Designing a Multimodal Haptic Device for Virtual Kissing

Emma Yann Zhang
City University London
London, UK
Imagineering Institute
Iskandar, Malaysia
emma.zhang@city.ac.uk

Adrian David Cheok
City University London
London, UK
Imagineering Institute
Iskandar, Malaysia
adrian@imagineeringinstitute.org

ABSTRACT
This paper presents the design and applications of an innovative haptic kiss device which simulates realistic kissing sensations through haptic, smell and other sensory stimuli. This device allows humans to express intimacy and emotion remotely with each other through mediated kissing, and also acts as an embodied agent for intelligent social robots to share physical intimacy with humans.

Author Keywords
multimodal device; haptic; kiss transmission; affective communication; human-robot interaction

ACM Classification Keywords
H5.2. User Interfaces: Haptic I/O.

INTRODUCTION
This paper presents the design and applications of an innovative haptic kiss device, named Kissenger, which simulates realistic kissing sensations through haptic, smell and other sensory stimuli. The device has a lip-like interface that interacts with a human user and senses the lip pressure of the user during a kiss. A micro linear actuator array underneath the lip surface generates real-time dynamic force feedback on various points of the the user's lips to replicate the haptic sensations of kissing.

This device allows humans to express intimacy and emotion remotely with each other through mediated kissing. It bridges the gap between traditional digital communication model, which has been focused on language and verbal information, and natural human communication, which largely depends on our body and senses to transmit meaningful non-verbal signals. In particular, physical touch [6] and smell [3] are the most effective channels to detect and communicate one's emotional states.

Besides enhancing the remote presence of humans, this device can also act as an embodied agent for intelligent social robots to share physical intimacy with humans through virtual kissing. This will result in new types of human-robot interaction, where humans and robots are able to communicate with each other on an emotional level, and establish intimate and humanistic relationships.

DESIGN FACTORS
Several important factors are taken into consideration in designing the haptic kiss device. These factors are also applicable to other affective haptic systems designed to facilitate intimate and emotional communication.

Type of Haptic Stimulation
Vibrotactile stimulation is most commonly used in many haptic systems [2,9] as vibration motors are lightweight, cheap and easy to control. However, using vibrational patterns or intensities to represent human touch does not exploit the rich emotional effects of the touch medium, but rather using it as a low-bit symbolic channel. The conveyance of emotion through the touch channel is immediate and does not go through any encoding [12]. A good example is the Huggy Pajama [11], which simulates a more realistic hugging sensation by using pneumatic actuators to generate pressure instead of vibrations. Hence the haptic feedback generated by the kiss device should reflect both the forces and movements felt by the lips during real kissing. We designed an array of micro linear actuators strategically positioned across the input surface to replicate the forces and movements of the human lips during kissing.

Physical Shape and Aesthetic Qualities
To achieve an appropriate level of embodiment, the physical shape of the haptic device should be informative and recognizable, such that it resembles a specific gesture or body part of the physical interaction it is designed for [2]. However, the design should strike a balance between simplistic and realistic, as a robot or robotic device with features with a high level of human likeness could easily be perceived as creepy or uncanny [10].

The material and aesthetic qualities are also crucial factors that affect the user's engagement and acceptance, especially in public use [8]. The texture of the lip surface that comes in direct contact with the user's lips has to be soft and flexible to mimic the texture of human lips. Materials such as silicone rubber will be a good choice for making a skin-like surface. The device will be designed in a way that users will feel comfortable kissing it and even using it in public.

Smell
Besides its profound effects on emotion [3], smell also plays a significant role in intimate interactions, and is believed to contribute to the bonding and mate assessment functions of kissing. Our body odour contains pheromones, which carry signalling information of our emotional and physiological states [3]. Pheromones allow infants to

identify their mothers [1]. Females use pheromonal cues to access their sexual compatibility with males by detecting a class of genes called the MHC present in body odours [13]. The exchange of pheromones occurs during close physical contact like kissing, hence leading to the effects of bonding and mate selection. Emitting body odour or pheromones from the kissing device not only creates a stronger sense of physical presence but also enhances bonding.

Temperature

Our perception of touch exhibits a dependence on temperature. As temperature varies, the mechanical properties of our skin are affected and the somatosensory responses to haptic stimuli change [5]. Similarly, the temperature of an object could also affect our emotional responses when touching the object. Heat is an effective channel in conveying intimacy in a remote touch system [4]. It is more natural and sensual to kiss a warm, soft surface than a cold one. Heating up the lip surface close to body temperature could enhance the realism of the system.

USER APPLICATIONS

Human-Human Remote Kissing

Kissenger is designed as an interactive device that connects to mobile phones to provide a communication channel for friends and families to maintain physical bonding and intimacy over a distance. With more generations coexisting and families spreading out in different parts of the world, physical interactions are not always available and people rely heavily on mobile communications. Kissenger will allow parents and children, or long-distance couples to remotely kiss each other while having a video chat on their mobile phones (Figure 1).

Figure 1. A user is sending a kiss with the Kissenger device while having a video chat on her mobile phone.

Remote kissing is an effective way to communicate with young children and people with physical disabilities or communication disorders when face-to-face interaction is not possible. Young children and babies do not have the language abilities to communicate efficiently using words, hence it is difficult for parents or grandparents to connect to their children or grandchildren while they are away.

However, babies have innate ability to understand the emotional meaning of touch, therefore the most efficient and intuitive way to communicate and bond with children is through physical touch, such as kissing. Similarly, kissing could also be an effective communication channel for people who have difficulties or have lost the ability to communicate through other sensory channels.

Human-Robot Kissing

This work has potential applications in the area of robotics and artificial intelligence. By extending a medium from the physical world to the digital space, making what was once feasible only in the physical world available in electronic forms, we will witness the emergence of new behaviour, definitions, cultures and relationships in an unpredictable way. New types of interaction and relationships will be formed between human and robots. Kissenger can act as an embodied agent for intelligent social robots to share physical intimacy with humans by giving a virtual kiss. This will require artificial intelligence to extend beyond logical data such that robots are able to process cognitive information and also possess emotional intelligence. Algorithms and models can be designed to teach robots how to kiss, and more importantly, how to understand the emotional meaning and pleasure of kissing. Eventually, humans and robots will be able to communicate with each other on an emotional level, express love and empathy, and establish intimate and humanistic relationships.

REFERENCE

1. Jennifer M Cernoch and Richard H Porter. 1995. Recognition of maternal axillary odors by infants. *Child Development*, 1593–1598.

2. Carl DiSalvo, Francine Gemperle, Jodi Forlizzi, and Elliott Montgomery. 2003. The hug: an exploration of robotic form for intimate communication. In *Robot and human interactive communication, 2003. In Proceedings. ROMAN 2003. The 12th IEEE international workshop on*, 403–408

3. Richard L Doty. 1981. Olfactory communication in humans. *Chemical Senses* 6, 4:351–376.

4. Daniel Gooch and Leon Watts. 2012. It's neat to feel the heat: how can we hold hands at a distance? *In CHI'12 Extended Abstracts on Human Factors in Computing Systems*, 1535–1540.

5. Christian Hatzfeld. 2014. Haptics as an Interaction Modality. In *Engineering Haptic Devices* (2nd. ed.), Christian Hatzfeld and Thorsten A. Kern (eds). Springer London, UK, 29-100.

6. Matthew J. Hertenstein, Dacher Keltner, Betsy App, Brittany A. Bulleit, and Ariane R. Jaskolka. 2006. Touch communicates distinct emotions. *Emotion* 6, 3:528.

7. Florian'Floyd Mueller, Frank Vetere, Martin R Gibbs, Jesper Kjeldskov, Sonja Pedell, and Steve Howard. 2005. Hug over a distance. In *CHI'05 extended*

abstracts on Human factors in Computing Systems (ACM), 1673–1676.

8. Shannon O'Brien and Florian'Floyd Mueller. 2006. Holding hands over a distance: technology probes in an intimate, mobile context. In *Proceedings of the 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments (ACM),* 293-296.

9. Young-Woo Park, Seok-Hyung Bae, and Tek-Jin Nam. How do couples use cheektouch over phone calls? 2012. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (AM), 763–766.

10. Hooman A. Samani, Rahul Parsani, Lenis T. Rodriguez, Elham Saadatian, Kumudu H. Dissanayake, and Adrian D. Cheok. 2012. Kissenger: design of a kiss transmission device. In *Proceedings of the Designing Interactive Systems Conference (ACM)*, 48-57.

11. James K.S. Teh, Adrian D. Cheok, Roshan L Peiris, Yongsoon Choi, Vuong Thuong, and Sha Lai. 2008. Huggy pajama: a mobile parent and child hugging communication system. In *Proceedings of the 7th International Conference on Interaction Design and Children (ACM)*, 250–257.

12. Rongrong Wang and Francis Quek. 2010. Touch & talk: contextualizing remote touch for affective interaction. In *Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction (ACM)*, 13–20.

13. Claus Wedekind, Thomas Seebeck, Florence Bettens, and Alexander J Paepke. Mhc-dependent mate preferences in humans. 1995. In *Proceedings of the Royal Society of London B: Biological Sciences* 260, 1359:245–249.