

Telepresence 6.S063 Engineering Interaction Technologies Prof. Stefanie Mueller | HCI Engineering Group







My goal is to understand what is a human. So that is the reason why I'm building a big human-like robot.

have a **mission** for your life!

telepresence:

a set of technologies which allow a person

- to feel as if they were present,
- to give the appearance of being present, and
- to have an effect at a place other than their true location.

motivation



travel is great. but how to **stay in touch** with our loved ones?







[kids react to old technology]







you **invent the next telepresence** system. how would it look like, what would it do?

<30s brainstorming>

you **invent the next telepresence** system. how would it look like, what would it do?

 \cdot involve more senses

today we use mainly audio and video

- letters -> hand-written words
- phone -> spoken words
- skype -> spoken words + video stream



but the presence of a person involves so much more!



touching, seeing, smelling, hearing, tasting = information

if we only have hearing and seeing, we are **lacking information...**

telepresence = bandwidth problem:

today information exchange is poor

without channels with sufficient bandwidth for haptic, visual, olfactory and auditory communication.

To increase the feeling of connectedness at a distance, all that's necessary is to **increase the bandwidth**.

let's look at some projects that increase the bandwidth

audio





Jogging over a Distance – Supporting a "Jogging Together" Experience Although Being Apart

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Abstract

Jogging is a healthy activity and many people enjoy jogging with others for social and motivational reasons. However, jogging partners might not always live in the same location, and it may be difficult to find a local jogger who runs at the same pace, we found through a survey. "Jogging over a Distance" allows geographically distant joggers to socialize and motivate one another by using spatialized audio to convey presence and pace cues, similar to the experience of running side by side. We hope our approach encourages active and prospective joggers to jog longer and more often, while simultaneously supporting friendships.

Keywords

Jogging, running, social support, mobile phones, Exertion Interface, physical, sports, active, exhausting, social interaction

ACM Classification Keywords

H5.2. Information Interfaces and presentation (e.g., HCI): User Interfaces.

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touch

hand holding...



both shake together

[Strong, Shaker '96]



both roll together (mechanically coupled)

inTouch: A Medium for Haptic Interpersonal Communication

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ABSTRACT

In this paper, we introduce a new approach for applying haptic feedback technology to interpersonal communication. We present the design of our prototype inTouch system which provides a physical link between users separated by distance.

Keywords

Haptics, interpersonal communication, force feedback, telepresence

INTRODUCTION

Touch is a fundamental aspect of interpersonal communication. Whether a greeting handshake, an encouraging pat on the back, or a comforting hug, physical contact is a basic means through which people achieve a sense of connection, indicate intention, and express emotion. In close personal relationships, such as family and friends, touch is particularly important as a communicator of affection.

Current interpersonal communication technology, such as telephones, video conferencing systems, and email, provides mechanisms for audio-visual and text-based interaction. Communication through touch, however, has been left largely unexplored [4]. In this paper, we describe an approach for applying haptic feedback technology to create a physical link between people separated by distance. The aim is to enrich current real-time communication by



Figure 1. inTouch conceptual sketch

Two geographically distant people can then cooperatively move the rollers, fight over the state of the rollers, or more passively feel the other person's manipulation of the device. The presence of the other person is thus made tangible [2] through physical interaction with the seemingly shared object. Since the two objects are not mechanically linked in reality, inconsistencies in their states must be resolved by the system agreeing on a single consistent state and then employing the motors to guide the objects into that state.

Objective

Unlike the majority of applications of haptic technology, inTouch is not focused on the simulation of physical forms. Much of haptics research is aimed at the creation of virtual objects with form, mass, and texture that can be felt through feedback from a haptically augmented device. With



force feedback

[Alhalabi, Telehandshake '01]

Tele-Handshake: A Cooperative Shared Haptic Virtual Environment

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Abstract

A cooperative shared haptic virtual environment, where the users can kinesthetically interact and simultaneously feel each other, is beneficial for many VR simulations. We have implemented a tele-handshake system that enables the participants to shake hands over a network and feel each other's pushing concurrently. A client-server architecture has been used with a specific implementation to meet the requirements of the haptic device. The users were able to feel each other simultaneously and shake their hands in an intuitive way. An objective evaluation based on force feedback was conducted. The results showed that the force feeling induced at the remote site was very close to that felt at the remote site. Also, a subjective evaluation based on a rating questionnaire is described. The results prove that the feeling was instant without any perceptible delay.

1. Introduction

The ability to feel objects in a shared virtual environment simultaneously can markedly enhance the effectiveness of many VR applications. Haptic cooperative virtual environments, where the users can simultaneously manipulate and haptically feel the same environment is in entertainment, which would allow the participants to kinesthetically interact with each other. This adds a new dimension of enjoyment and brings us one step closer to more realistic interactivity. Moreover, there will be a great benefit from such kinesthetic interaction in some sports training systems, especially the kind of multi-players sports that include direct contact between the players such as boxing, sumo wrestling, and football. The resulting virtual training system has the potential to be more realistic and efficient. In addition, there are many advantages of multi-hand manipulation that can be realized from daily life. More precise manipulation can be achieved using both hands [4]. Also, the manipulation with both hands is more efficient than one hand as has been mentioned by some ergonomic studies [5].

Buttolo et al. [6] proposed an architecture for shared haptic virtual environments where they pointed out the difference between collaborative and cooperative virtual environments. The collaborative environment is a sharing environment, in which the users take turns in manipulating the virtual object. Meanwhile, the cooperative environment is an interacting one, in which the users can simultaneously modify the same virtual object. According to these definitions most of the cooperative haptic environments that have been proposed in the last few years fall under the banner of collaborative haptic environments as all of them cannot support



hand is squeezed from the back

[Hemmert, Intimate Mobiles '10]

Intimate Mobiles: Grasping, Kissing and Whispering as a Means of Telecommunication in Mobile Phones

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ABSTRACT

In this paper, we explore how direct physical cues of interpersonal nearness can be achieved in mobile phones. Exemplarily, we present three novel means of communication for mobile phones: grasping, kissing and whispering. Reviewing the related work, we point to a research gap in direct physical near-body actuation in mobile telecommunication. To assess this gap, we present three prototypes that implement the proposed novel means of communication. We present initial user comments on the prototypes, which point to acceptance issues. We conclude in a set of research questions for future explorations in this field.

Author Keywords

Mobile phone, grasping, kissing, whispering, intimacy.

ACM Classification Keywords

H5.m. Information interfaces and presentation: Miscellaneous.

INTRODUCTION

Conceptualizing the past decades' changes in the ways in which we interact with computers, Dourish proposes *Embodied Interaction* [6] as the new paradigm: it combines *Tangible Computing* and *Social Computing*.



Figure 1: Grasping prototype, grasping telecommunication through pressure sensing and tightness actuation.

In their current form, mobile phones rely primarily on text, speech, and video communication. This may suit information exchange, but may lack the capacity to give users a feeling of physical proximity.

The question that this project seeks to answer is how mobile communication devices could provide users with direct physical cues of interpersonal nearness, in order to stimulate a discussion on how we want to communicate in the future.

BACKGROUND

Intimate interaction and physical telepresence are emerging fields of research. On the theoretical side, research includes hugging...



pressure vest

[Mueller, HugOverADistance '05]
Hug Over a Distance



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ABSTRACT

People in close relationships, who are separated by distance, often have difficulty expressing intimacy adequately. Based on the results of an ethnographic study with couples, a prototype was developed to test the feasibility of technology in the domain of intimacy. Hug Over a Distance is an air-inflatable vest that can be remotely triggered to create a sensation resembling a hug. Although the couples did not consider the vest to be useful in their daily lives, the prototype served to provoke and stimulate design ideas from the couples during participative design workshops. An additional and unexpected benefit was also found: the prototype enhanced the couples' understanding of the researchers' methods, suggesting that prototypes can serve as tools to make participatory design volunteers aware of their importance in academic research.

Author Keywords

Social interaction, haptic interface, tactile display, remote interaction, intimacy, participatory design, wearable computing, ubiquitous computing, design workshop.

ACM Classification Keywords

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

INTRODUCTION



Figure 1. Rubbing the koala sends a wireless Hug over a Distance executed through the vest.

RESEARCH QUESTION

Through the use of focus groups and design workshops, we sought to answer the question: What would an interface look like that is designed from the outset to facilitate and encourage social, even intimate interaction?

Research Plan

In our initial empirical study using focus groups and cultural probes, we examined personal interactions of six intimate couples [6]. We then set out to design and build a



pressure belt

[Tsetserukou, HaptiHug '10]



International Conference on Human Haptic Sensing and Touch Enabled Computer Applications EuroHaptics 2010: <u>Haptics: Generating and Perceiving Tangible Sensations</u> pp 340-347 | <u>Cite as</u>

HaptiHug: A Novel Haptic Display for Communication of Hug over a Distance

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1 25 1.2k

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Abstract

The motivation behind our work is to enrich social interaction and emotional involvement of the users of online communication media. The paper focuses on a novel haptic display HaptiHug for the representation of hug over a distance by means of online communication system supporting haptic feedback. The system integrates 3D virtual world Second Life, intelligent component for automatic recognition of hug cue from text messages, and innovative affective haptic interface providing additional nonverbal communication channel through simulation of social touch. Based on the real data (the pressure and duration of the interpersonal hug), the control system generates a signal that produces the feelings similar to the real hugging sensations. User study revealed that social pseudo-touch was successful in



[Noburiho, Hug Yourself '11]

Sense-Roid: Emotional Haptic Communication with Yourself

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Abstract—What type of emotions could be obtained if you were able to hug yourself? When we hug someone, we feel a sense of ease coming from emotions such as belief, security and love. However, it is not possible to hug oneself, who is the closest person. To experience this situation, we proposed a tactile device called the Sense-Roid. The system is composed of a lay figure with tactile sensors to detect the user's caressing motion, and a tactile jacket with vibrators and artificial muscles to reflect the caressing motion to the user. As a result, users caress themselves through our Sense-Roid. We believe that this self-caressing experience will enlighten people about the value of caressing.

Keywords-communication; haptic; intrapersonal; tactile

I. INTRODUCTION

Hugging someone gives people a great sense of ease. This fact indicates that haptic communications such as touching, stroking and caressing are one of the basic communication channels that sometimes are more effective than verbal or visual communications such as conversation or eye-contact.

On the other hand, there is a limitation to hugging. It

embracement in the 3D VR world such as Second Life [5], by feedbacking embracement to the user's chest, which is synchronized with the avatar's embracement.

All these devices have tried to achieve tactile communication with a remote user. However, tactile communication with oneself has not been investigated. Therefore, we developed a device to communicate with oneself.

III. TECHNOROGY

A. System configuration

The system consists of the humanoid device "Sense-Roid" and a tactile jacket. An overview of the system is shown in Figure 1.





Input Device : Sense hug and convey expressions





Air Actuating Module : reproduce hugging feeling on child



Color Changing : for parents to convey expressions or mood to child

pressure arm band

[Teh, Huggy Pajama '08]

Huggy Pajama: A Mobile Parent and Child Hugging Communication System

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ABSTRACT

Huggy Pajama is a novel wearable system aimed at promoting physical interaction in remote communication between parent and child. This system enables parents and children to hug one another through a novel hugging interface device and a wearable, hug reproducing pajama connected through the Internet. The hugging device is a small, mobile doll with an embedded pressure sensing circuit that is able to accurately sense varying levels of the range of human force produced from natural touch. This device sends hug signals to a haptic jacket that simulates the feeling of being hugged to the wearer. It features air pockets actuating to reproduce hug, heating elements to produce warmth that accompanies hug, and color changing pattern and accessory to indicate distance of separation and communicate expressions. In this paper, we present the system design of Huggy Pajama.

Categories and Subject Descriptors

H.5.2 [Information Interfaces And Presentation (e.g.,HCI)]: User Interfaces—Haptic I/O, interaction styles

1. INTRODUCTION

than words.

This problem is more pronounced for parents with young children. Children of these young ages need a lot of care, guidance and love [7]. Parents are generally able to reach their children by telephone or video phone, but communication purely by voice or video lacks the physical interaction which has been shown in previous research to be vital in effective communication [1]. Younger children might have difficulties understanding the true meaning of words spoken by their parents. As a consequence, we require a more effective way of remote communication between parents and young children. While it may not always be possible for parents to decline work commitments (such as long office hours and business trips) to spend time with their children, remote haptic interaction may be a feasible alternative when the parent must be away from the home. Although never intended to replace real physical hugging, we believe this system would be of great benefit for times when the parent and child cannot be at the same place. A very related scientific proof showed that infant monkeys grew up healthily when artificial contact comfort was given even in the total



pressure arm band

Design and Evaluation of A Wearable Remote Social Touch Device

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ABSTRACT

Psychological and sociological studies have established the essential role that touch plays in interpersonal communication. However this channel is largely ignored in current telecommunication technologies. We design and implement a remote touch armband with an electric motor actuator. This is paired with a touch input device in the form of a force-sensor-embedded smart phone case. When the smart phone is squeezed, the paired armband will be activated to simulate a squeeze on the user's upper arm. A usability study is conducted with 22 participants to evaluate the device in terms of perceptibility. The results show that users can easily perceive touch at different force levels.

ACM Classification Keywords

H5.2. User Interfaces: Haptic I/O, Theory and methods H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

communication. Under different contexts, touch can express greetings, support, comfort, love, anger, attention getting emphasis, etc [1]. Unfortunately, this expressive channel is largely ignored in current telecommunication technologies. If and how one may mediate human touch digitally, and how such mediated touch may be used in telecommunication merits significant exploration.

A survey of the literature on remotely-conveyed touch shows that while there is significant work in haptic touch devices, these devices are typically used as 'signaling channels' to convey brief symbolic information [2]. However touch is much more than a low-bandwidth symbolic signaling channel. When a kid hugs his parents, he is not signaling to make a "love you" statement. He did so just because he wants to and needs to. Touch can convey emotion/affect, emphasis etc. in unspeakable ways that cannot be easily expressed symbolically, if at all. This makes touch a unique channel in interpersonal communication. An essential research question of remote touch is how to maintain this uniqueness of touch in a telecommunications setting. We believe that touch is inherently multimodal and requires a contextualizing channel to



tugging

[Adcock, Tug n Talk '07]

Tug n' Talk: A Belt Buckle for Tangible Tugging Communication

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Abstract

Tug n' Talk is a prototype of a tuggable communication device, allowing for intimate communication between two individuals using tugging as a metaphor. In this paper we discuss the advantages of tugging over other haptic communication modalities, such as vibration, with a focus on input/output spaces and meaning construction.

Keywords

Tuggable, tangible, haptic, communication

ACM Classification Keywords

H.1.2: Models and Principles: User/Machine Systems., H.5.2: Information Interfaces and Presentation: User Interfaces. K.8.0: Personal Computing: General. J.7: Computer Applications: Computers in Other Systems.

Introduction

A tug is an intimate and quiet way to request the attention of another. Children will often seek the attention of a parent with a simple tug on their clothes. We believe there is significant potential to use tugging as a communication metaphor. A tug from a child on her father's shirt while he speaks on the phone can be easily processed without necessarily interrupting the flow of the phone call. Tugging also has a variety of



pressure sensors
+ heat sensor/reproducer + microphone/speaker

[Forlizzi, The Hug '03]

The Hug: a New Form for Communication

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hug



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Abstract

Recent advances in telecommunication and wireless networking technology have exploded the possibilities for remote communication between people.

We present a product called the Hug as a challenge to familiar telecommunication products. A visionary design born out of research with elders, the Hug addresses a very human need for physical closeness in remote communications. It uses the same network infrastructure as many appliances today, but places a new face on human product interaction.

Keywords

Telecommunication, Robots, Anthropomorphism, Conceptual Product Design, User Research, Interaction Design

Project statement

Our project on people and robots [1] is researching and developing compelling robotic products for the aging population. Specifically, we are interested in the design of products that allow elders to lead fulfilling and safe lives independent of institutional care. We believe as designers that we can shape future robotic products to be more appropriate and sensitive to the human experience. and kissing...



feel the kiss on the cheek (moisture sensor + actuated wet sponge in the device)

[Hemmert, Intimate Mobiles '10]

Intimate Mobiles: Grasping, Kissing and Whispering as a Means of Telecommunication in Mobile Phones

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ABSTRACT

In this paper, we explore how direct physical cues of interpersonal nearness can be achieved in mobile phones. Exemplarily, we present three novel means of communication for mobile phones: grasping, kissing and whispering. Reviewing the related work, we point to a research gap in direct physical near-body actuation in mobile telecommunication. To assess this gap, we present three prototypes that implement the proposed novel means of communication. We present initial user comments on the prototypes, which point to acceptance issues. We conclude in a set of research questions for future explorations in this field.

Author Keywords

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Figure 1: Grasping prototype, grasping telecommunication through pressure sensing and tightness actuation.

In their current form, mobile phones rely primarily on text, speech, and video communication. This may suit information exchange, but may lack the capacity to give users a feeling of physical proximity.

The question that this project seeks to answer is how mobile communication devices could provide users with direct physical cues of interpersonal nearness, in order to stimulate a discussion on how we want to communicate in the future.

BACKGROUND

Intimate interaction and physical telepresence are emerging fields of research. On the theoretical side, research includes



silicone lips register and replicate lip movements

[Kiss Transmission Device '11]



Lovotics

silicone lips register and replicate lip movements

[Kissenger '12]

Kissenger: Design of a Kiss Transmission Device

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ABSTRACT

In this paper, we present Kissenger (Kiss Messenger), an interactive device that provides a physical interface for transmitting a kiss between two remotely connected people. Each device is paired to another and can sense and transmit the amount of force that a user applies to a pair of lips which is recreated on the other device using motors. Kissenger was designed to augment already existing remote communication technologies such as video chat. The goal of this work is to promote intimacy between humans in long distance relationships. After presenting the background and motivation for the need of such a device, we describe the design process that consisted of three iteration stages, each with its own focus and evaluation. We then present a preliminary user study performed with seven couples that compare Kissenger to current video chat technology.

Author Keywords

Kiss transmission, tangible user interface, haptic interpersonal communication, remote tactile communication.

ACM Classification Keywords

H5.2. User Interfaces: Haptic I/O.

INTRODUCTION

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means of communication and serves as a powerful personal communication tool. However, communication devices that use touch are less common than devices that use audio and video [6]. Researchers around the world have been examining the possibility of embedding haptics into everyday human communication because by nature, humans are physical creatures that long for a physical touch.

Kissing is one of the most important modes of human communication as it conveys intimacy. It involves the physical joining or touching of lips by one individual on another individual's cheek, forehead, etc., to convey many deeply felt positive emotions such as respect, greeting, farewell, good luck, romantic affection, and/or sexual desire [27].

Considering the missing dimension of representing a kiss using current remote communication technologies, we aim to design a device to facilitate the exchange of emotional content between people who are physically separated. Despite the availability of haptic communication devices, not much attention has been given to the use of kiss as a mode of remote social interaction. We propose to address this vacuum and give humans a new dimension to express a kiss by augmenting their current remote communication methods with Kissenger.

taste

not much research here...



taste output device



LOLL_{io} – Exploring Taste as Playful Modality

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ABSTRACT

In this paper we describe an exploratory design study of the potentials of taste as a playful interaction modality. We present the design and implementation of LOLLio – an interactive lollipop that serves as a haptic input device that dynamically changes its taste. We conclude this paper with three basic principles for potential game designs, where we see how the interactive lollipop we have built can foster novel, playful game experiences.

Author Keywords

Taste, Gustatory Interfaces, Gustation, Food

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: User Interfaces

General Terms

Design, Theory, Human Factors.

INTRODUCTION

For many years HCI researchers have been exploring the benefits of different tangible interaction modalities and techniques. The research has mostly been focused around designing tangible artifacts to manipulate and directly or indirectly control some digital representation; e.g., playing a game, drawing an image or inspecting a digital 3D model. These kinds of artifacts usually provide tactile and visual feedback; that is, a representation of an object on a display can be controlled through a physical artifact. Using physi-





public spaces. Taste is associated with strong experiences and while in our society visual and auditive experiences are being exploited by designers for various entertaining activities, taste-based experiences are still and mainly associated with practices related to eating and drinking.

smell

same as for taste... heavily underexplored area...



digital scent technology:

- hard to direct the smell at the user
- doesn't disappear quickly

sensing + actuation

you always need both:

- sensing the input of the sender
- actuating the receiver



[Sawada '07]

BYU-BYU-View ~A Wind Communication Interface~

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1 Introduction

BYU-BYU-View is a novel interface realized with the symbiosis of the input/output of wind and the computer graphics. "BYU-BYU" is a japanese onomatopoeia for a howling wind. It adds a new element, that is, "wind", to the direct interaction with a user and a virtual environment, and the communication through a network, by integrating the graphic presentation with the input and output of wind on a special screen.



Figure 1 : BYU-BYU-View system. Application is virtual breakout.

This system brings the new communication medium of "wind" into the bidirectional interaction between the BYU-BYU-View uses "wind", the new communication medium to bring the different information from the acoustic or visual one. We aim at the establishment of the totally new interface that uses a communication medium of wind as an interaction system connecting people of distant places with the cutaneous sensation or as an interaction device with the virtual world.

2 Exposition

2.1. The core technology of BBV system

This system has three core techniques.

1. Synchronization of graphics and wind with the wind-permeable screen

- 2. Two-dimensional sensing and presentation of wind
- 3. A bidirectional interaction of wind

1. The screen of this device uses a special wind-permeable material. This screen, which Teijin Nestex limited developed, has 4 fibers in 1mm width and 150 μ m gaps among fibers so that it can breathe. Simultaneously, it can display as beautiful image as a normal movie screen. With this screen, we can integrate the input/output of wind and the projected image naturally.



being present without interrupting...

most interfaces are **synchronous interfaces** they require both people to simultaneously pay attention.

similar to having a phone call with each other.



synchronized beds

[Goodman, SensingBeds '03]

The Sensing Beds

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ABSTRACT

The Sensing Beds domesticate communications devices by placing them in the bedroom. The beds mediate between two romantic partners who are not co-located by sensing body position in each bed and using a grid of small heating pads to warm the congruent points in the other bed. As an experiment in telepresence, they bridge the physical distance between two people who would normally share a bed, but find themselves sleeping apart. As an experiment in slow technology and emotional communication, they articulate users' existing concerns about intimacy, trust and knowledge.

Keywords

Intimacy, body, limited communication, telepresence, networks

INTRODUCTION

Intimacy and distance are an ever-fruitful source of inspiration for networked projects, from *Feather, Scent, Shaker* (1996) [1] to *LumiTouch* (2001) [2]. Often these projects use multiple physical objects as "digital, but physical, surrogates" [3]. That is, they embody a

through the emotionally meaningful site of the bed. The bed, which usually unites a couple, here displays the presence of a distant loved one through heat. Sensors located in one mattress pad track the position of its occupant. The position data is transmitted every five minutes to the other bed where heating pads are activated at the same coordinates. Each sleeper thus synchronously feels the ghostly warmth of the absent partner.

SLOW-TECH

The beds are an example of what has been called *slow technology* [4]. They respond over hours, not milliseconds. Their effects mimic the pace of unenhanced life: the slow warming of a newly occupied bed; the cooling of an empty one. Designed to frustrate conventional expectations of immediate, obvious interactivity, the beds react sluggishly and unpredictably. Their artificial heat can be confused with their owners'; their communication is at best delayed by seconds, even minutes.

Slow technology regards the passing of time as an opportunity for engagement not an obstacle to be



synchronized cups

[Chung, Lover's Cups '06]

Lover's Cups: Drinking Interfaces as New Communication Channels

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Abstract

This paper shows how computer interfaces can enhance common activities and use them as communication method between people. In this paper, the act of drinking is used as an input of remote communication with the support of computer interfaces. We present Lover's Cups which enable people to share the time of drinking with someone they care about in different places. Using a wireless connection, an otherwise ordinary pair of cups becomes a communication device, amplifying the social aspect of drinking behavior.

Keywords

Drinking Interfaces, Implicit Interaction, Communication, Ambient Media.

ACM Classification Keywords

[H5.2 User Interfaces] Interaction Styles.

Introduction

In human relationship, not only explicit communication with voices or texts but also recognizing common activities are important; people notice that their friends are walking by, drinking coffee, or sighing, and respond to these common activities to build more intimate relationship. Can such behaviors be part of a computer

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synchronized robotic phones

[Sekiguchi, RobotPhone '01]

RobotPHONE: RUI for Interpersonal Communication

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ABSTRACT

RobotPHONE is a Robotic User Interface (RUI) that uses robots as physical avatars for interpersonal communication. Using RobotPHONE, users in remote locations can communicate shapes and motion with each other. In this paper we present the concept of RobotPHONE, and describe implementations of two prototypes.

Keywords

Robot, Interface, Interpersonal communication, Physical avatar, Bilateral Servo, RUI

INTRODUCTION

For a long time, robots have chiefly been considered as machines that perform work in the place of human beings, such as industrial robots. However, considering the characteristic of their physical embodiment, robots can also be recognized as interfaces for human beings. The concept of using a robot as an interface between the real world and the information world can be referred to as a Robotic User Interface (RUI). An intelligent robot as a physical entity for an Artificial Intelligence agent or a haptic feedback robot arm used in VR systems are good examples of an RUI.

In this paper, we propose RobotPHONE. RobotPHONE is a RUI system for interpersonal exchange that uses robots as agents for physical communication.

ROBOTPHONE

The RobotPHONE system employs robots as devices that are called *shape-sharing*. The shape and motion of remote

possible to have an object exist virtually in a remote place on behalf of user. RobotPHONE transfers the existence of the user not by attempting to transmit the user itself but to transmit the user's substitute.

Consider a mother giving her daughter a stuffed doll to keep her company at night. This is a form of communication aided by a physical entity. RobotPHONE can allow this kind of communication to become possible.

Initial prototype

As an initial prototype based on the RobotPHONE concept, we implemented an experimental system which has two snake-like robots for a shape-sharing device. Each snakelike robot has six parallel axes, and these axes make a right angle with the long side of the snake's body. Therefore, the range of body movement is limited to the two-dimensional plane, but the body itself represents a shape that can be easily modified by hand.





synchronized slippers

[Forlizzi, ComSlippers '06]

ComSlipper: An Expressive Design to Support Awareness and Availability



figure 1. ComSlipper offers emotionally rich communication by indicating presence and availability in a non-obtrusive way.

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Abstract

In our increasingly decentralized world, demands to maintain relationships over long distances continue to increase. It is more and more difficult to maintain a sense of connection with others, to communicate with others in an emotionally rich way, and to know whether one is available for initiating a conversation in an appropriate context.

This paper describes the design process and our solution to this challenge. The ComSlipper is a lightweight yet expressive sensible slipper that enhances the quality of computer-mediated relationships. The ComSlipper was developed using a human-centered design approach to better understand user behaviors and needs. The ComSlipper empowers the wearer to create a sense of connection to others. The wearer uses body gesture and tactile manipulation to feel and express emotions and availability to distant loved ones. The ComSlipper provides a natural and intimate way of communicating, and facilitates the development of intimate relationships.

Keywords

User-centered design, interaction design, presence, availability, awareness, expressive display, ambient display.



synchronized lights and heat

[Kowalski, cubble '12]

cubble: A Multi-Device Hybrid Approach Supporting Communication in Long-Distance Relationships

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ABSTRACT

Couples in long-distance relationships (LDR) want to keep in touch, share emotions and feel connected despite the geographical distance. Current approaches to solve this problem include dedicated objects, common communication channels and mobile applications (apps). To combine the advantages of all three approaches, this paper introduces a hybrid approach called *cubble*. *cubble* enables partners to share their emotions, simple messages and remote presence. The prototype offers color signals augmented with vibration patterns and thermal feedback. We performed qualitative user explorations, which show that users favor the hybrid communication concept and found that this fostered their intimate communication by providing emotional closeness.

Author Keywords

Long-Distance Relationships, Hybrid Interaction, Intimate communication

ACM Classification Keywords

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

General Terms

applications offering a dedicated omnipresent channel for couples and (3) traditional communication channels such as calls, emails or instant messaging (IM). These solutions come with advantages and disadvantages. While physical objects offer something tangible when a partner is away, people often do not want to carry extra items around [11]. Mobile apps are easy to bring along, but lack any physicality and are limited by the capabilities of the hosting device. Traditional channels can help couples to feel connected, but are not effective at facilitating intimate communication [7].

To leverage the advantages and overcome the shortcomings, we propose *cubble*, a hybrid communication concept. It consists of a stationary home-use object as well as a mobile application for on-the-go use (see Figure 1). The combination of these two client types offers a continuous, bidirectional (sending and receiving anytime, anyplace), exclusive (in contrast to social media which might even damage a relationship [18]) and private channel for couples. To examine this approach we implemented *cubble*, using colors and haptic tap patterns as ambiguous and self-assignable message and emotion templates for intimate communication. To provide a feeling of closeness, both partners can

others allow users to **asynchronously** communicate with each other



close the circuit with the finger sends a sms

[Werner, United Puls '08]

United-Pulse: Feeling Your Partner's Pulse

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ABSTRACT

This paper introduces a device that creates remote intimacy by the use of two rings named "united-pulse". Each ring can measure the wearer's heartbeat and send it to the partner's ring. Hereby, artificial corporeality is created between the couple. By means of a working prototype, united-pulse has been successfully tested. Among the 28 participants the prototype has attracted large interest. Through the heartbeat – the essential vital sign – a feeling of being very close to the partner is provided. Touching the ring allows a small moment of intimacy in situations where emotional support is needed.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: Haptic I/O, H.5.3 [Group and Organization Interfaces]: Synchronous interaction.

Keywords

Human-Machine-Interaction, Remote Intimacy, Design, User experience, Body-data, Tangible, Wearable, Digital Jewelry

1. INTRODUCTION

Within a partnership human beings are used to interact via tactile stimuli. "Touch is critical for [...] physical and mental wellbeing"[3]. Commonly such interpersonal communication is not available in case of spatial distance between the partners. In the following, a way to overcome spatial distance between the partners by means of tactile stimuli is examined. Within our studies we have been interested in whether it is possible to feel remote intimacy and whether there is a way to enable couples to share an intimate moment using the heartbeat as a bridge over distance. Moreover we wonder whether it is pleasant or irritating to feel close to the partner in this way without touching him or (aged 15 to 58 years), that live in a relationship for 4 to 33 years were asked what they miss most when their partner is not close by. The most frequent answers in descending order were: body contact (65%), voice (20%) and smell (15%). The awareness of not being alone is a further important part in the relationship, the participants answered. "It is essential to know that there is someone who thinks of me", said one female test person.

In addition the participants were asked how they express a sense of unity within their relationship. In the following some exemplarily answers: a picture in the purse, a picture on the cell phone, saved short-messages on the cell phone, a wedding ring or a tattoo. Moreover there are rituals that the participants employ, e.g. having a telephone-date at set hours (hear the partner's voice) or wearing a used t-shirt or a scarf with the partner's typical perfume (save the smell of the partner) [10].

Physical closeness is not provided by the above-described possibilities. According to the results of the interviews the unitedpulse ring would allow what most couples missed, the feeling of body contact. United-pulse makes it possible to experience sensual touch and the physiological presence of the loved person.

2. UNITED-PULSE CONCEPT-DESIGN

The "united-pulse" ring has been designed based on the aim to develop a device that allows people to share remote intimacy. At the beginning of the research-process, the most minimal sign of intimacy was searched for [9]. Inspired by pictures of a newborn baby that lies at the mother's breast, the meaning of the symbolism of heartbeat was analyzed [11].

On the one hand heartbeat stands for life and vitality [6, 3]. It might also be an indicator of how someone feels (nervous, sleepy)



heart rate monitor/inside
microcontroller and wireless



ambient displays

[Ishii, Lumitouch '01]

LumiTouch: An Emotional Communication Device

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ABSTRACT

We present the Lumitouch system consisting of a pair of interactive picture frames. When one user touches her picture frame, the other picture frame lights up. This touch is translated to light over an Internet connection. We introduce a semi-ambient display that can transition seamlessly from periphery to foreground in addition to communicating emotional content. In addition to enhancing the communication between loved ones, people can use LumiTouch to develop a personal emotional language.

Based upon prior work on telepresence and tangible interfaces, LumiTouch explores emotional communication in tangible form. This paper describes the components, interactions, implementation and design approach of the LumiTouch system.

Keywords

Ambient media, telepresence, tangible interfaces, emotional communication

INTRODUCTION

Photographs of loved ones are symbolic of a personal connection and provide a constant reminder of the emotional feelings contained in that particular snapshot of time. Couples who are living or working separately often gaze at a photograph of their loved one and wonder, "Are they thinking of me? If only I could share my feelings..."

Picture frames are used to display these photographs, to

LumiTouch focuses on communicating emotional content in addition to presence detection. LumiTouch is designed to be an asymmetric, bi-directional channel of communication. It is similar to the symmetric, haptic approaches embodied in inTouch [4], and handJive [5]. Until the recent introduction of web enabled devices, this particular combination of asymmetric (touch-to-light) and bi-directional data direction has been rarely explored in communication devices.

While existing technology already enhances the connections between people, most require active focused participation. New communication devices tend to be multimedia, supporting many different types of content (integrating text, audio, video). Over time, users feel the need to augment these existing communication mediums to convey emotional qualities. LumiTouch explores a design that solely supports emotional content.

IMPLEMENTATION

Part of the design emphasis was on what technology could be reasonably expected to operate in a user's home office environment. Figure 1 depicts the basic system components that are embedded in an ordinary picture frame.



persisting the message vs. letting it disappear over time

idea:

if the receiver does not pay attention, the **message ceases to exist** before being noticed... how would you **build a device** where the message disappears at some point? (go beyond mobile phone)

<30s brainstorming>



smell: vaporize essential oil

[Strong, Scent '96]





visual: feather is blown up the wind tunnel, then falls down

[Strong, feather '96]

Feather, Scent, and Shaker: Supporting Simple Intimacy

Rob Strong

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ABSTRACT

In this paper, we describe three experiments in designing for minimal, expressive communication. These are very simple networked devices that are aimed at supporting implicit, personal, and expressive communication, as opposed to the explicit, goal-oriented, and informative communication characterising most CSCW systems. We suggest that these prototypes open an interesting space for collaborative systems, and describe some of the issues and opportunities they raise.

INTRODUCTION

Systems supporting collaboration tend to share three characteristics: They rely on relatively explicit communicative acts, they stress the exchange of information, and they support goal-oriented activities.

In everyday life, on the other hand, sociality is often a more subtle and delicate thing. Think of being in the same room with a close friend or lover. There may be no explicit communication, but instead a myriad of more basic visual, auditory, and tactile links are shared. No information may be exchanged, but emotions, even simple contentment, may be expressed. And no goals may be pursued or met, but instead mere togetherness may lead to a feeling of warm companionship.

Could systems be developed to support this sort of intimacy at a distance? In this paper, we describe three prototypical systems designed to support simple, expressive interaction, and then discuss the issues and opportunities 1). It contains a small and quiet electric fan in its base, and a single feather that rests on an unobtrusive grill above it. When triggered by the absent partner holding the picture frame, the fan starts, wafting the feather into the air. The drifting feather is constrained by a clear, cone-shaped plastic enclosure extending from the base, and lifts and dips naturally as it catches the wind.

The combination of picture and feather provides an ephemeral, poetic experience of connection. Handling the picture object becomes an act of affection and reflection, made more poignant by the possibility of the other's awareness. Seeing the feather drifting in the air intimates the other's attention with a lightness and dynamic that reflects the transience of thought.



Figure 1: Feather

ephemeral user interfaces:

intentionally created to last for a limited time only. typically incorporate materials, such as water, fire, soap bubbles or plants.

A Design Space for Ephemeral User Interfaces

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ABSTRACT

In this paper, we present the novel concept of ephemeral user interfaces. Ephemeral user interfaces contain at least one user interface (UI) element that is intentionally created to last for a limited time only and typically incorporate materials that evoke a rich and multisensory perception, such as water, fire, soap bubbles or plants. We characterize the term "ephemeral user interface" and, based on a review of existing user interfaces that fall into this research area but have not been discussed under one common term before, we present a design space for ephemeral user interfaces providing a terminology for (a) *materials for ephemeral UI elements*, (b) *interaction* and (c) aspects of *ephemeral UI* this paper contributes to the ongoing research on materiality of user interfaces as well as on conceptualizing visionary interaction styles with novel materials.

Author Keywords

Tangible user interface, ephemeral user interface, materiality, ephemerality, interaction materials, soap bubbles, water, ice, fog, plants, food, fire, sand, clay, air, smart materials.

ACM Classification Keywords

H.5.2 Information interfaces and presentation (e.g., HCI): User Interfaces – Input devices and strategies, Interaction Styles.

General Terms

Design; Human Factors.



Figure 1. Examples for ephemeral user interfaces. Left: *Bit.Fall* by Julius Popp (courtesy Julius Popp Bit.Fall 2006 photo François Doury) [37], an ephemeral display made of water and light; middle: The *Soap Bubble Interface* [31] that offers bubbles as handles for interaction; right: *ThanatoFenestra* [32], a user interface that uses a candle's flame for input.

based interaction point of view, where the "goal is to give up reality only explicitly and only in return for other desired qualities" [13:205], user interface designers should start thinking about integrating ephemeral phenomena into HCI. Humans are used to and value the ephemeral: why should not also digital information be presented transiently? Could we even design systems that naturally grow and age? These aspects get increasingly important as we think about the information overflow and attention problem we face today caused by the ongoing integration of computer technology into all parts of our lives. To address this problem, researchers have developed the concepts of calm computing [39], ambient media (e.g. [11]) and ambient communication (e.g. [6]). When writing about a more humancentered perspective in HCI, Bannon discussed human needs for ephemerality and forgetting versus the prevailing technology-focused persistency of data [1].



how far can we push telepresence?

telepresence = bandwidth problem:

today information exchange is poor

without channels with sufficient bandwidth for haptic, visual, olfactory and auditory communication.

To increase the feeling of connectedness at a distance, all that's necessary is to increase the bandwidth.

that was our goal, right?



but do we really want full bandwidth?

do you think this is a good idea? how do you feel about this?

<30s brainstorming>



uncanny valley::

when human replicas look and act **almost**, but not perfectly, like actual human beings, it causes a response of revulsion among human observers.

"valley" = dip in a graph of the comfort level of humans as a function of a robot's human likeness.



still feels a little odd... but far away from the uncanny valley

[Double Robotics '12]

NewScientist



[Tobita, floating avatar '11]

Floating Avatar: Telepresence System using Blimps for Communication and Entertainment

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Abstract

We developed a floating avatar system that integrates a blimp with a virtual avatar to create a unique telepresence system. Our blimp works as an avatar and contains several pieces of equipment, including a projector and a speaker as the output functions. Users can communicate with others by transmitting their facial image through the projector and voice through the speaker. A camera and microphone attached to the blimp provide the input function and support the user's manipulation from a distance. The user's presence is dramatically enhanced compared to using conventional virtual avatars (e.g., CG and images) because the avatar is a physical object that can move freely in the real world. In addition, the user's senses are augmented because the blimp detects dynamic information in the real world. For example, the camera provides the user with a special floating view, and the microphone catches a wide variety of sounds such as conversations and environmental noises. This paper describes our floating avatar concept and its implementation.

Keywords: Computational blimp, avatar, floating interface, telepresence, communication, entertainment

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still clear that this is a robot

[Leonardo '12]



here we might feel uncomfortable

[ActroidF '11]



here we might feel uncomfortable

summary

telepresence:

a set of technologies which allow a person

- to feel as if they were present,
- to give the appearance of being present, and
- to have an effect at a place other than their true location.

what needs to be transmitted to give a feeling of presence?

- heavily context dependent...
- privacy concerns, misuse concerns...
- technology needs to be further developed!

#