

Traditionally crafted digital interfaces

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ABSTRACT

Digital textiles merged with traditional designs may create more culture-specific products for the users. The present paper elaborates designing of three LED embedded scarves – Aster, Iris and Nymphaea – merged with traditional embroidery and hand painting techniques. The evaluation of these interfaces has been carried out through a brief user study for assessing *aesthetics* and *emotions evoked* upon viewing or wearing the scarves. The results indicate that higher positive emotions were evoked in the respondents than the negative emotions upon viewing, wearing or using the scarves. Attributes such as attractive, desirability, beautiful were rated high by the respondents. Respondents showed positive inclination towards using digital textiles for non-verbal communication for creating a decorum around users. As textiles become responsive and connected through the Internet of Things technology, culture specific designs require creation of a common vocabulary for non-verbal communication for both the ethnic and global user groups.

Author Keywords

Traditional textile, Embedded electronics, Emotions, Aesthetics, Non-verbal Communication

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces---User Centered design; H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces---Evaluation Methodology; H.5.m. [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous; J.4 [Social and Behavioral Sciences]: Psychology.

INTRODUCTION

Textile traditions are wide and varied in different cultures across the globe. In India, every state has more than one unique hand-crafted practices creating a legacy of traditionally crafted products since centuries. With

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industrialization and globalization, the craft sector has been declining gradually [1]. The present paper discusses few traditional textile crafts of India and how these crafting techniques have been merged with embedded electronics to design dynamic interfaces. This enables the crafts to keep pace with technological advancements and create a specific genre of products for ethnic and global audiences. This also enables crafts to connect themselves through the Internet of Things technology as lifestyle gets smarter in recent times while augmenting functional aspects of textiles and other products. In subsequent sections authors discuss development of scale for *aesthetics*, *emotions evoked* and *non-verbal communication* for evaluating the interfaces designed and their implications in designing culture-specific products.

DESIGNING THE E-TEXTILE INTERFACES

Zardozi [2] is the craft embroidering cloth with precious and semi-precious metal, stones, sequins, etc. as depicted in Figure 1. It was patronized by royal families of the Mughal era and was originally done with gold thread, *zari*. In recent times, bridal-wear are ornamented with *zardozi* work apart from other textile products and accessories. Based on the elements used and designs of *zardozi*, a scarf was embellished with petal shaped stones and sequins in the shape of a six-petalled flower. This scarf called *Aster*, comprises of four micro RGB Led embedded floral designs in a row at the base controlled by three buttons to change colors as depicted in Figure 2.



Figure 1: *Zardozi* embroidery [2]



Figure 2: *Aster*, embellished scarf 1

Kantha is running stitch embroidery technique originating from West Bengal, India [3] as depicted in Figure 3.

Running stitch covers the base and design of the fabric completely rendering a wavy texture to the fabric. Significance and symbolism is attached to motifs and colors used for the embroidery. Design elements for most traditional craft patterns are drawn from flora, fauna, local architectural styles, daily life and mythology [4]. Based on running stitch floral designs, embroidery was made on a scarf with three rows of nine red, green and yellow LEDs embedded instead of floral motifs as depicted in Figure 4 and Figure 7. LED colors are controlled with three buttons embroidered at the edge of the scarf.



Figure 3: *Kantha* embroidery [3]



Figure 4: *Iris*, embroidered scarf 2

Madhubani paintings originated in Bihar [5] and were made on mud painted walls and floors (Figure 5). Different designs are made according to festivals, occasions or prayers. Although they were made with vegetable colors now synthetic colors are used to decorate walls, textiles, lifestyle products and accessories. It is identified by prominent black outlines for two-dimensional artworks of design elements which may or may not be filled with colors. Based on these paintings, *Nymphaea* was designed (Figure 6,8) which has rows of the auspicious lotus motif with five rows of red, yellow and green LEDs controlled by three buttons at the base. All connections for *Aster*, *Iris* and *Nymphaea* have been made with conductive thread connected to a portable, rechargeable 3.2V LiPoly battery at the back of the fabric. Figure 9 depicts draping styles rendered on a mannequin for the three scarves.



Figure 5: *Madhubani* Painting [5]



Figure 6: *Nymphaea*, painted scarf 3



Figure 7: *Iris*; Figure 8: *Nymphaea*



Figure 9: *Aster*, *Iris*, *Nymphaea* rendered on a mannequin

METHODOLOGY FOR CONDUCTING USER STUDY

With these three traditionally crafted textiles/scarves capable of changing color, a user study was conducted to evaluate the interfaces for aesthetics, capacity to evoke emotions in the users and if non-verbal communication can be established by changing visual cues, led colors in this case for expression and understanding. The sample size comprises 45 college going female users between the age group of 18-32 years studying at graduate and post-graduate level in national technical institution located in the North-East of India. 55% of the sample group explores trends more than the rest. 60% of them belong to semi-urban and 40% belong to urban background.

Scales of measurement

The scale for evaluating *Aesthetics* comprises terms – *Attractive*, *Desirable*, *Beautiful* and *Pleasing* [6,7]. The terms for *Emotions evoked* comprised of three positive

emotions – *Happiness, Awesome, Interesting*; two negative emotions – *Boring* and *Annoying* – derived from the Plutchik's Wheel of Emotion [8]. Attributes for evaluating *non-verbal communication* were derived from Daniel Goleman's Social Intelligence [9] – (i) Do you think colors can be used for non-verbal communication? (ii) Do you think visual cues can help understand wearer's feelings? (iii) Do you think visual cues can enable smooth non-verbal interaction? (iv) Do you think visual cues enable expression of personality non-verbally? The matrix, thus, in total comprises 13 attributes – four attributes for aesthetics, three positive emotions, two negative emotions and four attributes for non-verbal communication rated on a five-point Likert scale (1=Least; 5=Highest).

Conducting the user study

Through the questionnaire based study, researchers evaluated interfaces of *Aster*, *Iris* and *Nymphaea*, for aesthetics, emotions evoked and to understand how well they could be used to communicate non-verbally in scenarios such as traveling in a metro, café, airport, office, college, etc. An example of the functionality could be, when scarves glow Red it could mean *do not approach, discomfort, I am not interested, I am angry, I disagree*, etc. If scarves glow Blue (*Aster*)/Yellow (*Iris, Nymphaea*) it could mean *I am skeptical, cautious or doubtful or I refrain from being approached*. And if scarves glow Green, one could signal *I may be approached, I am interested or I am comfortable*, and so on.

The cues are meant for subtle expression instead of verbal communication in situations where unexpressed needs/feelings/opinions need to be expressed but not explicitly. For example, if strangers come too close while commuting, in a meeting for votes, in an office cubicle to denote availability, opinion or emotions, etc. The visual cues maybe expressed only when needed, otherwise they remain an embellishment neatly integrated with the textile. The user study was conducted in groups of two or three where users could interact with the scarves. Users had to imagine themselves in scenarios as mentioned above to interact with other users during the study and mark their response in the matrices provided.

USER STUDY ANALYSIS

The data obtained from 45 respondents has been tabulated as Mean, Standard Deviation (SD) and Mode for *Aesthetics* (Table 1), *Emotions evoked* (Table 2) and *Non-verbal communication* (Table 3) in this section. The reliability test for *Aesthetics*, Cronbach's Alpha was 0.845 on SPSS (Statistical Package for Social Sciences). The results of mean and mode reveal that the respondents found *Aster, Iris* and *Nymphaea Attractive, Desirable, Beautiful* and *Pleasing* with SD closer to the mean.

The reliability test for *Emotions evoked*, Cronbach's Alpha was 0.847 on SPSS. Positive emotions of *Happiness, Awesome, Interesting* were high and negative emotions

Aesthetics	Aster	Iris	Nymphaea
MEAN			
Attractive	4.17	4.15	4.25
Desirable	3.86	4.02	4.06
Beautiful	4.2	4.2	4.25
Pleasing	3.8	4.04	4.18
SD			
Attractive	0.91	0.86	0.83
Desirable	0.94	0.97	0.87
Beautiful	0.86	0.85	0.86
Pleasing	0.99	0.96	0.84
MODE			
Attractive	5	5	5
Desirable	4	4	4
Beautiful	5	5	5
Pleasing	4	4	4

Table 1. Mean, SD, Mode for Aesthetics

Emotions	Aster	Iris	Nymphaea
MEAN			
Happiness	4.2	4.13	4.15
Awesome	3.86	3.84	3.97
Interesting	4.24	4.15	4.2
Boring	1.35	1.28	1.42
Annoying	1.4	1.4	1.26
SD			
Happiness	0.86	0.99	0.92
Awesome	0.91	1.14	1.07
Interesting	0.93	0.95	0.81
Boring	0.71	0.78	0.86
Annoying	0.71	0.78	0.75
MODE			
Happiness	5	5	5
Awesome	4	5	5
Interesting	5	5	5
Boring	1	1	1
Annoying	1	1	1

Table 2. Mean, SD, Mode for Emotions evoked

Boring and *Annoying* were rated low with SD close to 1 in case of all responses. The reliability test for *non-verbal communication*, Cronbach's Alpha was 0.876. The response for *visual cues enable understanding feelings of others* and

if colors can be used for non-verbal communication was high. While the response for *visual cues enabling smooth non-verbal interaction* and *visual cues enable non-verbal expression of personality* was rated above average, as depicted in Table 3. The data obtained was similar for three of the scarves, hence the attributes were not significant in ANOVA results. No one particular scarf stood out as the best, but three of the scarves had similar likeliness for the attributes in the matrix.

Non-verbal communication	Aster	Iris	Nymphaea
MEAN			
Use of colors	4.37	4.35	4.22
Understand feelings	4.02	4.02	4.2
Smooth Interaction	3.86	3.84	3.8
Express personality	3.77	3.84	3.84
SD			
Use of colors	0.91	0.9	0.9
Understand feelings	0.96	0.98	0.89
Smooth Interaction	1.057	1.06	1.03
Express personality	1.29	1.18	1.12
MODE			
Use of colors	5	5	5
Understand feelings	4	5	5
Smooth Interaction	5	4	5
Express personality	5	5	5

Table 3. Mean, SD, Mode for Non-verbal communication

DISCUSSION

The traffic signal code has unique metaphorical usage across the globe for the colors Red, Yellow and Green [10]. Through dynamic visual cues of textiles, non-verbal communication could enable creation of a decorum in the social space of the user. This calls upon for creation of a common vocabulary for visual cues (for e.g. colors) and textiles that could mean the same across cultures like the traffic code signals. The applicability of such textile cues, be it visual or tactile could be beneficial for designing context specific applications for geriatrics, the specially-abled, medical sector, primary education, schools, offices, daily life applications, and so on.

With technology becoming a part of human body and textiles becoming responsive [11], traditional textiles and crafts could be embedded with electronics for augmented lifestyle applications. This would bring them at par with competitive products in the global scenario. It also enables creation of a genre of culture specific smart products for specific user groups. Technology embedded in traditional

crafts may also help in preservation of traditional methods of crafting rather than hierarchical crafts going obsolete with next-gen products becoming popular in recent times.

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