CheekTouch: An Affective Interaction Technique while Speaking on the Mobile Phone

Young-Woo Park
Department of Industrial Design,
KAIST, Daejeon, Korea
pyw@kaist.ac.kr

Chang-Young Lim
Graduate School of Culture Technology,
KAIST, Daejeon, Korea
cylim@kaist.ac.kr

Tek-Jin Nam
Department of Industrial Design,
KAIST, Daejeon, Korea
tjnam@kaist.ac.kr

CHI 2010, April 10–15, 2010, Atlanta, Georgia, USA.
ACM 978-1-60558-930-5/10/04.

Abstract
We present a new affective interaction technique, called CheekTouch, by combining tactile feedback, delivered through the cheek, and multi-finger input, while speaking on the mobile phone. We designed a prototype by using a multi-touch mobile device and a 4x3 vibrotactile display device. We identified six affective touch behaviors (pinching, stroking, patting, slapping, kissing and tickling) that can be exchanged through one another's cheeks while speaking on the phone. We mapped the affective touch behaviors on tactile feedback expressions of the vibrotactile display. Results of a preliminary user study suggest that our technique is positively evaluated by the participants and applicable to intimate and emotional communication.

Keywords
Affective interaction, emotion and affective user interface, cheek based interaction, vibrotactile feedback, mediated touch, multi-touch, mobile phone interface.

ACM Classification Keywords
H5.2. [Information interfaces and presentation (e.g., HCI)]: User Interfaces, Input devices and strategies, Haptic I/O.

General Terms
Design.

Introduction

In designing mobile phones, it has become critical to consider affective interaction [9]. The mobile phone became an emotional and social means. People use mobile phones more for informal and intimate purposes than for work or formal communication. On the other hand, touch is a powerful tool which enables affective interaction between humans. It is considered to be the most fundamental and primitive form of non-verbal communication methods. There is a growing interest on ways of incorporating touch in communication devices. However, as our daily social interaction is being mediated by mobile communication devices, it has become difficult to support affective interaction through touch when people are physically separated.

It is important to consider an affective interaction method that maintains natural voice communication. The voice is still the most frequently used channel for communication among other channels such as video and text. However, little has been studied on the ways to integrate touch as a means of affective interaction during voice communication. It is challenging because people cannot easily change modes of interaction or use other channels in parallel while focusing on voice communication.

The goal of this research is to propose and evaluate *a new affective interaction technique to support emotional and intimate communication while speaking on the mobile phone.* The new technique, called CheekTouch, uses cheeks as a medium of interaction. Tactile feedback is delivered on the cheek while people use multiple fingers as input while holding the mobile phone naturally.

Related Work

Mediated touch for mobile phone communication

Haans et al. explained mediated social touch which allows one actor to touch another actor over a distance by means of tactile feedback technology [10]. ComTouch presented a vibrotactile device sleeve that fits over the back of the mobile phone to transfer finger pressure into vibration [7]. This approach can be effective for presenting tactile information for mobile communication. However, using the pressure of one finger is quite limited to express dynamic affective information. Brown's research used Tactons [4], for presenting multi-dimensional information in mobile phone alerts [5]. But, delivering information only with the tactile channel can result in an abstract and incomprehensible language.

Mediated touch for emotional interaction

DiSalvo et al. presented Hug [8], a soft form cushion. By stroking or squeezing the device, the user can physically deliver emotional states to another user. And LumiTouch [6] enables emotional communication using a digital picture frame. When one user touches her picture frame, the other picture frame lights up. These researches show designs that express emotions with various touch behaviors. These are also highlighted that the uses of everyday objects are useful as a medium for emotional communication.

Technologies of tactile stimulation

Most widespread technology used in HCI is the offset motor used to generate vibrotactile stimuli. Also, there were attempts to deliver tactile stimulation similar to human-human touch. Kevin et al. presented tapping and rubbing. By moving actuators perpendicular and parallel to the user's skin, the prototype can tap and

rub the user [12]. Oliver et al. presented, BubbleWrap, which uses a matrix of electromagnetic actuators to provide different types of haptic sensations [3]. But these require high weight and voltages to actuate.

Many studies on tactile communication using mediated devices showed that touch is important for delivering non-verbal affective information on human to human communication. But little has been studied to enrich affective communication while speaking on the mobile phone. In addition, there has been limited research on intuitive detection and expression of tactile information for use in mobile communication. These issues need to be focused on in order to prevent arbitrary and abstract tactile communication.

Understanding Social Meanings of Cheek and Touch in Communication

Touching one another's cheek in communication can have various social meanings according to different touch gestures and level of intimateness. Its uses are also culturally diverse. If the cheek is touched by a stranger or person who has a lower social status, this can intend aggressive and impolite manner in Asian culture. On the other hand, cheek touch between intimate friends or lovers can intend more positive and playful affection in Western culture. Also, various types of touches have different symbolic meanings depending on the situation and the touched body part. Haans et al. suggested that a short touch by another person can elicit strong emotional experiences [10]. Touch behavior plays part in giving encouragement, expressing tenderness, and showing emotional support in non-verbal communication.

Proposed Technique: CheekTouch

Based on the review of related works and theories on social meanings of cheek and touch, we propose a new interaction technique, CheekTouch. It combines tactile feedback delivered via the cheek and multi-finger input while speaking on the mobile phone. It is natural to use because it maintains the posture of speaking on the phone. Also, adding a tactile interface on the cheek can compensate for non-verbal cues on voice communication [14]. If another audio signal is added for non-verbal cue while speaking on the mobile phone, then it might disturb communication and overlap with verbal signals. Also, if video signals are added, users have to move their devices from their cheeks to see the visual messages which could lead to missing verbal signals. Therefore, tactile interfaces on the cheek can enrich communication while speaking on the mobile phone.

Mapping Touch Behaviors onto Vibrotactile Patterns

To develop CheekTouch and the interface language with touch behaviors and vibrotactile patterns, we first selected six kinds of touch behaviors (patting, slapping, pinching, stroking, tickling and kissing) that can be expressed with multi-finger gestures and also felt on the cheek while speaking on the mobile phone.
The rationale for mapping input and output behaviors was to present one's intuitive expression of touches and also to deliver intuitive feedback onto one another. Those two must maintain synchronism while speaking on the mobile phone. Power, direction and position of touches are the elements to determine the pattern of vibrotactile stimulation to deliver intuitive feedback onto one another.

Type of touch	Meanings in social interaction
Patting	Comfort, Love, Farewell, Want for concentration
Slapping	Congratulate, Hard joke, Attention, Emphasize
Pinching	Tease, Playful, Intimacy
Stroking	Encouragement, Farewell, Love
Kissing	Love, Friendship, Appreciation, Farewell
Tickling	Tease, Intimacy, Love

table 1. Meanings of 6 touch behaviors in social interaction

figure 2. Example of expressing touch behavior while speaking on the mobile phone using index and middle finger

The selected six touch behaviors were extracted among Argyle's 16 kinds of touch behaviors that are considered to be the most common in human communication [2]. First, we selected the types of touches that can be expressed with multi-finger gestures (patting, slapping, pinching, stroking, shaking, holding, grooming and tickling). Because, we can intuitively express various touch behaviors on the mobile phone's screen using the same fingers that hold the phone while speaking on it. Then, we classified the types of touches that can be outputted on the cheek (patting, slapping, pinching, kissing, stroking and tickling). Because, we naturally use the cheek for mobile voice communication, the rich receptors on the cheek are suitable for detecting various affective finger gestures. Finally, five types of touches are classified as patting, slapping, pinching, stroking and tickling. We added 'kissing' because people from many cultures use this in common to give strong positive affection and also to indicate friendship to one another in communication. The social meanings of the classified six touch behaviors can be explained in Table. 1. This was based on the typical examples and enactment types of touches that Jones et al. identified in six different categories of meanings for individual touches (e.g., positive affection, control, playful, ritualistic, task-related, and accidental touches) [11].

Fig. 1 shows the mapping between touch behaviors and vibrotactile patterns. We used the index and middle finger (Fig. 2) for input, since those fingers are free to do gestures while holding the mobile phone for calling. For example, kissing was expressed by slightly gathering two fingers together (Fig. 1e).

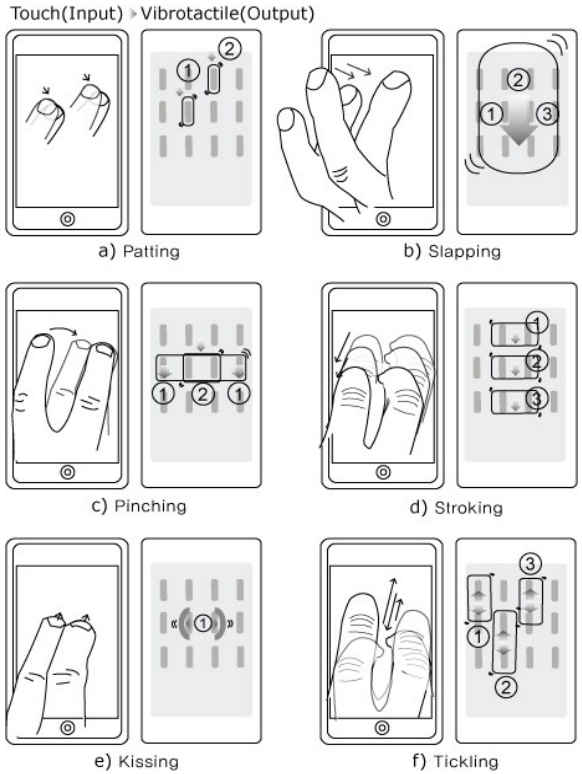

figure 1. Mapping between touch input with fingers and vibrotactile feedback pattern on the cheek

CheekTouch Implementation

Fig. 3 shows the structure of the prototype. We used a portable multi-touch mobile device (Apple's iTouch [1]) to express six types of affective touch behaviors while speaking on the mobile phone. We used the mobile device's screen as a mean for expressing touch behaviors and sending the values of the touched points to a PC with OSC (Open Sound Control) messages through Wi-Fi using OSCemote [13] application. The

received values were sent to a 4x3 vibrotactile display device made of 12 coin type actuators via OSC message analyzing software and an Arduino board. Each actuator was packaged with a sponge and soft clay to minimize the spreadability of vibrations. Therefore, this prototype enables one to express touch behaviors, such as 'patting', and feel the vibrotactile display pattern of 'patting' at the same time while holding the mobile device.

figure 3. Structure of CheekTouch prototype

Preliminary User Study

Purpose

A preliminary study of CheekTouch was divided into two parts. The first part was conducted to evaluate the usability of six touch behaviors while speaking on the phone. The second part was intended to examine the mapping appropriateness of six different vibrotactile feedback patterns on the cheek according to each touch behaviors.

Method and Procedure

Twelve university students (6 male, 6 female), between 24 and 29 years old, participated in the user study. We used the CheekTouch device (Fig. 3) for the study. In the first part, the experimenter shows a picture of the proposed method of six touch behavior input (Fig. 1) to participants. The participants express each touch behavior three times while thinking about the virtual scenario (e.g. patting: congratulate another for getting a job) given by the experimenter. After that, participants answer 13 questions categorized by five items which are usefulness, ease of use, ease of learning, satisfaction and intention of future usage through a questionnaire based on a 7 point scale (-3 ~ 3). In the second part, the experimenter randomly expresses six touch behaviors three times (total of 18 random touches), and the participants recognize the vibrotactile pattern on the cheek. Then, the participants distinguish which touch behavior was done by the experimenter on the multiple choice sheet.

	Usefulness	Ease of Use	Ease of Learning	Satisfaction	Intention of Future Usage
Avg	1.67	1.50	2.17	1.62	1.88
M	1.46	1.25	2.17	1.50	1.50
F	1.88	1.75	2.17	1.73	2.25

table 2. Average usability evaluation result of expressing touch behaviors while speaking on the mobile phone according to gender (N = 12, M: average of male, F: average of female, value between -3 and 3 on a 7 point rating scale)

Result and Discussion

In the result of the first part, it was generally positive in that the average of all five items were higher than 1.5 (Table. 2). Most participants reported that this method was easy to learn (Mean = 2.17) (Table. 2). Female participants reported the highest needs for future usage (Mean = 2.25) (Table. 2) of expressing touch behaviors while speaking on the phone. But three participants reported that expressing pinching behaviors was quite difficult (Mean = 1.25) (Table. 2). Also, nine participants reported that more touches like expressing shapes or unconscious touches should be included and not limited to six touch behaviors. These needs reflected the low results in the satisfaction category. An interesting result was that female participants reported more positively than male participants in all five items. This shows that satisfying needs for affective touches for females could be more

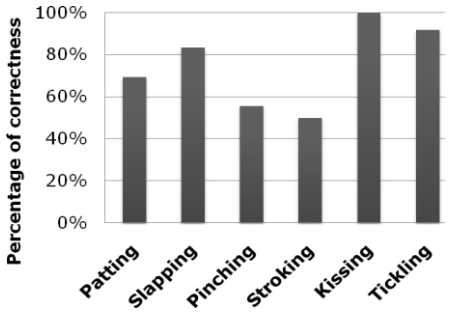

figure 4. Percentage of correctness on each vibrotactile patterns according to touch behaviors

important than males. Participants reported a low percentage of correctness on pinching (55.56%) and stroking (50%) touches than kissing (100%) and tickling (91.77%) (Fig. 4). They reported that the vibrotactile patterns of pinching and stroking were hard to distinguish. However, they reported high correctness for tickling. They felt that the sound and vibrating behavior of actuators acted like tickling with fingers.

Conclusion and Future Work

We made three contributions. First, we presented a new affective interaction technique, CheekTouch, in which its strength lies in its use of intimate tactile communication while speaking on the mobile phone naturally. CheekTouch allows users to communicate more emotionally by combining audio and tactile channels. Second, our preliminary user study informed us of positive future directions of CheekTouch and needs for improvement on touches with the vibrotactile stimulation. Third, we broadened the field of affective mobile interaction by understanding social meanings of cheek and touch in face-to-face human communication.

Future work will explore improving vibrotactile stimulation to provide more accurate and various feedback patterns to users. Also, we could improve this technique to exploit more intimate and emotional social interactions in mobile communication between lovers or close friends. We were limited to six touches but users can express unconscious touches or particular emotional shapes like a heart or a smile while speaking on the mobile phone.

References

[1] Apple I-Pod Touch. www.apple.com/ipodtouch/.

[2] Argyle, M. Bodily Communication. New York : International Universities Press (1975).

[3] Bau. O, Petreski. U, Mackay. W, BubbleWrap: a textile-based electromagnetic haptic display, *Ext. Abstracts CHI 2009*, ACM Press (2009), 3607-3612.

[4] Brewstar, S., Brown, L. M. Tactons: structured tactile messages for non-visual information display, *Proc. AUIC 2004*, Volume 28, (2004), 15-23.

[5] Brown, L. M. and Kaaresoja, T. Feel who's talking: using tactons for mobile phone alerts. *Ext. Abstracts CHI 2006*, ACM Press (2006), 604-609.

[6] Chang, A., Koerner, B., Resner, B., Wang, X. LumiTouch: An Emotional Communication Device. *Ext. Abstracts CHI 2002*, ACM Press (2002), 313-314.

[7] Chang, A., O'Modhrain, S., Jacob, R., Gunther, E., Hiroshi, I. ComTouch: Design of a vibrotactile communication device. *Proc. DIS* (2002), 312-320.

[8] DiSalvo, C., Gemperle, F., Forlizzi, J., Montgomery, E. The Hug: an exploration of robotic form for intimate communication. *Proc. RO-MAN* (2003), 1-4.

[9] Donald, A. Norman. Emotional Design (2004).

[10] Haans, A., Ijsselsteijn, W. Mediated Social Touch : A Review of Current Research and Future Directions, Journal of Virtual Reality (2006), 149-159.

[11] Jones, SE., Yarbrough, AE. A naturalistic study of the meanings of touch. Communication Monographs (1985), 19-56.

[12] Kevin, A., Patrick, B., Willam, G. G., James, D.H., Tapping and rubbing: exploring new dimensions of tactile feedback with voice coil motors, *Proc UIST*, ACM Press (2008), 181-190.

[13] OSCemote I-Phone application. http://www.appstorehq.com/oscemote-iphone/.

[14] Rover, A.F, van Essen, H.A. HIM: A Framework for Haptic Instant Messaging, *Proc. CHI 2004*, ACM Press (2004), 1313-1316.