Bear-With-Me: An Embodied Prototype to Explore Tangible Two-Way Exchanges of Emotional Language

Figure 1. The *Bear-With-Me* prototype system consists of two bears that can sense and receive physical hugs and other forms of tangible expression in real-time over geographically distributed areas.

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Abstract

Given the busy day-to-day schedule of families and couples, communication between loved ones is often limited to text-messaging, email, or phone calls. These forms of communication do not allow for more tangible modes of intimate expression like hugging. While previous work has explored sending tangible forms of emotion like hugging, this work has been limited by not supporting or encouraging users to reciprocate emotional pings or "hugs." In this paper, we introduce *Bear-With-Me*, a prototype system that allows users to exchange tangible expressions of emotions, such as hugs, in real-time. In contrast to previous work, *Bear-With-Me* is mobile, tangible, bi-directional, and real-time allowing for new types of exchanges of emotional, embodied communication. In this paper, we present our system design, results from a preliminary pilot study, and a discussion of future work.

Author Keywords

Intimate communication; mediated emotional expression; tangible interaction; physical embodiments

ACM Classification Keywords

H.5.m. Information interfaces and presentation (*e.g.,* HCI): Design.

Figure 2. Profile view of *Bear-With-Me* bear. Each bear wears a custom fabric backpack that hides the Arduino microcontroller, WiFi shield, and other electronics.

Introduction

In today's busy world, people are often separated throughout the day due to their schedules, job requirements, or other circumstances. Some couples may be separated for long periods of time because of business trips or may be in long distance relationships. Even long work hours or conflicting schedule shifts make it difficult for couples to connect beyond the occasional text or phone call.

While previous research has explored various techniques to enhance interpersonal relationships through systems that allow users to send emotional "pings" (*e.g.,* virtual hugs [7], hand holding [5]), these techniques are often limited in one or more of the following ways: mobility, tangibility, bi-directional, and real-time[1] communication. Mobile systems, such as smart phones, are prevalent in our society and are mobile, bi-directional, and foster real-time communication. However, these systems lack the tangibility found in real face-to-face interactions. Although there is a growing amount of tangible systems aimed at fostering relationships, they are also lacking in at least one of the aforementioned ways.

In this paper, we introduce *Bear-With-Me* (Figures 1 and 2), a prototype system that provides couples with a mobile, tangible form of bi-directional interpersonal communication in real-time. *Bear-With-Me* consists of two interactive bears capable of detecting squeeze, touch, and motion. The prototype system was developed to explore bi-directional exchanges of emotional language primarily through sending and receiving hug signals. In this paper, we describe the system, its interaction modes, and feedback from a preliminary pilot study.

[1] In this paper, we consider communication that happens within a minute to be real-time or near real-time communication. These terms will be used interchangeable.

Related Work

Traditional communication technology lacks one of the most important tangible aspects of face-to-face communication: the ability to touch. The sense of touch plays an instrumental role in traditional modes of communication [1]. The sense of touch is used to express an array of various subtle messages [4]. Long distance communications through the phone, or text messaging do not allow the users to hug or kiss, interactions that emotionally convey deep messages. There has been much previous research in promoting more tangible modes of communication for long distance relationships (*e.g.,* [3, 5, 6]). Our system uses real-time communication with a non-intrusive innovative design to send hugs. While previous work in this field has attempted to enhance interpersonal relationships, the absence of real-time or versatile design has prevented the system from being relevant for daily use.

Daily use and versatility

Past work reflects the importance of designing for daily use and versatility (*e.g.,* [6, 7]). Wearable technology is a common medium used to communicate tangible emotions. While wearable technology may be able to more closely simulate the feeling of a hug, it is intrusive in that it requires a person to wear the same item of clothing daily. Thus, wearable technology does not foster daily use. *Huggy Pajama* and *Hug Over a Distance* are examples of these wearable systems. *Huggy Pajama* allows parents to remotely hug their

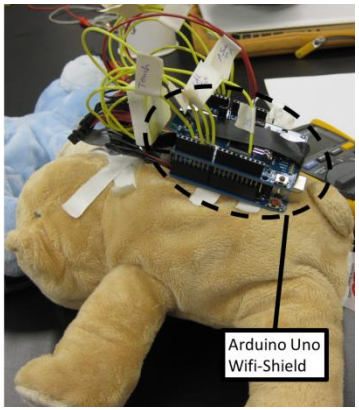

Figure 3. Sensors are connected to an Arduino Uno and a WiFi-shield. These electronics are hidden in a suitably placed backpack (see Figure 2).

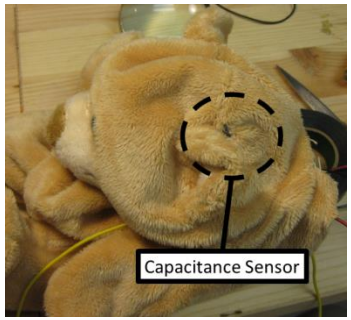

Figure 4. Conductive thread sewn on the bear was used to detect the user's touch and acknowledge a hug.

children by sending signals through a device to a pajama, which in turn simulates the feeling of being hugged through a change in temperature and air pockets in the pajama reproducing the hug [9]. While *Huggy Pajama* works well with adult-child relationships, our system is aimed towards enhancing both adult interpersonal relationships as well as familial relationships. *Hug Over a Distance* is a wearable vest that can be triggered remotely to simulate the sensation of a hug. Similar to our system, it uses a stuffed animal to send the "hug" signal [7]. While *Hug Over a Distance* serves as an inspiration to our system, it is unrealistic for daily use (*e.g.,* it is not practical for an adult to wear the same vest to work every day). Furthermore, our system is more versatile and less intrusive in nature because it can be used in most places. Bear-With-Me can be transported anywhere, whereas it would be less socially acceptable to wear a pajama or the same vest at work.

Face-to-face interaction allows for touch, such as holding hands. An experiment was conducted using probes to collect data to see when couples wanted to hold hands. However the design of the probe, a yellow ball, which users were embarrassed to hold precluded the experimenters from collecting any real data about the time of day users want to send signals to their partners. Additionally, these signals were not sent, but recorded and sent to partners after a week [8]. This research changes the nature of the interaction between the user and the probe and lies in contrast to real-life situations where interactions and reactions happen in real-time. Furthermore, Gooch and Chang [5, 3] have explored sharing remote touch experiences with interactive models of hands and picture frames, respectively. However, these systems were not mobile.

Others have explored how mobile phones can support tangible communication. The *Forcephone* is a system integrated in mobile phones that allows for haptic feedback called "pressages". During a phone call, users can send a "pressage" resembling an interaction of a hug, by squeezing the side of the mobile phone. A "pressage" is reminiscent of a non-verbal cue similar showing affection [6]. This design limits the user to sending emotional pings only during a phone call. Phone calls are a more intrusive form of communication and cannot be conducted multiple times throughout the day. Our system differs from the Forcephone in that the stuffed animal can simply be hugged to relay a message, not requiring a phone call to be made to the recipient.

Importance of real-time communication

Real-time communication is fundamental to our particular design. Immediate feedback is a result of face-to-face communication. A hug is the act of two parties actively involved in embracing one another. Some previous systems do not focus on the importance of real-time feedback. The TapTap, a wearable system, records nurturing human touch and allows it to be played back for emotional therapy. This wearable system provides haptic feedback for all of the human touch interactions that it records [2]. Unlike our system, it does not transport messages in real time. Bear-With-Me not only transmits hug interactions in real time, it also records the interactions throughout the day and allows users to see how many times they have been hugged.

Bear-With-Me Prototype

We created a prototype system to demonstrate the feasibility and appropriateness of our concepts. The

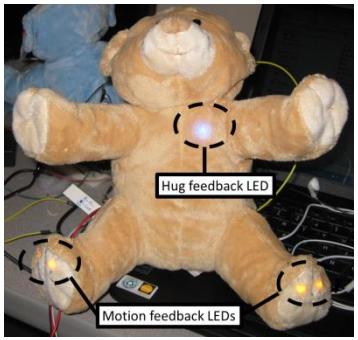

Figure 5. Each bear has glowing hearts and feet to indicate hugs and motion, respectively.

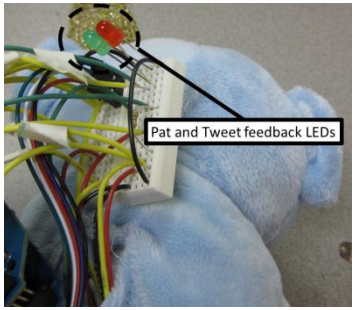

Figure 6. The red and green status lights provide users with feedback about when tweets are sent and when pats are detected, respectively.

prototype consists of two interactive bears capable of detecting squeeze, touch, and motion. The bears communicate with each other through Twitter via a WiFi-shield and Arduino Uno. We choose communication through Twitter because of the readily available Twitter Arduino library. Twitter provides an easy interface for the bears to send and read messages, which we will later describe. Using smartphones and Bluetooth to communicate are also options which we could explore in future works.

Input sensors

Each bear is equipped with a capacitance sensor, a squeeze sensor, and an accelerometer to sense touch, hugs, and motion respectively. For these prototypes, the sensors are connected to an Arduino Uno which we placed in a backpack behind the bear (Figures 2 and 3). We intend to minimize the size of the hardware in our next version of the system.

As previously described, the sense of touch is an important part of human interactions [1, 4]. We provide users two ways to share touch related expressions through the use of capacitance touch and squeeze sensors. The capacitance sensor simply consisted of conductive thread sewn into the bear connected to a voltage source and a digital Arduino pin, see Figure 4. We used a force sensitive resistor in a cotton casing to serve as a pressure sensor. By using a force sensitive resistor, we are able to detect hugs of different strengths. In our next prototype, we intend to make the pressure sensor more robust and omni-directional. Lastly, to detect motion, we placed a tri-axis accelerometer inside the bear.

Output devices

Each bear is currently equipped with a pair of LEDs in each foot and a tri-color LED sewn in its heart, see Figure 5. Furthermore, there are two status lights to give users various system feedbacks; one for tweet confirmation and another for pat confirmation, as shown in Figure 6. These output lights allow for a plethora of interaction, feedback, and gaming possibilities. By the very nature of Bear-With-Me interactions, users are encouraged to participate in actively exchanging hugs and not to merely send them.

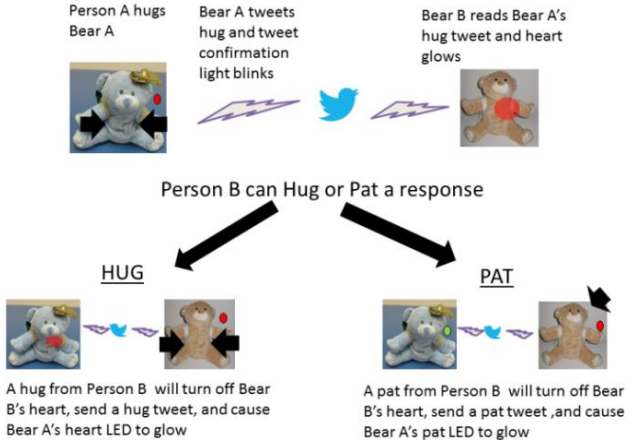

Figure 7. Bears exchange hugs and pats

Interaction modes

Hugging is the primary communication mediated by the two bears. Figure 7 summarizes this communication. When Person A hugs Bear A, Bear A sends a tweet that it has been hug. Bear A's tweet confirmation light will blink twice. Both bears have tweet confirmation lights which will blink after sending a tweet, giving users immediate feedback. Once Bear B, who is actively

Figure 9. User "hugs" or applies pressure to mid-section (stomach area) of teddy bear.

following Bear A on Twitter, reads Bear A's hug tweet, Bear B's heart will glow. Person B now has two options; to acknowledge the hug with a hug or a head pat. If Person B hugs Bear B, Bear B's heart will turn off. Bear B will send a hug tweet, causing Bear A's heart to glow. If Person B decides to pat Bear B's head, Bear B's heart will also turn off. Bear B will send a pat tweet. Once Bear A reads this tweet, its pat confirmation light will turn on. Hence, the users have the option to acknowledge but not necessarily reciprocate hugs. These exchanges are bi-directional and only take a couple of seconds.

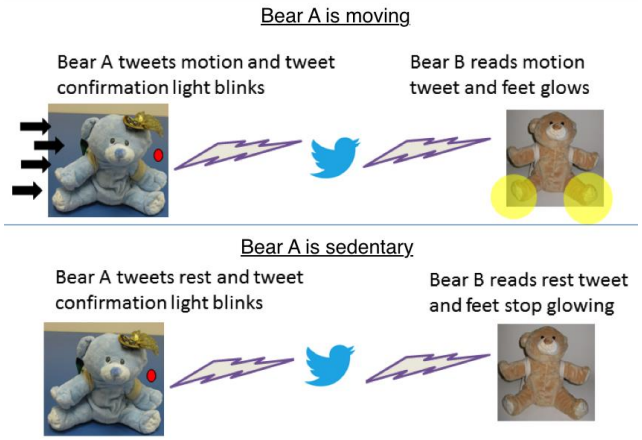

Figure 8. Bears exchanging motion information

The bears also share when they are being moved or played with, as shown in Figure 8. This gives couples a visual feedback when they are sharing the same event (*i.e.,* both playing or moving the bears) in close temporal proximity. When Person A is walking or playing with Bear A, Bear A will tweet that it is being moved. Once Bear B reads this tweet from Bear A, Bear B's feet will light up. Likewise, when Person A is no longer moving Bear A, Bear A will tweet that it is resting. When Bear B reads the resting tweet from Bear A, Bear B's feet LEDs will turn off. Both bears have the capability to share and receive their motion information.

Preliminary Pilot Study

To get initial feedback on our prototypes and concepts we conducted a preliminary pilot study survey. We showed and explained our prototype systems to ten people, five couples (*AVG*=33, *SD=7*) recruited via word-of-mouth. Most of the couples surveyed liked how this work was reappropriating the stuffed animal as a communication device and thought it could be helpful to long distance relationships. One person indicated how she would have loved to use it when she was in Indonesia and her husband was in the United States because "you could just send a little 'I'm thinking of you' hugs at random times when communication is so much more difficult." Another person mentioned that he liked "how the notification is a simple light and not something overwhelming or annoying."

Although there were a number of positive responses, the couples we interviewed also expressed some criticisms. They mentioned how the prototype system is still rather big and bulky and they would be more inclined to leave it at home rather than carry it around. Also, the couples we surveyed in this preliminary pilot study are all co-located. In our usability study, we intend to recruit users who are both co-located and in long distance relationships to explore differences in use and perspective.

Future Works/Conclusion

The Bear-With-Me system builds upon previous works in enhancing interpersonal relationships by allowing users to send and receive real-time emotional expressions through a tangible, embodied medium. We received initial feedback from various couples to preliminarily evaluate the efficacy of our system.

The next version of our system will be smaller and more transportable, thus less intrusive. We also want to continue exploring the interaction space for our system. Several people suggested different interaction modes, such as changing the brightness or color of the heart glow based on the strength or duration of the hug. Gamification of these exchanges is also possible. The current design of our system supports the potential to send notifications to the users if hugs are reciprocated within a certain amount of time. For example, if a hug is reciprocated within two minutes of being sent, there could be an additional visual notification for the recipients in an attempt to heighten the emotional connection. Vibration motors could also be incorporated to notify the users that hugs have been shared within a certain amount of time and to provide an additional tactile layer of expression. Such an interaction would feel more like a face-to-face hug because both users would be hugging their bears at the same time.

Additionally, we want to further explore temporal sharing of tangible interactions through motion. With the Bear-With-Me system, couples can receive real-time information when their significant other is playing or moving around with their bear; however, we did not yet explore this in our evaluations. Furthermore, we also want to continue exploring the application opportunities for these systems to compliment the parent-child relationship. In our next phase of research we aim to create several interaction modes for a usability study to investigate what would better help people feel closer connected and which modes of exchange are preferred.

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