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Using eTextile Objects for Touch Based Interaction for Visual Impairment

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Abstract

In this paper we explore the relationship between eTextiles and touch-based interaction with regards to visual impairment. We argue that smart fabrics and conductive materials have mostly been researched in terms of their attractive visual properties but that their tactile properties are largely underexplored. We discuss development of a number of eTextile prototype objects which we explored in conversations with blind participants. The focus is on how they use different gestures while interacting with the objects and reflect on these associations when exploring. Through these studies and conversations we propose to take forward a user-centered design approach to creating further objects which can be utilised in aiding or enhancing experiences for people who are visually impaired.

Author Keywords

eTextiles; haptic; visual impairment; dual impairment; wearable technology; embodied object, emotion.

ACM Classification Keywords

H.5.2. [Information Interfaces and Presentation]: User Interfaces – Haptic I/0, Prototyping, User-centered design.

Introduction

eTextiles are an umbrella term for a host of fabrics that are integrated with conductive materials and electronic components to fabricate garments or other textile based objects with novel interactive properties. Much of the emphasis has been on the attractive visual effects of eTextiles, in particular through the use of LEDs, and there has been less focus on the inherently tangible nature of the interaction with such artefacts.

In this paper we explore the possibilities of touch-based interaction in connection with the materiality of eTextiles. Our research is motivated by wanting to explore interactions that may be of interest for blind and visually impaired users for whom the smooth surfaces of current display technologies (including most smart phones and tablets etc) form a closed book. In particular we focus on the relationship between the materiality of the object, the gestures made to touch them, and the emotions associated with these gestures and materials. As part of our initial investigations we developed a number of eTextile prototypes and explored these in conversations with a number of users, including blind artists and professionals from the arts sector working with blind and visually impaired people. We discuss some of the themes that emerged and how we intend to take this work forward.

Related Work

Wearable computing, or 'wearables' are computers that can be worn on the body, and are usually in the form of miniature electronics packaged into boxes that are hidden in pockets or straps. In contrast eTextiles are created by combining ordinary fabrics and materials together with a range of conductive materials, allowing technology to be directly integrated into textiles and clothing. These result in fabric based sensors, which can pick up on physical movement through the way the fabric stretches, or react to touch, as people hold, squeeze or press against fabric layers to activate the electronics. In publications related to eTextiles the emphasis has tended to be on design issues [6] or on the novel visual effects that can be created [2].

However the question of how people actually touch eTextiles is relatively little researched. An exception is the work by Karrer [3], in their paper on Pinstripe, where they describe a system that lets the wearer pinch a fold of clothing, and roll it between their fingers in order to interact with the system they aim to control. The authors describe how people can either exert fine control, by pinching through the fingertips, or exert more coarse control, by grasping a larger fold in the material and they investigate where on the body people can easily perform these gestures. Whilst in their paper the gestures that can be made are central, these are not related to the materiality of the textile itself. In the textile and fashion domain this is an important research topic [4] and touching fabric is recognised as a pervasive element to human perception. It is recognized that people often make initial judgements on the quality of fabric through its tactile properties. Petreca et al build on this research but argue that too much emphasis has been on the semantic properties of fabric (its drapability, formability, tailorability etc) rather than the more emotional responses to touching fabrics such as it feeling pleasant or scratchy [5]. They argue that more knowledge on these affective touch behaviours can help to enhance online experiences of

Figure 1: Pom pom with conductive yarn.

Figure 2: Needle punched swatch with conductive yarn.

Figure 3: Rug-like swatch with conductive thread.

Figure 4: Crocheted ball with conductive yarn.

Figure 5: Crocheted circle with conductive yarn.
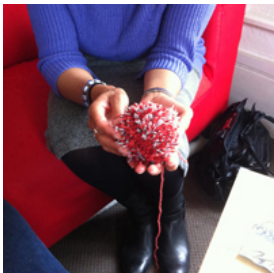

Figure 6: Participant with pom pom.

handling what they call digital textiles, which are online representations of textiles that are currently purely based on verbal or visual descriptions.

However, there still appears to be a gap in the knowledge of what type of gestures people make when handling eTextiles, and what their emotional response is to this handling. Given that touch is so central to textiles and eTextiles this is an important issue to address particularly as it can be of huge potential for blind and visually impaired users, who have a very strong tactile sensitivity.

Approach

To begin to explore the issue of gesture, touch and eTextiles we developed a number of prototypes, and used these as props in open-ended conversations with a range of people. This is taking an explorative 'in the wild' approach to the research, bringing early prototypes directly to users and capturing their ideas and feelings towards these prototypes in an effort to see how we can take these ideas forward for future designs.

eTextile Prototype Development

We investigated a number of existing soft circuit approaches by Leah Buechley and Hannah Perner-Wilson [1] in order to create a rich and diverse set of samples for interactions. Conductive materials which we chose to work with were conductive yarn, conductive thread and conductive fabric. We integrated these into prototypes along with non-conductive yarn, recycled fabric, felt and non-conductive embroidery thread. The prototypes were made with the conscious decision to have subtle effects between the conductive and non-conductive materials, but also to create some

contrasts through thicker and thinner yarns. Using these we created a pom pom using conductive and non-conductive yarn (see Figure 1), a needle felted swatch created using conductive yarn on recycled fabric (see Figure 2), a small rug-like swatch using felt, conductive fabric, thin conductive thread and non-conductive thread (see Figure 3), a small crocheted ball made from conductive yarn with padding in the middle (see Figure 4) and lastly a crocheted circle made from conductive yarn and cotton hemp yarn (see Figure 5).

Through creating these prototypes and asking people to interact with them we identified squeezing, stroking and rubbing as the main gestures for interacting with the objects. However, we also noted additional subtle differences in holding and interacting with the samples and also how people talked about these prototypes as discussed below.

Research Conversations

Open-ended conversations were held with different types of users: two blind artists who were asked to describe any associations and feelings they felt while handling the prototypes; and four professionals who work with blind and visually impaired people in a range of arts settings, including organising and running accessible workshops in art galleries and organising arts-based events for deafblind participants such as touch-based art exhibitions and drama workshops for young deafblind people. We invited them to interact with the objects to get an insight into how they thought they could be received by their user group and whether there was a role for eTextiles within their professional practice. We were also invited to participate in a workshop for children who are deafblind which used drama, movement, everyday objects and textiles as a

Figure 7: Participant with needle punched swatch.

Figure 8: Participant with rug-like swatch.

Figure 9: Participant with pom pom and capacitive sensing circuit with Arduino.

way for them to interact with the space around them and each other.

Emerging Themes

From these initial conversations and observations we identified three different themes: (i) Gestures and thought association, (ii) Social connectedness and independence and (iii) Embodied objects for expressing ideas and feelings.

Gestures and Thought Association

Both blind artists indicated a wide range of emotional responses and gestures whilst holding and touching the eTextile objects in very specific ways. However, they were also quite different in how they responded to these. The first artist talked in terms of imagined scenes She described the pom pom as feeling soft and cuddly, whilst holding it in a cradling type of way and gently squeezing it (see Figure 6). She described it as being a child-like object and it made her think of pastel colours. The needle punched swatch on the other hand, made her think of a farmer's field which has just been ploughed and she felt this was definitely brown in colour. She interacted with this swatch through rubbing her fingertips along the line stitches (see Figure 7). The rug-like swatch felt feathery and she spent a lot of time delicately stroking it with her hands (see Figure 8) but also bringing it up to her face and feeling it on her cheeks with gentle, almost caressing gestures. She said it made her think of fairy grass.

The second blind artist spent a lot of time searching for patterns and structures in each object, and seemed particularly interested in the construction of each one. He described the crocheted circle (see figure 10) as being 'gappy' and 'lumpy' spinning it round with his fingers whilst trying to find a pattern in it and seeing if he could fit his fingers through the holes in it. This object triggered his thoughts around how he likes lumpy things, in which he often tries to find patterns and meaning, comparing it to Braille. His reaction to the pom pom was verbally strong, exclaiming 'Ooh, it's Christmas' upon receiving it. He squeezed it and passed it between his hands, also feeling the threads to see if there was any formality in their length (see Figure 11). He described the object as not being neat and imagined it being red (we hadn't told him the colour). He said he saw it as a toy he wanted to play with and that it had strong memories with childhood, though he wasn't entirely sure which ones. It seemed to evoke childhood Christmas scenes, perhaps Christmas decorations, or perhaps memories of making Christmas decorations with his own children when they were younger. When presented with the rug-like object (see Figure 12) he said it felt chaotic and unkempt, with straggly, knotty fibers and with no apparent pattern or regularity. It reminded him of animal fur. He also observed that holding it with his hands and stoking it on a flat surface gave different experiences with it as a 2D and as a 3D object.

Apart from handling the textile objects as passive objects, we also explored them as capacitive sensing circuits by connecting them to an Arduino board with sound as an output to the interaction. The pom pom in particular provided a prominent reaction as it made a glitchy trickling noise, which made the first participant giggle and describe it as sounding like 'electronic Arabic' (see Figure 9). The other participant spent some time changing the sound output using the pom pom by squeezing it, whereas with the circle he rubbed and hovered over it.
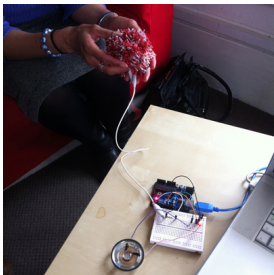
Figure 10: Participant with crocheted circle.

Figure 11: Participant with pom pom.

Figure 12: Participant with rug-like swatch.

Overall what stood out from the conversations with these two participants was how for each of them the small textile object evoked a rich set of associations, which were quite different for both. For the first participant the associations were very personal and each object seemed to paint a picture in itself. Whereas the other participant was more interested in discussing his thoughts around the physical structure of the objects and any possible patterns or lack of patterns.

In both cases the associations went well beyond the semantic qualities of the material itself, with descriptions like 'soft' or scratchy, but instead hooked into a vivid imagined world. It included childhood memories, comparisons to images from nature such as animals and ploughed fields, and there was clear delight in how some objects held a sense of intrigue.

Social Connectedness and Independence
The explorations of the eTextile prototypes with two professionals who work with deafblind people focused on their reflections on how the prototypes could have relevance for their users. A very important point for them in their work is how to encourage and enable a deafblind person to communicate with other people and also how to encourage independence. They felt that the eTextiles could be a promising medium to work with, particularly if they would encourage communication, where for example pom poms would be part of a shared physical game. Also if deafblind users could be involved in the making process this would give them a degree of freedom in expressing themselves. These thoughts were echoed by the other two people with experience of organising workshops for blind people around art.

Embodied Objects for Expressing Ideas and Feelings
The drama workshop for deafblind children that we attended contained many activities that were linked to communication and feedback. These included saying one's name whilst doing a specific movement, passing a 'poke' around the room in a performative way whilst making a sound and using an object of one's choice to transform into a character. All of these actions and sounds were everyone's own choice in what they did. A range of different users participated in the workshop, with varying levels of deafness and blindness. Objects of different sizes and material properties were provided by the facilitators and we noticed how each of the children participating had a different preference for certain objects and actions to go with them. One of the children was drawn to larger objects, for example a large sheet of stretchy material that she could wrap around herself which enabled her to transform into a character during role-play activities. She spent a lot of time running around the room with them and making very dramatic gestures whilst in character (see Figure 13). Another child was specifically interested in the smaller objects, particularly liking the sound based ones such as small bells and cymbals (see Figure 14). She spent a lot of time interacting with these in a very careful way. The third child interacted most with rubbery objects including a big rubber deflated ball and a rubber pom pom. She spent a lot of time cradling these objects or touching them whilst one of the facilitators was holding them (see Figure 15).

What stood out in this session was how different participants chose such very different objects, and that the different sized objects, along with their different material properties held different meanings. The large ones were likely to be used to wrap around themselves

Figure 13: Child in workshop role-playing with textile scarf.

Figure 14: Child in workshop playing with small cymbals.

Figure 15: Child in workshop engaging with rubber object.

in a performance or used as part of the space to go over or under, whereas the smaller ones were used like a prop, being something to use for more personal interactions.

Discussion

The themes we identified were derived from sessions that were quite different in nature, involving only a small number of participants with quite different outlooks and providing relevant insights. In particular they can be seen as dimensions that come together, showing us a way forward in the design process of eTextile objects. In the sessions with the artists we, as researchers had provided the objects for them to explore, whilst during the session with the deafblind children we noted how the participants voluntarily chose different objects and interacted with them. This was either as something to hold and play with independently or using them as embodied objects, to convey a character or emotion to others. In all these sessions we observed how the more ambiguous objects with interesting tactile properties could lead to detailed investigating and hold intrigue, triggering visible emotional responses.

It was also surprising to note how simple textiles could lead to such rich associations and imagery, as we found in the conversations with the two blind artists. It showed us that there is a lot of scope to use eTextile based objects for new ways of interacting through touch, where they can give the user their own voice and provide means of expressing themselves. In particular one of the participants talked for some time about the problem of shiny surfaces and how they throw up a huge barrier to him, blocking his thinking and experiencing. In contrast the small eTextile objects made him curious, wanting to know more about them and opening the way for memories to surface.

Conclusion

We have discussed the issues around eTexiles and how more emphasis has perhaps been placed on the visual as opposed to the tangible aspects of them. We have described our practice-based research in creating prototype objects so as to explore the emotional and gestural responses which might be associated with eTextiles. From our research and the conversations we have had with participants, we propose to move forward with a user-centered design approach, looking at these experiences that are connected to the people themselves. One thing that we want to explore is to facilitate making sessions in which blind and visually impaired users can design and create their own eTextile objects, creating similar ones to those of ourselves and Buechley and Perner-Wilston, focusing on the importance of the touch based aspects of them and what thoughts and emotions they evoke. This comes back to the discussion by Petreca et al about how the emotional and embodied experience which the user feels when interacting with an object is relevant to touch and in our work we would like to see this reflected in the eTextile objects created.

References

[1] Buechley, L., Perner-Wilson, H., "Handcrafting Textile Sensors", Textile Messages: Dispatches From the World of E-Textiles and Education. Ed. Leah

Buechley, Kylie Peppler, Michael Eisenberg and Yasmin Kafai. New York: Peter Lang Publishing, Inc., 2013.

[2]   Eng, D. Fashion Geek. Ohio: North Light Books Cincinnati, 2009.

[3]   Karrer, T., Wittenhagen, M., Lichtschlag, L., Heller, F. and Borchers, J.. Pinstripe: Eyes-free Continuous Input on Interactive Clothing. In Proceedings of the CHI 2011 Conference on Human Factors in Computing Systems, Vancouver, Canada, May 2011.

[4]   Laughlin, J., "Perception of Fabrics: A Textural Centric Study of the Visual and tactile Responses of Adult and Elderly Women", International Journal of Clothing Science and Technology, Vol. 3 Iss: 5, pp.20 - 31, 1991.

[5]   Petreca, B., Bianchi-Berthouze, N., Baurley, S., Watkins,P., Atkinson, D., "An Embodiment Perspective of Affective Touch Behaviour in Experiencing Digital Textiles", Humaine Association Conference on Affective Computing and Intelligent Interaction (ACII), pp. 770-775, 2013.

[6]   Post,E., Orth, M., Russo, P., and Gershenfeld, "N. E-broidery: design and fabrication of textile-based computing", IBM Syst. J. 39, 3-4, pp.840-860, July 2000.