Emlo Tangible Broadcast Buddy

ABSTRACT

The increasing popularity of micro-blogging services such as Twitter, Facebook, and Foursquare illustrates people's desire to create concise descriptions of what they are feeling and doing in the moment. People are also interested in what their friends are thinking and feeling. While the information being expressed is very personal, the devices that people use to communicate this information are cold and impersonal. In particular, a mobile phone keypad is an unnatural mode of expression. Emlo is a device that allows people to use natural gestures to broadcast a succinct message about emotion and location as well as to receive feedback about how others are feeling.

Here we present our research that attempts to connect gestures to emotions in a natural way, as well as prototypes that incorporate these findings. We discuss how our project builds on existing work in the space as well as the future of this concept.

Categories and Subject Descriptors

H.5.2 **[Information Interfaces and Presentation]**: User Interfaces—Input devices and strategies, Interaction styles

General Terms

Design, Human Factors.

Keywords

Physical computing, tangible user interface, mobile device, interaction design, social networks.

1. INTRODUCTION

Our goal was to explore the relationships between physical inputs and digital transmission of emotion and location information. We performed two phases of user research to determine how to map gestures to emotions. In the first phase we asked subjects to demonstrate emotions using everyday objects. In the second phase, we showed subjects gestures derived from the results of the first phase and asked them to select which emotion they thought that gesture best represented. From these results, we created a prototype device ("Emlo") that incorporates the most agreed upon emotion–gesture pairs and transmits and receives these messages.

Emlo is a tangible interface for creating and broadcasting emotional and location messages. Different motions—bending, pounding, and other manipulation of Emlo—produce different emotional messages. By combining these messages with geographic coordinates collected from an embedded GPS unit, Emlo is able to construct and transmit an emotional narrative. Emlo can also receive messages. When Emlo receives a message that it can understand from a user's friend, it will buzz and light up in the color corresponding to that friend's emotional message.

The popularity of applications like Twitter stems from users' ability to create concise, real-time messages from anywhere. Emlo extends this functionality to allow even more natural interaction than typing on a portable phone. Because users are sending messages using natural motions, there is a more fluid expression of the user's current emotional state. Because the location information is broadcast automatically, users do not have to think about adding that piece of information to the message. Using the device, people can quickly and naturally broadcast emotional and location messages, as well as keep tabs on the emotional/location messages being broadcast by a user's friends.

2. EXISTING WORK IN THIS SPACE

Previous projects have studied how people convey emotions through body movements. Under the umbrella of "affective computing," developed by Rosalind Picard at the MIT Media Lab, many projects have studied how computers can "recognize, express, and in some cases, 'have' emotions" [1]. The VICON [2] system measured basic emotions mapped to body movements. This study concluded that humans were quite successful in deciphering another human's emotional state based on body movements. The researchers were reasonably successful at training a machine to detect emotions from movement tracking as well. Several projects have tested how people communicate emotions to a physical object. SenToy [3] tested users' ability to find common gestures to indicate emotions using a doll. The actions performed using the doll correspond to a video game avatar that influences game play. In creation of the SenToy, the researchers found that some emotions such as happiness and anger were easy to find common gestures for, but gestures for other emotions such as disgust were more difficult to define. TEMo-chine[4] tested physical avatars in an office environment to aggregate emotional information of a group. In another project, Wensveen and colleagues [5, 6] designed an alarm clock that understands emotion expressed through actions and returns relevant feedback.

Other projects have focused on portable message devices. Holleis et al. [7] created portable devices with screens that enabled environment-based test messages. Users created questions through an online interface that would be displayed on the screen. Users would respond to a list of predetermined answers using a gesture. The study concluded that using gestures like tilting and shaking the display required a learning curve and made the screen difficult to read.

There are a few commercial products on the market for communicating location. Foursquare (http://www.foursquare.com) is a social networking system that allows users to "check in" to locations using their cell phones with embedded GPS units. Foursquare users often use Twitter to announce where they have checked in. Plazes (http://plazes.com) is a similar system that allows users to use their phones to share their current location with followers.

Our project expands on the existing work in these areas by connecting physical expression of emotions with geolocation information and disseminating that information through a Twitter feed. By combining natural gestures with human emotions, interacting with Emlo is a fluid expression of feelings. Instead of relying on text to create and receive messages, Emlo's input and output are embodied within the device. Our research builds upon the studies of how to map human emotion to a physical device while overcoming the limitations of transmitting messages using a display screen. Instead of sending just a geolocation message, Emlo provides a rich emotional story about its user at a current place and time.

3. PLUTCHIK'S WHEEL OF EMOTIONS

We selected Robert Plutchik's Wheel of Emotions as the emotional framework to use in our project based on its concise, 8-facet model of basic emotions. In addition to specifying eight core emotions (*joy*, *trust*, *fear*, *surprise*, *sadness*, *disgust*, *anger*, and *anticipation*) [8], the model also allows for combinations of basic emotions to generate 8 additional complex emotions. While we did not employ the complex emotions in our study, they provide the option for future extensibility.

4. RESEARCH

In order to devise a natural set of emotion–gesture pairs, we engaged in two phases of research. The first phase was an open-ended inquiry, the goal of which was to describe a set of gestures to test more rigorously in the second phase. In the first phase we presented 4 objects—sponge, ping pong ball, velcro hair roller, hair scrunchy—to subjects and had them model the 8 basic emotions using one or multiple objects. Each object had qualities that encouraged a certain type of interaction. The ping pong ball was small and could be tossed, bounced, and rolled. The velcro hair roller was scratchy, the sponge soft and flexible, and the hair scrunchy stretchy. Based on the subjects' responses, we were able to devise a set of 10 motions to test further. We analyzed the responses from the first phase of research to develop gestures to test further. For example, we noticed that almost all of our subjects used the ping pong ball to model joy and a significant proportion tossed or bounced the ball. Similarly, a significant number of people chose the hair roller to model fear. Using these and other qualitative observations, we devised our 10 gestures (figure 1). We then made a composite non-working prototype that combined the affordances of each of our first-phase test objects into one device. The device was able to be manipulated in the 10 ways that we identified as being the most appropriate gestures for each of our 8 basic emotions.

The second phase of research was more structured. Each of the 10 gestures was presented to the subjects in a video that featured our non-working composite prototype. The subjects were then instructed to choose 1 of the 10 gestures for each basic emotion (some gestures were left over). The goal of this phase of the research was to find the emotion–gesture pairs that subjects found most natural. The study was presented in the form of an anonymous online survey.

Four emotion–gesture pairs stood out (figure 2). For *joy*, *surprise*, *sadness*, and *anger*, between 66% and 87% of subjects chose the same gesture as the best choice for modeling that emotion. Responses indicate that these 4 gestures were unambiguous in terms of the emotions they could describe. Anger is a particularly good example: 87% of users chose "H. pound in palm" as the most appropriate gesture for that emotion. Furthermore, 90% of users who chose "H. pound in palm" for anything chose it for anger (the other 10% of people who chose "H. pound in palm" chose it to model disgust). Trust had the least agreement between subjects; the largest group (30%) chose "G. touch the spines," as the most appropriate gesture, followed closely by 20% of subjects who chose "F. stretch the arms out," 17% of subjects who chose "D. hold by one arm and wiggle," and 13% each for "C. roll back and forth in hands" and "E. toss in the air."

Because of the wide range of responses for all but 4 emotions, we chose to focus on the 4 emotion–gesture pairs with the most clear "winner" when designing our working prototype.

5. PROTOTYPE

Based on our findings, we fashioned a prototype that could be manipulated in the ways we identified in our research. Our prototype had a rounded body (like the ping pong ball), bendable arms (like the scrunchy), and spiky hair (like the velcro hair roller). Our working prototype (figure 3) was created using a tennis ball and plastic tubes. A felt cover with plastic "hair" gave the prototype tactility. On the front of the tennis ball, a button, a full-color LED, and a photocell gave the prototype a "face." Inside the tennis ball we installed an accelerometer, a force sensing resistor, and a DC motor. The tube arms contained a flex sensor. Although a GPS unit was not included in this working prototype, ideally it would also be located inside the tennis ball.

The working prototype implemented the 4 strongest emotion–gesture pairs (joy, surprise, sadness, and anger). Joy is modeled by tossing Emlo in the air, surprise by covering Emlo's "face" with your hand and then removing it, sadness bending Emlo's arms down, and anger by pounding Emlo in your hand. To input an emotion, the user first pushes the button to put Emlo into a "receiving" state, indicated by a white light. This was meant to prevent accidental messages from being sent and to indicate that Emlo is ready to read a gesture. The user then performs a gesture and pushes the button a second time. Emlo's LED lights up with the color corresponding to the input gesture (*joy* = yellow, *surprise* = teal, *sadness* = dark blue, and *anger* = red), indicating that the message that has been transmitted.

5.1 Social Networking

The current prototype posts messages to a user's Twitter feed. The user's followers receive these messages in the same manner as other Twitter messages. Other implementations of Emlo could transmit messages using any number of social networks, a proprietary system, or more traditional communications systems. The Twitter message is composed of the user name, emotion, and location. A sample message might read: "EmloA is angry at 2312 McGee Ave, Berkeley, CA 94703 (37.86585780153977, -122.27731704711914)."

5.2 Customization

Although our research endeavored to facilitate the transmittal of a cardinal set of emotions using a natural and intuitive set of gestures, we wanted to allow users to tailor their experience with the device. The Emlo web application provides two basic customization options. First, Emlo users are able to re-map the emotion labels based on personal preference to produce messages that are more meaningful to them (e.g. *angry* could be changed to *frustrated* or *delighted*). The updated labels are used in future Twitter messages triggered by the corresponding gesture. Additionally, users are able to apply a plain-English label to any location at which they have previously used Emlo. These labels are then used in place of the street address for future Emlo updates originating from that location.

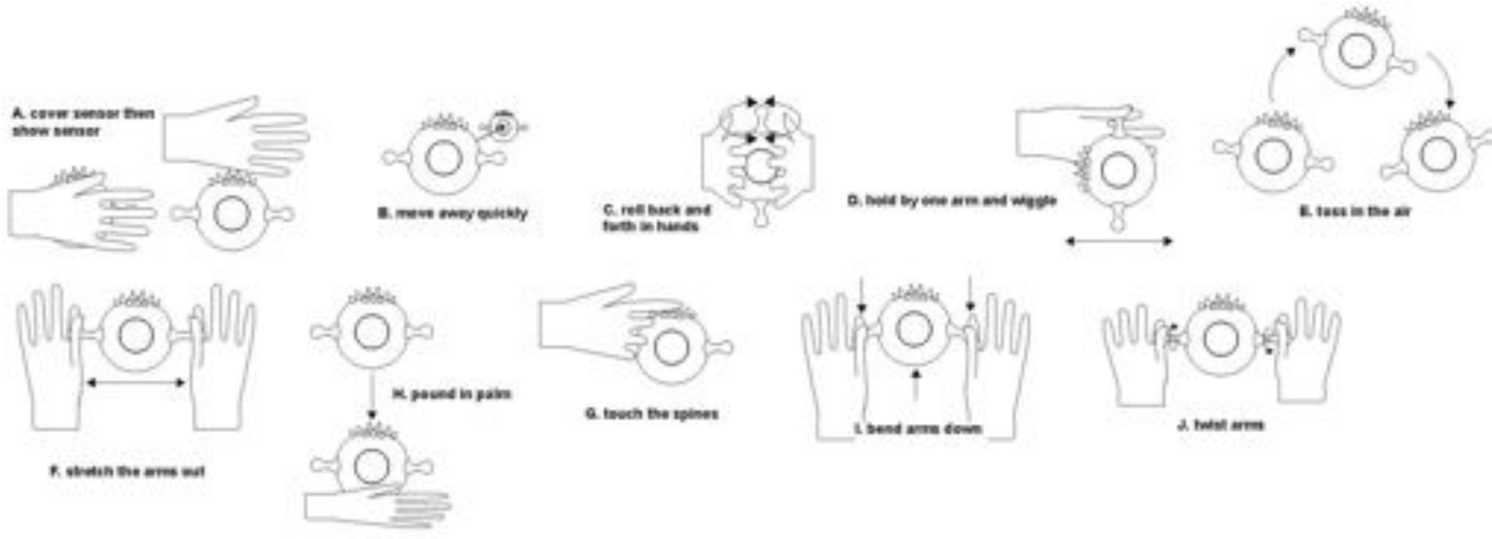

Figure 1. Gestures

	Joy			Trust			Fear			Surprise			Sadness			Disgust			Anger			Anticipation			
A. cover sensor then show sensor	0	**0%**	0%	0	**0%**	0%	4	**13%**	14%	20	**67%**	71%	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	4	**13%**	14%	28
B. move away quickly	0	**0%**	0%	0	**0%**	0%	16	**53%**	53%	4	**13%**	13%	0	**0%**	0%	7	**23%**	23%	1	**3%**	3%	2	**7%**	7%	30
C. roll back and forth in hands	5	**17%**	19%	4	**13%**	15%	0	**0%**	0%	0	**0%**	0%	2	**7%**	8%	2	**7%**	8%	0	**0%**	0%	13	**43%**	50%	26
D. hold by one arm and wiggle	1	**3%**	4%	5	**17%**	18%	2	**7%**	7%	2	**7%**	7%	1	**3%**	4%	9	**30%**	32%	0	**0%**	0%	8	**27%**	29%	28
E. toss in the air	21	**70%**	75%	4	**13%**	14%	1	**3%**	4%	2	**7%**	7%	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	28
F. stretch the arms out	3	**10%**	19%	6	**20%**	38%	1	**3%**	6%	1	**3%**	6%	0	**0%**	0%	3	**10%**	19%	1	**3%**	6%	1	**3%**	6%	16
G. touch the spines	0	**0%**	0%	9	**30%**	50%	3	**10%**	17%	0	**0%**	0%	2	**7%**	11%	1	**3%**	6%	1	**3%**	6%	2	**7%**	11%	18
H. pound in palm	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	0	**0%**	0%	3	**10%**	10%	26	**87%**	90%	0	**0%**	0%	29
I. bend arms down	0	**0%**	0%	1	**3%**	4%	2	**7%**	7%	0	**0%**	0%	23	**77%**	85%	1	**3%**	4%	0	**0%**	0%	0	**0%**	0%	27
J. twist arms	0	**0%**	0%	1	**3%**	10%	1	**3%**	10%	1	**3%**	10%	2	**7%**	20%	4	**13%**	40%	1	**3%**	10%	0	**0%**	0%	10
	30			30			30			30			30			30			30			30			

% in bold = percent of all subjects

% regular weight = percent of subjects who chose that gesture at all

Figure 2. Research Results Table

5.3 Output

Emlo transmits messages to the Twitter API through a custom Python program. Messages received from people the user is following also activate Emlo. Emlo will buzz notifying the user that a friend has created a new message, then light up in the color corresponding to the emotion the friend transmitted. The same Python script that posts status updates also sends regular requests to the REST-ful Emlo API to check for updates from other Emlo units. When new updates are detected, they are transmitted as numerical status codes back to the Emlo device. Arduino interprets the numerical status and causes the Emlo device to react appropriately.

As there is currently only one Emlo device in existence, we developed a web-based interface to simulate the existence of other Emlo devices and users. Using this interface, a user can click on a map (implemented through the Google Maps API) to specify a location, specify the user that is "gesturing" and specify the emotion to be transmitted. The status update is then processed in the same manner as the updates from the actual Emlo device.

6. ANALYSIS

Our project hinged on the ability of users to physically model emotions in an intuitive manner using our device. We found strong agreement between gestures and emotions for the emotional concepts we chose to model, though the others were notably less clear. This lack of agreement poses a significant challenge to constructing a full set of intuitive emotion–gesture pairings and suggests the necessity of a customizable set of gestures for a full-featured interface. We focused on the strongly correlated gestures for our prototype; while we did allow users to specify labels for different gestures through the web interface, they were unable to customize the gestures themselves. Future expansion may allow users to both make up their own gestures and to designate what they signify.

It remains to be seen how or if users would want to engage with Emlo in their daily lives. We were only able to construct one prototype, and due to hardware constraints, it was tethered to a single location. As a result, serious field testing was impossible. In order to more fully explore this concept we would need to fabricate a pool of devices to distribute among existing networks of individuals, then monitor the use of the devices over a period of weeks. One test we've considered is to distribute Emlo units to each resident on one floor of a dormitory (~30 students), and ask the residents to use the devices for one month. Following the test we could both analyze usage data to see how widely the system was used, what types of messages were transmitted, and what level of customization was employed. Additionally, interviews conducted at the end of the test could unearth reasons for use or lack of use, along with unexpected use cases. Many features in the existing Twitter system are a result of Twitter users repurposing existing tools in ways the designers never intended; it is conceivably that we might find such behavior with Emlo as well.

7. CONCLUSION

Our project explores the realm of real-time, intuitive, tangible communication, though there is still much to discover in the field. More research is warranted in determining the type and granularity of personal data users are interested in disclosing and to whom they want to disclose it. On the input side, it remains to

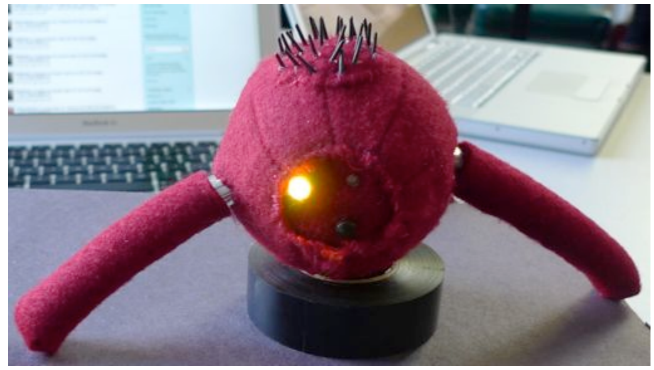

Figure 3. Emlo Working Prototype

be seen whether the immediacy of gestural input overcomes a reduced vocabulary. Finally, future research could explore ways to expose the rich emotional/location data to users. The Emlo device itself could potentially communicate different facets of the behavior of other in-network Emlo units to give the user more granular information without requiring a visit to the Twitter website. On the other hand, some data might be more interesting once aggregated; visualizing sentiment by location over a community of users is inherently interesting, and knowing how users feel in different types of spaces at different times might have broader applications to fields as diverse as city planning and psychology. Given that the signals generated by Emlo contain time, location, and sentiment data, the potential applications are boundless.

8. REFERENCES

[1] Picard R. W., Affective Computing. MIT Press, 2000.

[2] Kapur, As., Kapur, Aj., Virji-Babul, N., Tzanetakis, G., and Driessen, P. F. Gesture-based affective computing on motion capture data. In *ACII 2005*, Springer-Verlag Berlin Heidelberg (2005), 1-7.

[3] Paiva, A., Prada, R., Chaves, R., Vala, M., Bullock, A., Andersson, G., and Hook, K. Towards tangibility in gameplay: Building a tangible affective interface for a computer game. In *International Conference on Multimodal Interfaces 2003*, ICMI (2003), 60-67.

[4] Mubin, O., Al Mahmud, A., and Bartneck, C. TEMo-chine: Tangible Emotion Machine. In C. Baranauskas, P. Palanque, J. Abascal & S. D. J. Barbosa (Eds.), *Human-Computer Interaction—INTERACT 2007, LNCS 4662* (pp. 511-514). Berlin: Springer.

[5] Wensveen, S., Overbeeke, K., and Djajadiningrat, T. Touch me, hit me and I know how you feel: A design approach to emotionally rich interaction. In *Designing Interactive Systems 2000*, ACM Press (2000), 48-52.

[6] Wensveen, S., Overbeeke, K., and Djajadiningrat, T. Push me, shove me, and I show you how you feel: Recognizing mood from emotionally rich interaction. In *Designing Interactive Systems 2002*, ACM Press (2002), 335-340.

[7] Holleis, P., Rukzio, E., Kraus, T., Schmidt, A. Interacting with Tangible Displays. In *Workshop on Pervasive Display Infrastructures, Interfaces, and Applications*. Pervasive 2006 (2006).

[8] Plutchik, R. *Emotion: Theory, research, and experience*. Vol. 1. Theories of emotion, 1 (1980).