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# Exploring potential of traditionally crafted textiles to transform into e-wearables for use in socio-cultural space

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**Abstract.** With digital wearables becoming a popular trend, this paper explores understanding user behavior and acceptance of e-textile prior to designing a textile wearable that has roots in Indian culture. The potential of traditional textile designs to become part of the emerging e-textile wearable scenario is crucial in order to preserve design traditions and also to prevent redundancy of crafts skills due to advancement of technology. In order to explore attitudes and acceptance of embedding traditional design elements by the younger generation of e-wearable adopters, a study was conducted in India, wherein prototypes were tested for their potential and acceptance of becoming interactive communication aids in the social space. A hand-embellished scarf with micro RGB LEDs named as *Aster*, has been prototyped with traditional motifs local to India so as to gather response for the capacity of e-textiles to aid non-verbal communication. The perception of respondents towards acceptance of *Aster* based on Technology Acceptance Model was analyzed. Thirty users took part in the preliminary study to understand user behavior and sixty users took part in the subsequent study pertaining to assessment of the digital wearable scarf. The analysis of responses reveal high acceptance towards textile wearables for daily interactions and improved self-expression. Usability assessment indicates positive experience of users while using *Aster* for daily interactions in specific social contexts. The inferences drawn from the study are encouraging and indicate optimism for inclusion of traditional craft design elements in digital textile wearables. The results provide optimism for craft makers to expand their traditional skills towards embedding electronic components thereby ensuring relevancy of traditionally skilled work without having to face work redundancy due to technology advancement.

**Keywords:** Wearable, Non-verbal expression, Acceptance, Usability, Behavior

## 1 Introduction

Textiles have a rich history, lineage and evolution in terms of their designs. They carry cultural traditions within their folds. Like every other mass manufactured product, textiles in India have a wide range of colors, textures, motifs, patterns and materials that are unique and contextual to Indian cultural milieu. Throughout centuries one can find traditional motifs, borders, embellishments, weave pattern and

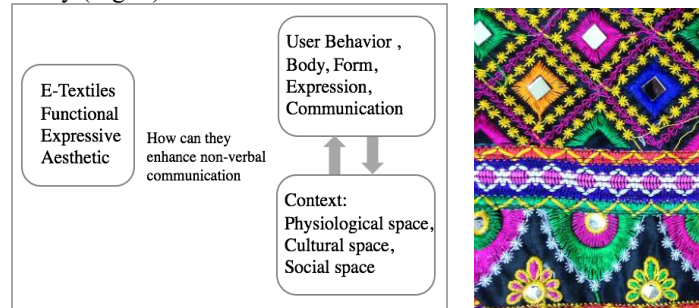
the like, being retained and continued with a sense of pride in India's visually rich ethnographical and cultural landscape. Textiles have been embedded with colors and motifs since prehistoric times to celebrate, protect or symbolize cultural beliefs [1]. They have been largely inspired from flora, fauna, architectural forms and everyday things. Entwined with the continuation of traditional designs are lives of the skilled craft makers for whom textiles are a source of work and livelihood. Technological advancements, like elsewhere, has cut short avenues for growth for the craftsperson unless one is open to re-training and acquiring techniques that are more machine oriented [21]. The threat of being displaced by electronics and machines is more true of craft makers who are involved in creation of textiles with patterns, colors, motifs, laces, weaving, stitching, etc.

How can designers ensure the continuity of skills and livelihood while embracing technology is the question that motivates the exploratory research study in this paper. Not many Indian researchers have explored and published work pertaining to the impact of or potential of e-textiles emerging in India. Of the few works that can be cited are those of Designer Gaurav Gupta who created LED *saree-gown* in association with IBM for Vogue Women of the Year Award ceremony 2017 [17]. Designers Pankaj and Nidhi created LED embedded collection *Geometrica* showcased at Wills India Lifestyle Fashion Week 2012 [18]. Although these designs are unique in terms of fashion statements and couture wear, they may need to be enriched so as to become a part of users' daily lifestyle and also augment user needs, such as for example communication, protection and facilitating new forms of social interaction that open up due to social networking. To remain relevant fashion couture will need to become part of the emerging internet of things (IOT). The very use of e-textiles will open up new and interesting applications. The question facing the researchers is - Will such new applications be readily adapted by young Indian generation? Will the young Indian population, which is comfortable with today's smart devices, accept new e-textile applications, such as, for non-verbal communication or starting a silent conversation with an unknown person in a public space? Will the early adopters of innovation also accept textile designs loaded with traditional signs and symbols such as motifs and patterns? We posit that India is a culturally diverse country and since users have diverse preferences, designing culture specific e-textile products could enrich the textile market segment for both the Indian and the global markets. In particular, it would offer ways and means to integrate traditional textile craft artisans' work with the promising new markets that are emerging out of embedding textiles with electronic capabilities.

In Europe, extensive research studies are being conducted to adopt designs for e-textiles. Buble dress by Philips [14], is based on emotion sensing and changes colors in response to physiological changes of user's body. Galaxy dress [15] is world's one of the largest wearable display with 24000 color pixels embroidered on silk. Nemo dress [16] comprises 2000 LEDs creating a retro-futuristic couture dress.

With digital technology becoming part of daily lifestyle [2], textiles have become an interesting and useful medium for embedding, collecting and transmitting information in several domains such as health, sports, military, security, interiors, clothing, automobile, etc. E-textiles – which are essentially textiles with embedded electronics, will find interesting applications through artificial intelligence and Internet of Things (IOT) connected technologies by augmenting user lifestyles. E-

textiles have untapped design potential for increasing their usability as mediums for interactions and communications in every day social space. Designing e-textiles or textile wearables will involve aspects such as usability, communicability and intractability for the wearer as well as for others in the wearers' environment, apart from functionality (Fig. 1).



**Fig. 1.** E-textiles and Social Space as studied; **Fig. 2.** *Lambani* embroidery design

The research reported in this paper finds its inspirations in the elaborate textile crafting traditions of India and an inquisitiveness to merge it with smart materials for context specific applications in the social space. Researchers believe that doing so could lead to preservation of hierarchical crafts and merge them with technologically advanced e-textile trends of the future. The idea is to embed electronics seamlessly by reinforcing traditional design elements such as motifs, patterns, colors with smart materials to enhance the functions of a static traditional textile. Figure 2 represents a traditional *Lambani* embroidery design and potential of incorporating embedded electronics neatly within the motifs.

## 2 Wearables and the socio-cultural context

Dolan and Holloway in their research on traditional garments of Europe mention that textiles are cultural transmitters as they are emotionally stimulated due to several traditions associated with crafting, community bonds, admiration of skills, their closeness with skin and memories involved [3,4]. Textiles thus become a natural extension of self. Textiles have been known to influence the moods and emotions of the wearers and the viewers in a social space [5]. Traditional textiles comprise of several motifs that protect or symbolize cultural traditions [1]. Since, textiles through their colors and motifs communicate traditions, the researchers hypothesize that textile wearables of present times could enhance social intelligence [8] of the user and collective intelligence of the space through non-verbal communication. For instance, the colors and motifs could become flowing fluid dynamic elements instead of static patterns, to enhance self-expression through nonverbal signaling so-as-to communicate with like-minded people in a social setting, i.e., formal or informal get together.

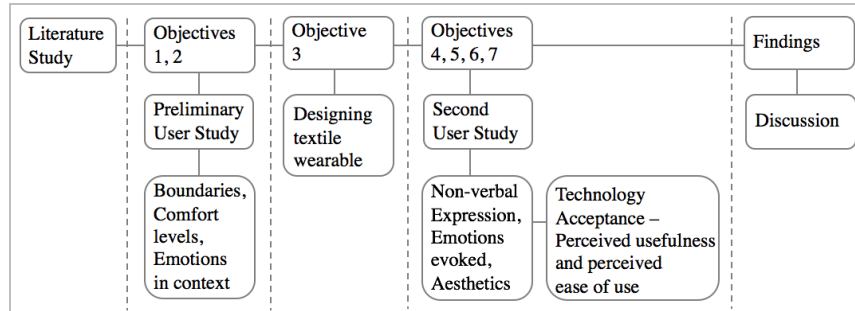
Users are specific, guarded and selective in terms of how they communicate and express themselves in a social space which in turn depends on the context. Similarity in traits, attitude, behavior govern individuals likes and dislikes and how social

groups are formed [6,7]. Proximity principle mentions how individuals build relationships through sharing beliefs, experiences and social exchange [6,7]. If textiles could enhance social facility, social cognition and synchronicity [8] with known and unknown individuals around non-verbally, this could lead to collective intelligence of the users' social space. Social space in this research is believed to be usable for not only socializing and leisure activities but also is a 'formal and informal working space'. It is the belief that social space in India has always been utilized in an interactive informal way when Indians of different age groups interact with each other in different contexts, such as – in school, at college, at work, while commuting, at a social gathering, at a park, and so on. In such socio-cultural space, interactions, apart from being polite, also accomplish community level work by reinforcing cultural beliefs and practices. This form of work though differing from formal work for money in an office or industry, does generate and contribute value notionally.

In this paper, we first attempt to understand user behavior of young Indian generation communicating with each other with reference to the nature of boundaries that they create around themselves based on sense of privacy limits, comfort levels and emotions they experience with different categories of individuals in different social contexts. This was followed by assessing the levels of acceptance of use of digital elements in textiles. A traditionally handcrafted interface in the form of a e-scarf, named as *Aster*, was designed, developed and tested for non-verbal communication in the social space. The scarf has been assessed for technology acceptance [9], usability [10,11,12], emotions evoked [13] and social intelligence pertaining to non-verbal communication [8]. The handcrafted textile is a micro RGB LED embedded stole capable of changing colors through three buttons, named as *Aster* in this study.

The objectives of the data collected through a questionnaire were as follows: – (i) Understanding boundaries created by users and comfort levels experienced for sharing information and if they differ from close friends than strangers; (ii) To understand emotions experienced by users in different social spaces; (iii) To design a traditionally crafted wearable which could communicate non-verbal expression of boundaries, comfort levels and emotions; (iv) To probe if emotions evoked by the traditionally crafted wearable influence technology acceptance (perceived usefulness and perceived ease of use); (v) To identify if aesthetics of the traditionally crafted wearable influences technology acceptance (perceived usefulness and perceived ease of use); (vi) To experiment if variables measuring non-verbal expression influence technology acceptance (perceived usefulness and perceived ease of use); and, (vii) Usability assessment of users' experience while using *Aster* for non-verbal communication.

### 3 Methodology for data collection



**Fig. 3.** Experiment overview

Figure 3, describes the experimental overview with objectives addressed in each phase leading to findings being discussed towards the end of the paper. A questionnaire based study was conducted in two phases with young students between the age group 18-32 years studying in a national technical institution located in the North-East of India. Phase one was carried out with 30 respondents (Table 1) for understanding boundaries and comfort levels experienced as part of a behavioral study. Phase two was carried out with 60 respondents (Table 2) for analysis of *Aster*'s acceptance, usability, social intelligence and emotions evoked. Data collected has been analyzed quantitatively on SPSS (Statistical Package for Social Sciences).

**Table 1.** Demography for preliminary study 1

Sample Size	Age (years)	Male	Female	Place of origin	Educational Background
30	18-28	10	20	Semi-urban (18), Urban (12)	Undergraduates and Post Graduates

**Table 2.** Demography for user study 2

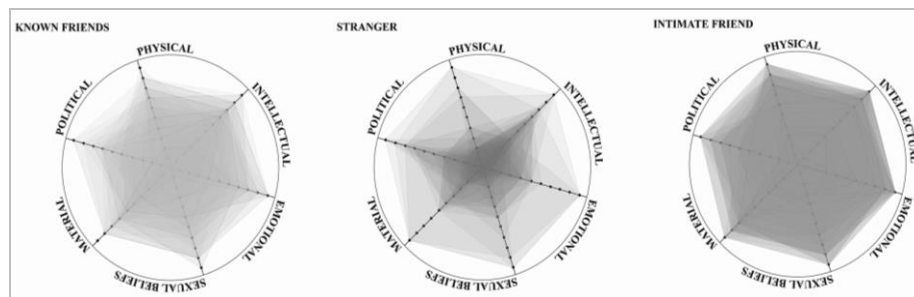
Sample Size	Gender	Age (years)	Place of origin	Educational Background
60	Female	18-32	Semi-urban (36), Urban (24)	Undergraduates and Post Graduates

The experimental set up for preliminary study comprised of six categories of response, of which three parts (Annexure 1-3)– boundaries, comfort levels and emotions experienced in certain contexts, have been discussed in this paper. The second study with *Aster* was conducted in groups of 2-3 users at the same time in a defined space where users were to interact with *Aster* and communicate with each other to see if they could understand one other via non-verbal visual cues.

For example, when the viewer asked “Could you spare some time” and if the wearer of *Aster* responded through ‘Blue’ it was understood that the wearer did not have enough time to spare and could be approached later again. The participants were acquainted with the meanings of signaling color codes before the scenario was enacted. After a brief interaction with *Aster*, the users had to mark their response in the questionnaire provided. This questionnaire was printed both sides on A4 sheet in a three-column format with 5 matrices, 3 sets of Likert scale questions, 3 binary questions and 6 descriptive questions. Few parts of the questionnaire on Emotions, Social intelligence, Usability and Technology Acceptance Model have been included in the annexure at the end of this paper (Annexure 4-7).

#### 4 Preliminary user study analysis

30 respondents mentioned the boundaries they create for sharing intellectual, emotional, political, physical, sexual and material beliefs or information with known friends, intimate friends and strangers on a scale of 0-10. The data has been represented in a radar diagram and was also analyzed quantitatively on SPSS. The Cronbach’s Alpha for reliability was 0.883. ANOVA results showed significant values as described in Table 3. The diagram in Figure 4 reveals that respondents share information with intimate friends most openly, known friends openly and with strangers restrictively. 3 respondents discussed restrictively with intimate friends and 4 respondents shared information with strangers openly.



**Fig. 4.** Line diagram and area diagram for boundaries for sharing belief systems

**Table 3.** ANOVA results for boundaries of sharing information

	Physical	Intellectual	Emotional	Sexual Belief	Material	Political
F	21.271	11.878	29.952	8.816	15.500	3.796
Sig.	.000	.000	.000	.000	.000	.026

**Table 4.** ANOVA results for comfort levels expressed by users

	<b>Different Community</b>	<b>Same Community</b>	<b>Acquai ntance</b>	<b>Social Friend</b>	<b>Close Friend</b>	<b>Intimate Friend</b>
F	5.433	5.770	7.598	5.657	3.020	1.603
Sig.	.000	.000	.000	.000	.012	.162

Respondents had to mention their comfort levels on a scale of 0-100 (0-20 very low, 21-40 low, 41-60 average, 61-80 high and 81-100 very high) while interacting with six categories of people namely – stranger from different community, stranger from same community, acquaintances, social friend, close friend and intimate friend for sharing information such as – social life, academics, professional life and relationships. The Cronbach's Alpha value for reliability test of the data collected was calculated as 0.843. ANOVA results revealed that respondents were restricted in sharing information with strangers from different community, same community and acquaintances. Comfort levels with intimate friends was high for some and low for some respondents, response for which was not significant as mentioned in Table 4.

10 Emotions [13] – Joy, Trust, Optimism, Love, Vigilance, Admiration, Surprise, Fear, Pensive, Remorse, Annoyance and Fear - experienced in 6 different contexts – Office, School, College, at a Wedding, Park and while commuting were denoted on a scale of 0-100 (0-20 very low, 21-40 low, 41-60 average, 61-80 high and 81-100 very high). The Cronbach's Alpha was. 0.767. It was revealed that emotions are significantly expressed in each of these contexts by respondents (Table 5).

**Table 5:** ANOVA results for emotions experience in different contexts

	<b>Office</b>	<b>School</b>	<b>College</b>	<b>Wedding</b>	<b>Park</b>	<b>Commuting</b>
F	4.237	13.186	13.323	10.092	11.726	5.618
Sig.	.000	.000	.000	.000	.000	.000

#### 4.1 Implications of Preliminary User Study Analysis on designing wearable

The preliminary user study was conducted to understand how young respondents create or draw invisible boundary limits for sharing information, different comfort levels experienced when interacting with different categories of people and which type of emotions are experienced while interacting in certain contexts. Significant results imply that identifiable unexpressed boundaries and comfort levels in certain known and unknown social settings exist. Known settings and unknown settings, both could be college library, café, college premises, at office, commuting, airports, bus stops, parks, etc. depending on the person.

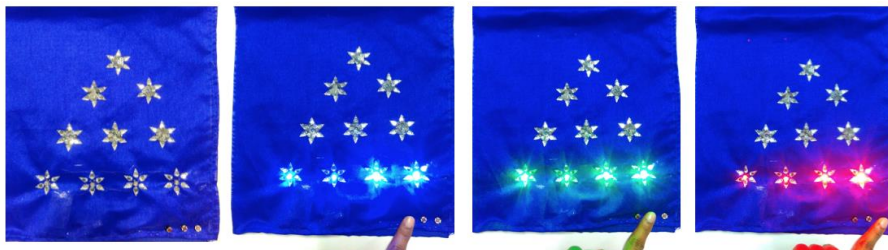


Based on the above results, the researchers hypothesize, that if textiles worn could express, when needed, the comfort levels and boundaries being experienced in a subtle non-verbal manner to the people around, it could help in creating a conducive atmosphere with decorum in a socio-cultural space. This would lead to increased understanding among individuals besides assisting and reinforcing users through non-verbal mediums. This would also empower users to express themselves in contexts when words can't be used. Thus, make them socially intelligent through textiles worn which in turn leads to collective intelligence and well-being of the individuals in their social space.

*Aster*, the wearable prototype scarf was designed with sequins and petal shaped embellishments hand embroidered on poly-dupion fabric surface with micro RGB LEDs embedded in the center of floral configurations of Embellishments (Fig. 5-8). The design elements for *Aster* have been inspired from architectural reliefs of a fort located in Madhya Pradesh, India [20]. Four LEDs have been embedded in the bottom row and other floral centers have been embellished with sequins. The LEDs are connected through conductive thread, three switches to control 3 colors – red, blue, green and 3.7V Li-Poly battery source. 60 respondents took part in an interactive session, where they were asked to imagine being in any one or more of the scenarios, such as travelling alone in a metro, bus stops, college library, strolling in a park, etc. The users then communicated meanings through visual cues/colors of *Aster*. The study captured the experience and functionality of *Aster* when it changes its colors/visual cues to express certain additional meanings, such as red glow could mean *I am uncomfortable, do not approach, I am not interested, I am angry, I disagree*, etc. Blue glow could mean *I am slightly comfortable, slightly approachable, I am slightly interested, I am not very pleased, I slightly disagree*, etc. While a Green glow could mean, *I am comfortable, you may approach, I am interested, I am pleased, I agree*, etc.



**Fig. 5-7.** Embroidering *Aster*; *Aster* static-dynamic rendered on mannequin; Respondents



**Fig. 8.** *Aster* – Static and Dynamic - three colors controlled by three buttons

## 5 Analysis of second phase of user study

Positive emotions were evoked much higher than the negative emotions as described in Table 6 and is evident from Friedman's ANOVA and post-hoc analysis in Table 7. It was thus indicated that traditionally crafted textile wearable *Aster*, evokes positive emotions strongly in users than negative emotions. 10 emotions were rated on a 5 point Likert scale by the respondents (Annexure 4).

**Table 6:** Descriptive statistics of emotions evoked Experimental study 2 – *Aster*

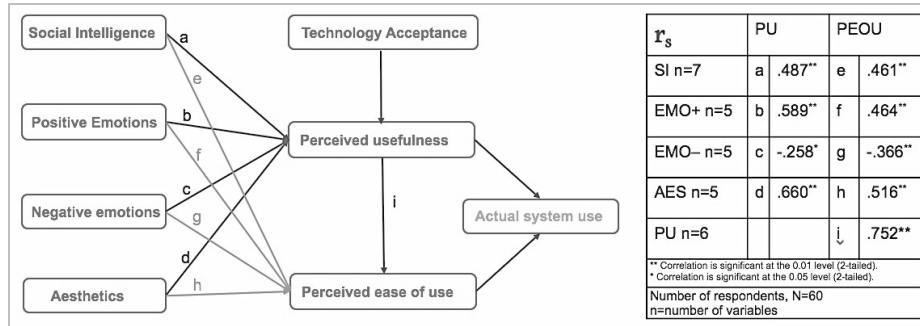
	Happiness	Optimistic	Awesome	Interesting	Admirable	Sad	Pessimistic	Boring	Annoying	Disgusting
MEAN	3.98	3.81	3.61	4.1	3.85	1.25	1.46	1.33	1.41	1.18
STDEV	0.96	0.89	1.01	0.96	0.89	0.63	0.94	0.68	0.81	0.65
MODE	5	4	4	4	4	1	1	1	1	

**Table 7:** Friedman's Test Statistics and Wilcoxon Signed Ranks Test - Statistics

N	60	Positive and Negative emotions	
Chi-Square	243.682	Z	-6.674 <sup>b</sup>
Asymp. Sig.	.000	Asymp. Sig. (2-tailed)	.000

Spearman's Correlation results for *Aster* revealed that– positive emotions were positively correlated with perceived usefulness and perceived ease of use of Technology Acceptance Model (TAM, Annexure 6),  $r_s = 0.589$  and  $0.464$  respectively, significant at  $p < 0.01$  for a two-tailed test. Negative emotions were negatively correlated with perceived usefulness and perceived ease of use  $r_s = -0.258$  significant at  $p < 0.05$  for a two-tailed test and  $r_s = -0.366$  significant at  $p < 0.01$  for a two-tailed test. Aesthetic attributes were positively correlated with perceived usefulness and perceived ease of use  $r_s = 0.660$  and  $0.516$  respectively, significant at  $p < 0.01$  for a two-tailed test. Results indicated that *Aesthetics* of *Aster* has significant effect on technology acceptance - perceived usefulness and perceived ease of use for traditionally crafted wearables. The five Attributes of Aesthetics - Attractive, Desirable, beautiful, Pleasing and Enjoyable, were rated on 5 point Likert scale by the respondents (Annexure 4). 7 variables of non-verbal communication (Social Intelligence-SI) were positively correlated with perceived usefulness and perceived ease of use  $r_s = 0.487$  and  $0.461$  respectively (significant at  $p < 0.01$  for a two-tailed test). Results indicated, that traditionally crafted wearable *Aster*, significantly enhances non-verbal expression among users in a given social space leading to high perceived usefulness and perceived ease of use. The seven variables of non-verbal communication (NVC) were rated on 5-point semantic differential scale by the respondents (Annexure 5). The results for *Aster* in the form of associations, have been described through a connected model in Figure 9 and also tabulated in Table 8. Cronbach's  $\alpha$  for reliability for the model (Fig. 9) ranged between .767 and .883.

Usability assessment of *Aster* based on System Usability Scale (SUS, Annexure 7) revealed positive results as SUS score for *Aster*=72.54. This indicates that respondents preferred usage of *Aster* for non-verbal communication and their experience of using *Aster* was ‘good’, as per the SUS score [12].



**Fig. 9.** Posited model for non-verbal communication with *Aster*

**Table 8:** Summary of evaluation for Spearmans' correlation of Posited model for *Aster*

	PU	PEOU
NVC	.487**	.461**
EMO+	.589**	.464**
EMO-	-.258*	-.366**
AES	.660**	.516**
PU	1	.752**

Principal component analysis for 7 variables measuring non-verbal communication (NVC/Social Intelligence-SI), [8] with respect to perceived usefulness and perceived ease of use was carried out for *Aster*. KMO test for sampling adequacy was 0.799. Bartlett's Test for component correlation was significant,  $p=0.00$ . 2 components were extracted on the basis of Eigen values. The 7 variables of NVC loaded together (Table 9) and hence accurately measure non-verbal communication with traditionally crafted wearable *Aster*.

**Table 9:** Pattern Matrix for *Aster*

Pattern Matrix SI-PU-ASTER			Pattern Matrix SI-PEOU-ASTER		
	Component			Component	
	1	2		1	2
SI1	.032	.712	SI1	.076	.671
SI2	.086	.696	SI2	-.052	.778
SI3	.328	.635	SI3	.168	.759
SI4	-.044	.612	SI4	.092	.501
SI5	-.112	.761	SI5	-.181	.786
SI6	.317	.492	SI6	.002	.698

SI7	-.034	.640	SI7	.108	.543
PU1	.898	-.044	PE1	.881	-.090
PU2	.951	-.128	PE2	.756	.119
PU3	.848	.066	PE3	.759	.158
PU4	.900	.029	PE4	.793	.091
PU5	.852	.017	PE5	.817	.111
PU6	.723	.156	PE6	.971	-.164
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. a. Rotation converged in 5 iterations.					

In a descriptive section, respondents were asked to write their opinions about interacting with *Aster*. 89% of respondents rated *Aster* to be very interesting and smart. Some respondents suggested that *it could help people with impairment, something should be designed for men as well, a common language of colors is required* and that *the number of LEDs could be increased in Aster*. 11% of respondents seemed apprehensive about the disadvantages of wearables on health, they were not ready to use unless *it became popular*, they were skeptical about *electronics working well* and *communicating effectively at times* and that *the world would become too robotic with automation embedded in clothes*. These 11 % of respondents can be categorized as late and cautious adopters of technology.

## 6 Discussion

As inferred from the experiment results, E-textile *Aster*, enabled non-verbal communication in a social space. Interaction with *Aster* takes place in 4 parts – (i) When user expresses through colors; (ii) when user presses the button on textile to change color, or undo the previous action; (iii) when the viewer perceives the color and understands expression; (iv) if the viewer has a similar textile, responds through same language (which is not a part of the experimental set-up). This was a preliminary study about perceptions of young Indian users. Study needs to be conducted on much larger scale for complex interactions in actual scenarios. In the present experiment users are in a hypothetical social situation with basic interaction happening to express degree of comfort, agreement/disagreement, like/dislike, yes/no/maybe in three stages of low, medium and high according to the three colors of LEDs. Studies with larger sample size are required to be conducted further.

Proximity principle [6,7] states that there are two main reasons why people form groups with others nearby rather than people further away. First, human beings like things that are familiar to them. Secondly, the more people come into contact with one another, the more likely the interaction will cultivate a relationship which is the benefit or payoff for interaction. Also, proximity promotes interaction between individuals and groups, which ends up leading to liking and disliking between the groups or individuals. The Johari Window [19] by Joseph Luft and Harrington Ingham (1955) mention the following about boundaries that people create for sharing information (Fig. 10).



**Fig. 10.** Johari Window (1955)

Based on the user study conducted in two phases and the proximity principle and the Johari Window, the researchers formulate that boundaries for sharing information have not been found to be rigid. Boundaries for sharing belief systems differ for different kinds of individuals in the social space of the user. It was observed that different comfort levels are experienced with different kinds of people in known and unknown settings. If textiles could communicate these subtle boundaries that users create and dissolve for others, it could lead to subtle non-verbal expression of boundaries around users through visual cues. It was also inferred that these visual cues can be embedded using traditional textile design crafted elements thereby opening up new avenues of gainful employment of craftsmen.

## 7 Inference and future work

This research paper presents a study on the effect of embedding electronics into a static textile which can enhance non-verbal expression of users in specific contexts. The aim is to understand the role dynamic textiles could play by first understanding the behavior of users pertaining to boundaries they create around themselves and comfort levels experienced in specific contexts. The wearable thus designed augments expression and non-verbal communication of users in the given scenarios to enhance inter-personal interactions and reinforce personality traits of the users. The second phase of user study reveals that changing visual cues for non-verbal communication, leads to improved social and collective intelligence. Technology acceptance study (TAM) indicates strong inclination of users for using such wearables for daily interactions.

Usability assessment encourages user study with larger sample groups for further insights and redesigning of the prototype for better experience and reduced efforts while interaction. Assessment of cognitive load subsequently becomes important to understand the effort, stress, frustration being experienced by the respondents while interacting with these smart products. In further studies, it will be important to correlate usability, acceptance and cognitive load parameters with a larger sample size of respondents to gain further insights on the effects of one on another.

Digitized textile wearables with traditional design elements have high probability to be accepted by the younger Indian generation. Their openness to adopt and experiment for using them in social and cultural interactive spaces would mean an optimistic work outlook for craft makers in the digital era where the craft traditions are on a gradual decline.

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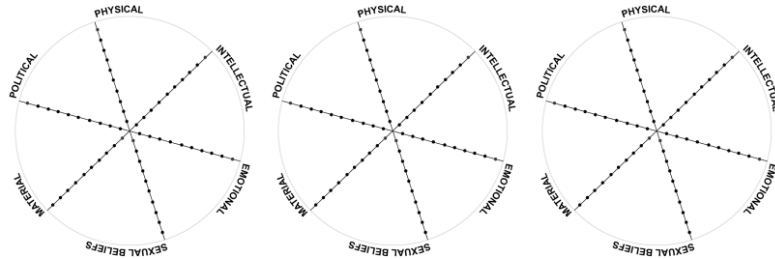
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## ANNEXURE

Parts of Questionnaire as administered has been mentioned below:

**1 Please rate by circling a point between 1-10 on each axis indicating the limits of boundaries you would create when socializing with – (center= 0, perimeter= 10)**  
 KNOWN FRIENDS - STRANGER - INTIMATE FRIEND



**2 Please mention the percentage of comfort levels (0-100%) about sharing the below mentioned details with the following categories of people -**

Types of Information	Stranger from different community	Stranger from same community	Acquaintance	Social Friend	Close Friend	Intimate Friend
Sharing your Past						
1. Social						
2. Academic						
3. Professional						
4. Relationships						
5. Family						

**3 Please mention the percentage (0-100) of feelings corresponding to the contexts that may be expressed –**

	Emotions	Office	School	College	Wedding	Park	Commuting
1	Joy						
2	Trust						
3	Optimism						
4	Love						
5	Vigilance						
6	Admiration						
7	Surprise						
8	Fear						
9	Pensive						
10	Remorse						
11	Annoyance						
12	Aggression						

Pertaining to experimentation with *ASTER*



**4 Please tick the emotions, aesthetic appeal and attitude associated with *Aster* when LIT UP in the tables below, 1 is least and 5 is highest score.**

EMOTIONS	1	2	3	4	5
Happy					
Optimistic					
Awesome					
Interesting					
Admirable					
Sad					
Pessimistic					
Boring					
Annoying					
Disgusting					

AESTHETICS	1	2	3	4	5
Attractive					
Desirable					
Beautiful					
Pleasing					
Enjoyable					

**5 Understanding social intelligence pertaining to the usage of *Aster* in the given scenarios –**

- Do you think that *Aster* can create a dignified decorum by letting you understand the visual language of changing colors, thus create a better understanding among the people around non-verbally?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you think you were able to understand wearer's feelings, non-verbally better with *Aster* if not necessarily put in words?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you think you could *hear* or *feel* the wearer's feelings, non-verbally through *Aster*?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you think that using *Aster* is letting interaction among people around you happen smoothly and socially dignified (within social norms)?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you think that *Aster* lets wearer express his/her personality effectively?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you think *Aster* can modify/influence the outcome of people's behavior around the wearer, if symbolic messages are sent visually?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree
- Do you believe colors could be used as signals to communicate and interpret feelings and make people around act accordingly?  
☐ Agree      ☐ Slightly agree      ☐ Neutral      ☐ Slightly disagree      ☐ Disagree

**6 Technology Acceptance Model – Analyzing acceptance of *Aster* among the users.** Please tick appropriate cells below, 1 is least likely and 7 is most likely, for non-verbal communication –

Perceived Usefulness	1	2	3	4	5	6	7
<i>Aster</i> could enable quick communication							
<i>Aster</i> could improve the process of communication							
<i>Aster</i> improved the productivity of communication							
<i>Aster</i> could enable effective communication							
<i>Aster</i> could enable easier communication							
I found <i>Aster</i> useful for communication							
Perceived Ease of Use							
Learning to understand <i>Aster</i> is easy for me							
I find <i>Aster</i> easy to use for communicating							
My interaction with <i>Aster</i> is clear and understandable							
I find <i>Aster</i> to be flexible to interact with							
It is easy for me to become skillful at using <i>Aster</i>							
I find <i>Aster</i> easy to be used							

**7 System Usability Scale** - After using *Aster* for the scenarios as specified above, please tick appropriate cells below to convey how efficient, effective, engaging, easy to learn and error tolerant the experience of using *Aster* for communicating through visual cues was to yourself; **1 is low** and 5 is **high**.

	Usability factors	1	2	3	4	5
1	I think I would like to use <i>Aster</i> frequently					
2	I found <i>Aster</i> unnecessarily complex					
3	I thought <i>Aster</i> was easy to use					
4	I think I would need support of technical person to be able to use it					
5	I found the functions were well integrated					
6	I found there was too much inconsistency					
7	I imagine most people would find it easy to learn how to use <i>Aster</i>					
8	I found <i>Aster</i> very cumbersome to use					
9	I felt confident while using <i>Aster</i>					
10	I needed to learn a lot before I could get going with <i>Aster</i>					