
Toward Lighthearted Mobile Non-verbal Expression

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Abstract

We describe an evolution of methods for non-verbal communication and expression using mobile devices. The first method utilizes the capability of mobile phones to send still pictures over a data network. In the second method, we send a sequence of pictures over the network in order to create an animation, as a more dynamic means of expression; we also include the sending of an indication of skin conductivity response. Finally, we examine the potential of mobile phones to send messages to animatronic agents, which, upon receiving these messages, can move and make sounds to exhibit certain emotions and states.

Keywords

Mobile communication, interaction design, computer-mediated communication, robotic user interface, physical embodiment

ACM Classification Keywords

H5.2. [Information interfaces and presentation (e.g., HCI)]: User Interfaces: Interaction Styles.

Introduction

Mobile phones are no longer used solely for making and receiving phone calls and voice mail messages. Text messaging via mobile phones has grown extremely popular as a communications medium, especially among teenagers [2]. Now with the increasing

popularity of camera phones, it is also possible to engage in multimedia messaging, or sending photographs via mobile phone [6]. There are, in fact, many instances in which it is more suitable to send a text or a picture message as a means of exchanging information, rather than making a phone call. Text and multimedia messages have the advantages of being more discreet and less disruptive than regular mobile phone calls; no one can overhear them, and it is possible to send and receive them in situations in which talking on the phone is inappropriate, such as in a movie theatre, or during a meeting.

Another common use of text messaging is to determine one's availability and coordinate times for a phone call [2]. This ensures that both parties will be available to talk at the specified time and it eliminates the need for phone tag, in which there are multiple voice mail exchanges before the two parties actually connect with each other synchronously.

Finally, text messaging is also used as an indication of shared awareness between two people; messages are sent primarily for staying in touch, rather than for exchanging information [6]. Picture messages are well suited to this purpose; their visual nature is a good fit for ambient communication. In fact, picture messages may be a better medium for just letting someone know you are thinking of them, rather than using text, which is a more explicit means of communicating specific information.

In our research, we took advantage of the visual and personal nature of photographs by using photos as personalized emoticons. In EMotoPhone, we captured pictures of our own faces showing different affective

states, and we sent these pictures to others via mobile phone to show how we were feeling. EMotoPhone users could also send sequences of images, allowing for crude animations of emotions being acted out, such as winking, or sticking out one's tongue.

As an extension of EMotoPhone, we also created GalvaPhone, which allowed a user to send his/her current galvanic skin response (GSR) reading, as recorded by a galvactivator [7]. The user's GSR, which is a measurement of arousal, was represented in conjunction with the pictures on the phone, through changes in the background colors of the pictures.

Finally, we moved from 2D animated pictures to 3D movement via a physical animatronic agent, in this case a monkey. This project, known as Monkey Business, involves sending messages over a data network to a robotic monkey via a networked computer. If the recipient is close to the monkey, s/he will receive the message via the monkey's movements and sounds, rather than via mobile phone. All of these projects are described in more detail in the following sections.

EMotoPhone

EMotoPhone explores a means to communicate affective information non-verbally, such as letting a friend know you are thinking of him by sending him a picture of you waving, or letting him know that something has upset you by sending him a picture of you making an angry face. Figure 1 shows two examples of EMotoPhone icons.

Non-verbal information can also be used to precede a phone call, providing contextual information about the

call before the recipient even decides whether to answer. For instance, if I wanted to call a friend to share some gossip, I might first send an animated EMotoPhone picture of my winking face, as shown in Figure 2. My friend would then have information about the nature of my call before even picking up the phone, and could anticipate the tone of the phone call. On the other hand, if I sent my friend an EMotoPhone picture of myself pouting, and she was not currently in the mood to talk to a sad person, she could decide not to take my call, based upon the affective information I had provided her. Thus, EMotoPhone can be used not only to determine one's availability for a phone call in terms of time, but also one's emotional availability for a potentially emotionally-charged phone call.

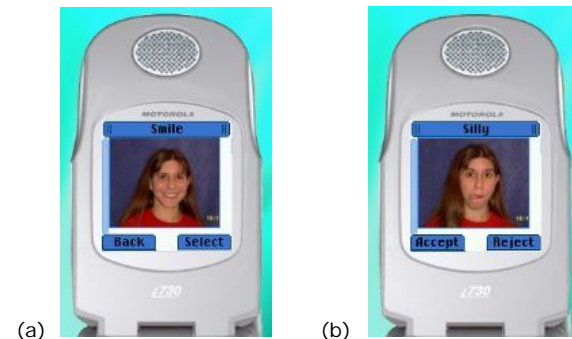


Figure 1: EMotoPhone. In (a), the user is deciding whether to select a smiley face to send. In (b), the user has received a silly face, and can choose whether to accept or reject a phone call from the sender.

GalvaPhone

One problem with EMotoPhone is that the emotions sent by the user are all self-reported. EMotoPhone users may try to deceive their recipients by choosing misleading faces, perhaps in order to entice recipients

to answer a call that they would otherwise ignore. We wanted to add another component to EMotoPhone that could automatically sense something about the user's current affective state, and send this information over the phone, in addition to the user's self-reported emotion. To do so, we decided to incorporate a galvactivator into the system.



Figure 2: An example of a “wink” animation in EMotoPhone – a sequential display of these images creates a winking effect.

A galvactivator is a special glove, shown in Figure 3, which measures one's galvanic skin response (GSR) via electrodes that press against the palm of one's hand [7]. A GSR reading, which indicates how well one's skin conducts electricity at any given moment, provides a measurement of arousal, an important aspect of emotion. It is important to note however, that arousal is not the same thing as affect. Rather, arousal indicates emotional stimulation or initiation; highly arousing situations also tend to be more memorable and compelling than low-arousing events.

We decided to use the same EMotoPhone faces in GalvaPhone, coupled with a changing background color to portray arousal, as measured by the galvactivator. A neutral grey background indicates low arousal, a

background that changes from grey to pink indicates medium arousal, and a background that changes from grey to pink to bright red indicates high arousal, as shown in Figure 4.

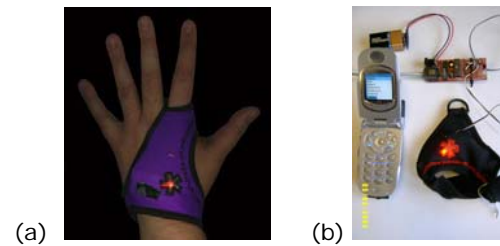


Figure 3: (a) A galvactivator glove worn on one's hand. (b) A galvactivator connected to a mobile phone via serial port.

Unfortunately, when GalvaPhone was exhibited during an open house demonstration, most people confused the concept of arousal with emotional intensity; they tended to think that the background color designated the strength of the emotion, rather than arousal, which is more a measure of how recently the emotion was activated. Despite this problem, GalvaPhone is a good initial attempt at automatically detecting information about a user's current affective state before sending it, instead of relying on users themselves to be completely truthful about their feelings.

Physically Embodied Agents

For our next endeavor, we experimented with a more novel medium of emotional expression; we decided to take our 2D emotional animations and represent them in the physical world, via animatronic agents. This work was inspired by Marti's research with physically embodied agents [4]. The embodied agents exist in the physical world alongside humans, and their physical

presence allows them to interact with people in a potentially more expressive, intuitive, and human-like manner. Marti found, through building an animatronic parrot, bunny and squirrel, that people exhibited strong attractions for these agents, and thus we decided to continue our research along this vein [4].



Figure 4: The progression of screens shown when someone is happy and exhibits high arousal, as measured by the galvactivator glove.

Monkey Business

We chose a monkey, as shown in Figure 5, as our expressive animatronic agent for several reasons. First, monkeys have more intelligence than most animals, and thus, humans might trust monkey agents to convey information more than they might trust other animal embodiments. Second, monkeys suggest an air of lighthearted playfulness, and this lightheartedness complements the informal nature of communication that our system is meant to promote.

We constructed the animatronic monkey from a monkey puppet. We removed the stuffing from the puppet and replaced it with servo motors and aluminum rods to hold the motors in place. The monkey has five degrees of freedom – it can move its

head up and down, wave both arms, turn its body from left to right, and swing back and forth from its tail. Due to the mechanical difficulty of animating the face, and trying to reproduce the complex interplay of facial muscles, we decided to let the face remain static.

We took the six basic Ekman emotions [1] – happy, sad, angry, surprised, disgusted and fearful - and attempted to represent them with the monkey through its movements. We programmed the monkey to move in a different way for each emotion - swinging back and forth to represent happiness, hiding its head in its hands to represent sadness, etc. We realized that the addition of sound would further bring the monkey's expressions to life, so we edited accompanying sounds, based on recorded chimpanzee vocalizations, to clarify each emotional expression.



Figure 5. An animatronic monkey used in the Monkey Business project.

Users of the system can choose which emotion the monkey will express using a Java application on a mobile phone. The phone sends a message to the IP address of a networked computer, which in turn, instructs the monkey how to move and which sounds to make through a serial port connection. Thus, users can control the monkey remotely with a mobile phone. The recipient receives the message via the monkey's

behavior. Accordingly, we have dubbed these 3D animated messages "behavior messages", as opposed to text, picture, or voice messages. Though not yet implemented, we envision using audio cues to specify the sender of the message.

User Study and Results

We conducted a short user study with the monkey to determine whether its emotional representations were intuitive, and whether it was a good tool for expression in general. We had 8 subjects in total, ranging in age from 20 to 50. In the first part of the study, we demonstrated each of the monkey's six emotion sequences for the subjects, and asked them to write down what they thought the monkey was trying to express. In the second part, we again demonstrated each emotion sequence for the subjects, but asked them to choose an emotion from a closed set of the six Ekman emotions. Finally, we asked the subjects a few brief survey questions. For each subject, we changed the order in which we demonstrated the emotions, but kept the order consistent between the first part of the study and the second.

We found that the responses to the different emotions varied considerably in the first part. In the second part, every subject correctly identified the happy emotion, and 7 out of 8 correctly identified the sad emotion. Subjects were less successful in identifying the other four emotions, with a 50% success rate or less for angry, fearful, disgusted and surprised.

We believe the fact that the monkey is cute and appealing introduces an inherent bias toward positive emotion. Even though we thought its static facial expression was neutral, some subjects referred to the

fact that the monkey seemed to be constantly smiling. One subject wrote that the monkey's "smiling face always makes me feel it's cute and cheerful". Therefore, when the monkey expressed happiness, its face also looked happy and was thus congruent with the corresponding sounds and movements; this allowed the happy emotion to be easily identified.

Conversely, when the monkey expressed sadness, it hid its face from view; thus its perceived happy facial expression did not introduce a confounding factor to its sad movements and whimpering sounds. In all the other expressions, the monkey showed its face, which perhaps confused the subjects. For example, in response to the monkey's exhibition of "surprise", one subject wrote: "Sounds like it's asking for help, but when I saw its smiling face, it doesn't look like much in danger [*sic*]."

Conclusions and Future Work

Facial expressions are extremely communicative, and the user study showed us how much people rely on faces to interpret emotion, even when the expressive agent itself is not a person. It would be interesting to repeat our study using an abstract form with no face, instead of an animatronic agent. Given the appropriate resources, it would also be valuable to repeat our study with a more complex animatronic agent that can manipulate its facial expressions, to see if it is more effective than the monkey at communicating non-verbal messages in a lucid manner. Perhaps our first project, EMotoPhone, is really the best solution, as we use actual human faces instead of trying to represent them with non-human forms. There is still a great deal of work to be done in this realm, to determine how best to design these new means of mobile non-verbal

expression to be as effective as possible at getting their intended message across without causing confusion.

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