Exploring Use of AR and Soft Knitted Sensor Technology for Co-located Parent-Child Quality Time

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Communicating emotions and spending quality time with parents is an essential component of childrens' wellbeing and development. Existing technology like smartphones often replaces quality time or creates distractions that take away from communication and connection, partially due to the fact that they are not integrated into the home environment. We explore the use of touch-sensitive fabrics and augmented reality (AR) visuals to create an interactive environment for parent-child communication to promote co-location, play and comfort in an unintrusive way at home. Through participatory design with children and parents, we hope to develop designs that will encourage children to express themselves and talk about their feelings with their parents.

Additional Key Words and Phrases: Augmented Reality, Knitted Touch Sensors, Parent-Child Quality time

1 INTRODUCTION

Emotional Awareness, or the ability to recognize and describe self and others' emotions, is an essential skill that contributes to better mental health. [10, 16]. Social Emotional Learning (SEL) [24] and recent RULER research at the Yale Center for Emotional Intelligence [7] have developed curriculum for children to learn these skills in school. However, children can benefit from practice and demonstrations on how to apply these skills outside school, at home and in real life with parent involvement [14]. Slovak et al [18] summarize the current challenges in SEL and outline how these could be addressed by digital technology, thus providing a basis for a strong HCI research agenda in this space.

While previous technology in this field has shown benefit in using tangible interfaces and AR to create interactive story books [19, 23] and games [11], we look at how technology can help create a playful and supportive environment for conversations between parents and children at home. Touch-sensitive fabrics can be integrated into different areas of the home, from a warm blanket, to an interactive chair, clothing, or placemat at the dinner table. This provides many new design opportunities, especially when paired with augmented reality to provide visual and audio information and feedback.

We propose using participatory design methodology with parents and children to design the environment. Through this process we aim to understand how to design technologies to best support co-located parent-child communication in various home contexts. Finally, we would like to investigate how the use of such technology effects parent and child's emotional awareness and closeness.

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2 BACKGROUND AND RELATED WORK

2.1 Touch-Sensitive Fabric in the Home

Although there are various methods and technologies for detecting touch in fabric, we focus on capacitive knitted fabric sensors due to their ease of manufacturing, scalability, and design variability [12, 20, 21]. Currently, fabric-based touch and pressure sensors are being explored for use in many different settings, such as smart homes [26], healthcare [1, 2, 9], wearable devices [25, 27], and accessibility [4, 22]. One of the main benefits of using touch-sensitive fabrics is their potential to be seamlessly integrated into various environments in intuitive and non-intrusive ways. Previous work has explored playable surfaces for children using similar sensors. [4, 13, 22]. They are ideal for children due to their soft, flexible and portable nature. While their use free play and specific games have been previously implemented, we study how knitted touch sensitive fabrics integrated in home environments can support expression of their emotions and communication with parents.

2.2 Augmented Reality Environments for Children

Augmented Reality (AR) provides an opportunity for creating playful, immersive and interactive environments for children [6, 15]. EmoFindAR [11] is a Mobile AR game that can be played in collaborative and competitive modes with friends to find emoticons and interact with them in a room. This game was shown to increase children's emotional awareness. Tangible AR adds tangibility to AR and satisfies user need for direct manipulation. Hutchins et al. [9] [8] show that such tangibility can help users focus on the goal rather than the process, hence, tangible AR has previously been applied in education and learning settings [3, 5, 17]. We are exploring if a tangible AR environment can similarly improve focus on emotions, and help increase emotional awareness, rather than serve as a distraction.

3 DESIGN DEMONSTRATIONS

The knitted sensors can be integrated with children's clothes, or blankets, or other furniture, and we aim to explore the potential of this technology in different home contexts. To do this, we are creating designs iteratively to communicate and demonstrate potential use cases of this technology. We will use these prototypes to demonstrate potential functionality and introduce the concept to parents and children in future user studies. We created these initial designs by brainstorming a list of questions that the parents might ask children while having a check-in conversation. Such as: "How are you feeling right now?", "When did you first feel this way?", "Where were you when this happened?", or "What did you forget to pack?". The parents can ask such questions and the children can answer by tapping on the knitted sensor part corresponding to the AR visual they want to select. The selected AR visual will respond by getting bigger or appearing brighter. More complex questions and conversations will have elaborate gestures like swipes, dragging, or squeezing.

Fig 1 shows some initial paper prototypes created by our team. Fig 1a consists of several animated objects that the parent and child could potentially use in conversation. Fig 1c shows animated representations of the different places the child might visit in the day.

From the paper prototypes, we developed higher fidelity prototypes that are shown in Fig 2. These include a knitted blanket that has been produced (Fig 2a). The black squares represent the touch sensitive area. Fig 2b shows the different school items displayed on the fabric using AR. This can be used as a checklist by parents and children while packing their bag. While the paper prototype in Fig 1c and Fig 2c use emoticons and Disney movie characters to depict different emotions.

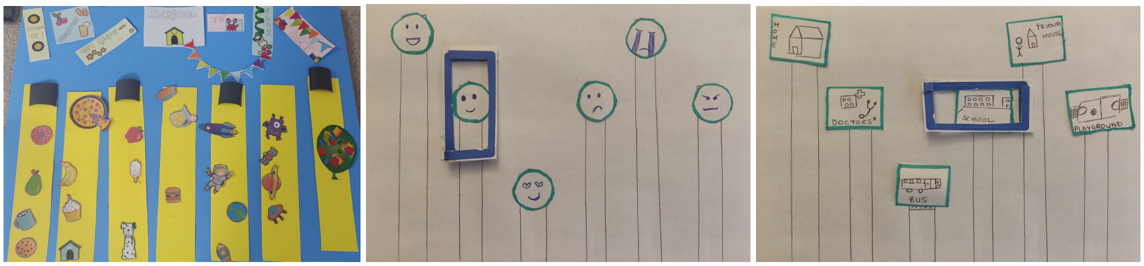

Fig. 1. Paper Prototypes *(a)*: This paper prototype contains several movable components depicting animated objects that will be a part of the AR *(b)*: The emoticons represent different emotions user can chose from. These will be displayed through AR. *(c)*: The emoticons represent different places that user can chose from. These will be displayed through AR.

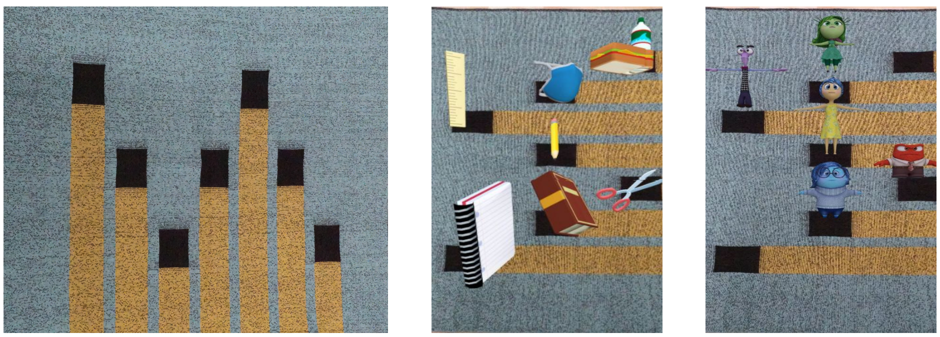

Fig. 2. Touch-sensitive knitted fabric and example designs with Augmented Reality *(a)*: The knitted blanket with black touch-sensitive areas *(b)*: AR visuals displayed on the fabric showing different school items to function as a check-list *(c)*: AR characters to help children label their emotion

4 PARTICIPATORY DESIGN METHODOLOGY

Following participatory design methodology will help us understand the current methods parents and children use to talk about their emotions, how they express themselves and if there are any challenges in this space. We can then co-design interfaces with parents and children that will support emotion expression and carry out daily emotional check-in conversations. Additionally, we are interested in studying how the interactions can be developed to feel intuitive and natural. For example, what gestures or AR visuals to accommodate in the designs.

We plan to recruit 10 children and their parents. The parent and the child will be interviewed and asked to complete a co-design task together. The study will be conducted in 3 phases. In the first, introductory phase, will aim to gather participant background, and the current methods they use to talk about emotions, and what challenges they face while doing so. In the second phase we will gather participants' opinions and reactions after interacting with the technology. In the final phase, parents and children use the paper prototypes in Fig 1, rearrange components, draw new ones if needed, and design an interface.

- **Introductory Phase:** In this phase, we will interview parents and children about their family structure, background, along with their typical daily routines. We will ask them about their conversation methods and flow about their feelings. We will do this by asking them to recall two recent experiences when the child was in a bad mood, and another when they were in a good mood. Keeping these experiences in mind, we will ask follow up questions to learn details about how they processed their mood, what caused it, and how they spoke about. Lastly, we will enquire more about their home environments and conditions to further study if there are any other factors that affect these conversations.

- **Post-Demonstration Phase:** After we demonstrate the design in Fig 2 to parents and children and allow them to interact with it, we will ask them questions to gather their opinions about the technology and the design features. This phase will contain questions about their interest in using it, if so, when and how.
- **Co-design Phase:** In this phase, we will ask parents and children to reflect back on a time when they were having a check-in conversation about their emotions, discuss what happened, and come up with a conversation flow they would find ideal. Following this reflection, we will ask them to use paper prototypes to design to support that ideal conversation. In the end of this phase, the researcher will ask the parent and child to describe their design choices.

5 DISCUSSION AND CONCLUSION

This work explores the use of knitted touch sensors and AR to support parent-children communication while they are co-located at home. Through the proposed user study and participatory design methodology we hope to learn about the different ways in which parents and children communicate about their emotions and also find challenges or gaps in their approach. Using the participants' designs from the participatory design tasks, we will be able to understand the needs of parents and children and create a detailed, flexible and adaptable final design.

Building this technology presents several challenges. One challenge is finding ways to build personalized technology that accommodates the differences in communication and expression styles in children. Another challenge is building technology that offers personalized conversation support in real-time.

AR and knitted sensors combination technology creates a non-interfering, but interactive and immersive, portable environment that has potential and can be studied further to help foster parent and children relationships at home.

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