azure and illuminating green in contact with ultraviolet light. Figure 8 and 9 show the different visual appearances of Swatch C.

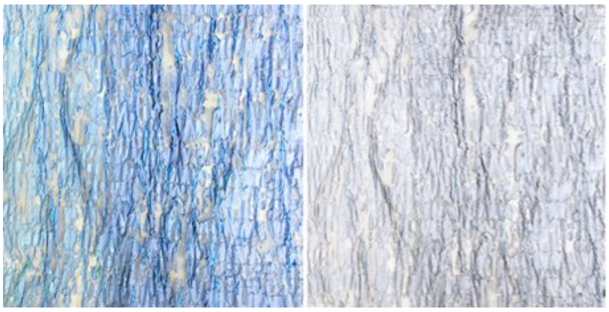

Figure 8: Swatch C under different levels of temperature

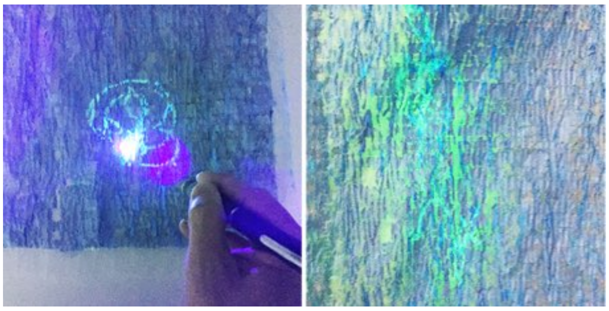

Figure 9: Swatch C stimulated by UV light

4. CONCLUSION

In addition to the mono-responsive textile projects completed by other pioneering researchers, this study has further created hybrid textiles which are capable to present multiple appearances under different environmental conditions.

This paper shows the initial feasibility of combining photo- and thermo- sensitive properties on both the pre- and post-fabric-formation levels. Located at different stages of the textile process, the two sensitivities were combined with fours measures as follows:

- Reactive medium mixing (Yarn C)
- Yarn formation (Yarn D & E)
- Fabric formation (Swatch A & B)
- Post fabric formation (Swatch C)

As a primary step testing initial applicabilities, the study incepted with a conditional optimised start, yarn and fabric development. It is believed that if the integration of environmental sensitivities on textiles is practically applicable on fibre level prior to yarn formation, the design possibility will be significantly enlarged. For example, introducing the environmental sensitivities to the manufacturing of monofilament is logically possible to create fibre base reactive fabrics, from multiple colour changing organza to illuminating artificial fur.

Secondly, it is possible to introduce more types of environmental sensitivity to the textile creation. Another parallel development thread of the on-going research is investigating hydro-reactive yarns. By consolidating the achievements of each thread, creating triple or multiple sensitive textiles is highly feasible.

Thirdly, advanced textile technologies are applicable to enhance the sophistication level of the design. With assistance of the computer-aided design softwares and machines, the interactive design complexity can be improved. For example, creating digital jacquard tapestry with engineered multiple reactive graphics merged with other nonreactive patterns would introduce a more provocative interaction and experience to the audience. A single surface will be able to present and carry several signifiers, and hence lead to different signified enriching human interactions.

The attempts made at the initial stage were primary. Further attempts are being made to study the relationship between different parameters, for examples viscosity, concentration and thickness of the reactive media and the textile performances. With the data and evaluations generated through assessments, in-depth investigation will be conducted to explore different dimensions throughout the textile process including material attributes, application measures, advanced textile technologies and the corresponding designs. More sophisticated design experiments will be conducted with parameters specifically set according to different textile technologies.

REFERENCE

Quinn, B. (2010). Textile Futures. New York: Berg.

Quinn, B. (2013). Textile Visionaries. London: Laurence King Publishing Ltd.