Sharing the Squid: Tangible Workplace Collaboration

Rebecca Stern
Arts, Media, and Engineering
Arizona State University
699 S. Mill Ave., Room 393AC
Tempe, AZ 85281 USA
Rebecca.Stern@asu.edu

Lisa Tolentino
Arts, Media, and Engineering
Arizona State University
699 S. Mill Ave., Room 393AB
Tempe, AZ 85281 USA
Lisa.Tolentino@asu.edu

Aisling Kelliher
Arts, Media, and Engineering
Arizona State University
699 S. Mill Ave., Room 396
Tempe, AZ 85281 USA
Aisling.Kelliher@asu.edu

Winslow Burleson
Arts, Media, and Engineering
Arizona State University
699 S. Mill Ave., Room 392
Tempe, AZ 85281 USA
Winslow.Burleson@asu.edu

CHI 2008, April 5 – April 10, 2008, Florence, Italy
ACM 978-1-60558-012-8/08/04.

Abstract
Effective communication is central in building trust and negotiating differences in diverse, multidisciplinary working environments. In this paper we discuss a tangible mediated environment designed to facilitate positive social interaction between colleagues in a research workplace. Through our multi-user tangible interface in the form of a plush squid, participants can share media resources and collaborate in a playful and inviting setting. Results from preliminary studies indicate that playful mediated work environments stimulate constructive discourse, strengthen social bonds, and enhance creative output.

Keywords
Tangible user interface, social interaction, play, casual computing, RFID.

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interface — Input devices and strategies
H.5.3 **[Information Interfaces and Presentation]**: User Interfaces: Group and Organization Interfaces — Collaborative computing, Computer-supported cooperative work

Introduction

In a multidisciplinary, multicultural workplace, it can be difficult to collaborate with individuals from diverse backgrounds. Team building activities are important for strengthening group cohesion and diffusing tension. Within groups, trust can be built through discourse and respectful negotiation; these skills can be honed and practiced in carefully designed, playful scenarios. It is well documented that experiences are more engaging when they are fun [1, 4]. Additionally, pleasurable experiences can be thoughtfully engineered and designed to satisfy particular goals [8].

Figure 1a: The plush Sensor Squid at rest on a couch.

One way to encourage the emergence of trust and strong team spirit is by sharing media objects (pictures, videos, and sounds) in a process of inquiry and storytelling. Story-sharing activities in inviting, intimate and playful environments further enhance camaraderie and respect between work colleagues.

In this paper, we discuss the design, development and preliminary evaluation of a mediated workplace environment built to support mutual awareness and strengthen social bonds between colleagues in a diverse transdisciplinary research workplace. The environment is composed of two main components – an audiovisual relationship-forming game, and a multi-user tangible interface. The audiovisual Relation Game component supports participants in exploring community-generated media using the Sensor Squid tangible interface as an input device. The sensor-enhanced squid is a large soft plush toy that can be held comfortably by multiple people at once.

The Sensor Squid's goal is to create a collaborative creative interaction. The playful form of the plush animal lowers the barrier to collaborative technology-focused creativity by encouraging users to play. Users are playing together; they are forming social bonds, encouraging our team-building goal. The squid's character is designed to promote curiosity in adults who may be reminded of their youth [3].

In the next section we will describe the game interaction we have designed, followed by a more in-depth description of how the Sensor Squid works in this game. Then we will discuss our preliminary user study and implications for future development.

Relation Game

We are building this system to help explore sharing community media as a form of collaborative brainstorming and team building. In this audio-visual

Figure 1b. An RFID tag being read in the face of the Sensor Squid.

Figure 1c. A group using the Sensor Squid to play the Relation Game.

metaphor activity, up to five participants use the Sensor Squid to audition sounds, pictures, and videos. The goal is to make meaningful relationships between two of the three objects on screen. Each participant has a different input control over the process. These interactive controllers are built into the ends of the tentacles of the squid. When using the current prototype, users seated together on a couch use their individual squid tentacle controller while faced towards a large screen. While all users can shape and impact this communal experience, they may not be directly aware of the small motions of their colleagues' hands on each individual controller. Therefore, participants must rely on verbal communication and on-screen feedback to collaborate successfully. The following will briefly describe the Relation Game's on-screen actions (see Figure 2).

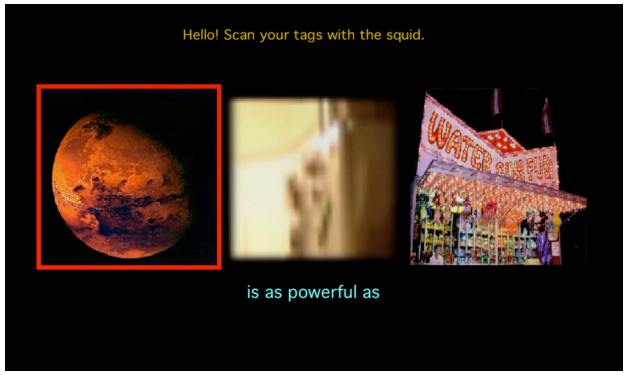

Figure 2: The on-screen display of the Relation Game.

- A user auditions one piece of media at a time by turning a knob, highlighting the object in red.
- Users can also control what relationship (e.g. "is as powerful as") they are aiming to create with a light sensor. When the sensor comes near a bright light, the relationship displayed on the screen changes.
- Similarly, one user can change the collection of media with which the group works by separating and rejoining to tentacle ends. When the tentacle ends are touched together, the three displayed media objects are refreshed.
- Finally, the bend sensor is used to discard the piece of media that "does not fit" or "least fits" the relationship. By bending the tentacle, the media highlighted at that time will be removed from the screen, and a message confirming that 'you have made a relationship' will also be displayed.

Our aim is to create a nuanced experience for collaborative creativity and team building. We wish to create a variety of experiences that support sustained and frequent interactions from both novice and expert users of the squid interface.

The Sensor Squid

The physical manifestation of the squid supports simultaneous input from multiple users through its many tentacles (see figure 1). Each tentacle has a different sensor/controller, so each collaborator has control over only one part of the interaction, necessitating team collaboration and discussion [6]. In the Relation Game, attention is focused on shaping the interaction, not performing individually, so the pressure of performing for a group is greatly reduced. We now describe the sensors' current functionality and potential for future development.

- The RFID Sensor is located in the head of the squid (see figure 1b). Each user can log in to the game by scanning his or her personal RFID bracelet [5] in front

Figure 3: The bend sensor in two states.

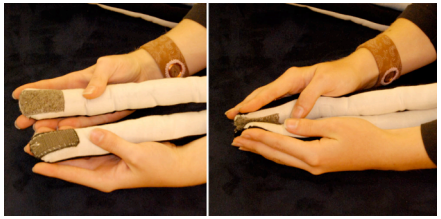

Figure 4: The conductive Velcro® switch in two states.

of the squid's head, which is a natural motion while embracing or holding the squid. The software we are developing collects information from all the users in a given session. In this way the computer knows who is interacting with the squid and may tailor an on-screen and personalized experience accordingly.

- The knob (potentiometer) at the end of one tentacle is an analog sensor whose input is converted to a digital value by the microcontroller. In our current software implementation, the knob is used to audition media objects by moving a highlighting box back and forth horizontally on the screen according to the clockwise or counter-clockwise motion of the knob. This focuses the group's attention for discussion on one media object at a time. It also has natural affordances for volume control, horizontal and vertical scrolling, and other measurements where a gradient of values can be used.
- Like the knob, the bend sensor is also analog. We currently use the bend sensor tentacle to select media objects once the highlighter is positioned over the desired objects. The user bends the tentacle in his or her hand as if to "grab" the object. We are achieving this effect by sensing when the tentacle is bent beyond a certain threshold. In the future we wish to use the level of bend to impart a more qualitative judgment about the media being auditioned, for example a weak bend could indicate a low level of certainty in a decision, whereas when the tentacle is bent very far, the decider is very confident. The range of values this bend sensor reads affords this kind of affective measurement.
- The light sensor is a light-dependant resistor (LDR) that is used to make a change in the software's function when it measures light over a certain threshold. It is possible to use it as a switch for intentionally triggering an action by pointing it at a lamp and then moving it away. It could also be used to measure ambient light conditions. In the Relation Game, we use the light sensor to renew the relationship applied to the media objects.
- The conductive switch is comprised of two Velcro® pads at the ends of two separate tentacles. This is a digital switch, indicating only whether it is open or closed. The Relation Game currently senses the gesture of separating and reconnecting the Velcro® pads as a "refresh" function, presenting the user with new media options.
- The pinch sensor is similar to the Velcro® switch, but it is encased in the end of one tentacle. Two pads of conductive fabric [2] are separated by a thin layer of plush batting inside the tip of the tentacle. When a user pinches the end, the pads come into electrical contact, alerting the microcontroller to this change. This sensor is also digital, but if exchanged for a force-sensitive resistor (FSR), an affective quality of the pinch could be measured.

Technical specifications

The Sensor Squid uses an Atmega186 microcontroller (Arduino NG board). The microcontroller's serial data output is connected to a BlueSmiRF Bluetooth module for communication between the microcontroller and the computer. The small ID-12 RFID reader was chosen for its compact size and internal antenna, making it suitable to embed in the plush squid. It is connected to the microcontroller's serial data input. The user wears a passive RFID tag embedded in a personalized bracelet. The squid is powered from a nine-volt battery connected to the Arduino's external power input, which

then makes five-volt power available to the rest of the circuit. These components are located in the head of the squid (see figure 5).

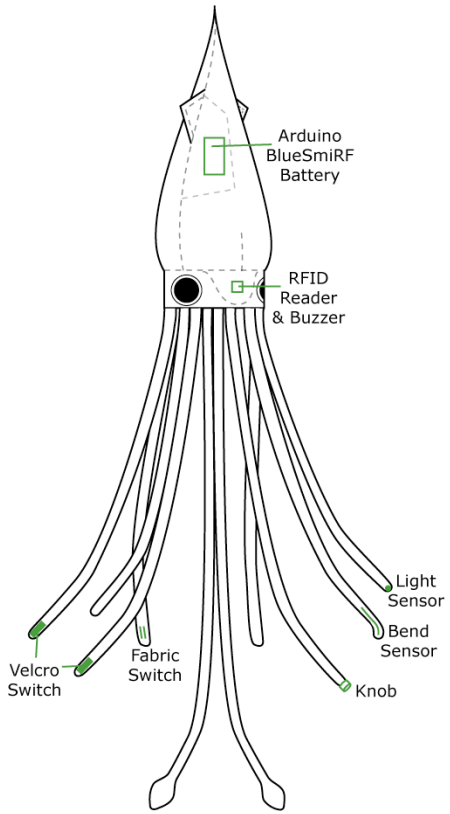

Figure 5: A diagram of the sensor and logic systems and their positioning in the plush squid.

The sensors are connected to the microcontroller's analog and digital inputs via wires passed through the lengths of the squid's tentacles.

While not all tentacles have embedded sensors, each does contain wire to accommodate future sensor additions. The microcontroller's software module receives the analog and digital sensor values and any scanned RFID tag (a unique character string), assembles these values into a space-delimited packet, and then transmits to the computer host application via Bluetooth.

Preliminary User Study

The purpose of the preliminary user study was to gauge how successfully the system invited playful interaction, stimulated discourse and strengthened community bonds. The study was also used to test our design decisions and gather information for future development of the Sensor Squid and Relation Game. 11 subjects from our research community volunteered to participate in short game activity sessions, which were observed and video recorded by the authors. Following the session, the subjects participated in a Q&A interview session also with the authors. While some subjects were familiar with components of the system, others were encountering the environment for the first time. Additionally, some users were already acquainted with their collaborators, while others were relative strangers to one another.

After receiving some basic system training, groups of three to four people at a time were invited to collaborate with one another in a Relation Game session lasting approximately 10 minutes. During the follow-up interview, users informed us that the activity was good for ice-breaking, team building, and getting to know colleagues in a fun setting [7]. The activity was reported as relaxing, partially due to the enjoyment of touching the soft, non-mechanical squid. It was

described as being disarming and created a less threatening environment in which users felt invited to be creative. We observed that users didn't necessarily make direct eye contact during the activity, with some users reporting feeling less pressure to perform in front of his/her peers, making the interaction more natural. Users also described feeling a connection to each other through sharing the same physical object.

Implications for further development

Based on user suggestions and our own research goals, we will continue to develop and enhance the sensor squid functionality. We wish to incorporate additional analog sensors and develop interactions that enable users to engage in more qualitative judgments. For example, stretch sensors could show how hard someone tugged a tentacle, while pressure sensors could read how tightly the squid is being hugged [9]. Other research directions include allowing users to input a non-binary reaction such as a level of confidence in a decision or how applicable a particular text statement is to the given image. We would also like to implement haptic feedback into the squid such as light, sound, and vibration. Further development of RFID jewelry systems will also enhance the natural, casual user experience. We will continue to refine and evaluate our tangible mediated environment over the next 12 months with a dedicated group of users within the transdisciplinary Arts, Media and Engineering community at Arizona State University.

Acknowledgements

The presented work is developed in Arts, Media and Engineering at ASU (Reflective Living group). The authors would like to thank the AME community, particularly Ryan Spicer, Assegid Kidané, and Byron Lahey.

References

[1] Berger, Jonathan, <jonathanpberger@gmail.com> "Design, Wit, and the Creative Act panel discussion," 4 Dec. 2007, personal email. Panel discussion hosted by Core77. http://www.core77.com/offsite/.

[2] Buechley, L., Elsenberg, M. Fabric PCBs, Electronic Sequins, and Socket Buttons: Techniques for E-textile Craft. *Pers Ubiquit Comput* (2007) DOI 10.1007/s00779-007-0181-0

[3] Carvey, A., Gouldstone, J., Vedurumudi, P., Whiton, A., Ishii, H. Rubber Shark as User Interface. In proc. In *Proc. CHI 2006*, ACM Press (2006), 634-639.

[4] Fernaeus, Ylva. Tangibles for Social Interaction. *Pervasive Interaction Lab Shareable Interfaces Workshop 2007*.

[5] Medynskiy, Y., Gov, S., Mazalek, A., Minnen, D. (2007). Wearable RFID for Play. *Intelligent User Interfaces 2007 Tangible Play Workshop*.

[6] Norman, D.A.: *The Design of Everyday Things*. Doubleday, New York, NY. 1988.

[7] Schiporst, T., Nack, F., KauwATjoe, M., de Bakker, S., Stock, Aroyo, L., Perez Rosillio, A., Schut, H., Jaffe, N. PillowTalk: Can We Afford Intimacy? In *Proc. TEI '07*, ACM Press (2007).

[8] Sengers, Phoebe. The Engineering of Experience. *Funology: From Usability to Enjoyment*, Ed. Mark A. Blythe, Kees Overbeeke, Andrew F. Monk, Peter C. Wright, Norwell, Massachusetts: Kluwer Academic Publishers (2004), 19-29.

[9] Stiehl, W. D., Lieberman, J., Breazeal, C., Basel, L.,Cooper, R., Knight., H., Lalla, L., Maymin, A., Purchase, S. The Design of the Huggable: A Therapeutic Robotic Companion for Relational, Affective Touch. AAAI Fall symposium on Caring Machines: AI in Eldercare, 2006.