MOBILITY AND EMOTIONAL DISTANCE: EXPLORING THE CEILING AS AN AMBIENT DISPLAY TO PROVIDE REMOTE AWARENESS

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Abstract

Living and working have become more and more mobile. This may have negative impacts on the quality of relationships. Recent research work on emotional communication showed the potential of new technologies to improve intimate long-distance communication. The goal of this project is to suggest the ceiling as a projection space in order to create a continuous feeling of remote awareness. We conducted a qualitative study to investigate how remote couples currently use technologies for communication. We also asked people about their preferences and desires concerning non-verbal information. People were most interested in knowing the emotional state of their partners and moreover, the fun factor of a new tool was very important to them. On the contrary, they rejected approaches that supported location, movement, or sound awareness. Based on these results we developed initial prototypes that can serve as a basis for future evaluations and further refinements.

1 Introduction

Technology-mediated communication allows us to communicate with family members and friends across the street or across the world [4]. However, existing communication devices only afford explicit communication and require people to have a reason for contacting someone [4]. Especially in intimate relationships people have the desire to receive and give a feeling of continuous connectedness [15]. While current technologies, such as SMS (Short Message Service) or instant messengers, have the capability to supply this desire up to a certain extend, the lack of everyday knowledge about intimate friends creates a sense of emotional distance [12]. Continuous and asynchronous connectivity can potentially improve the feeling of togetherness in relationships and awareness among distributed family members [13].

Awareness systems can also improve the atmosphere in office environments by creating a better sense of connectivity among colleagues [1]. However, the type of awareness information used in such environments is fundamentally different from the information that is necessary for mediating emotional awareness in home environments [4]. Our work specifically settles in the field of remote awareness for distributed couples.

We use a previously unexplored domain to provide a sense of awareness in a home environment: the ceiling. Many emotional communication applications are embodied as physical artifacts (e.g. [11, 2]). Other projects were developed that investigate the use of large-screen displays for remote awareness, e.g. located at the wall[1] or table [8]. Our goal was to explore a yet untouched terrain. The ceiling is typically ubiquitous, peripheral, and always visible. Thus, it represents a potential stage for displaying ambient information. We developed initial prototype applications as technology probes [6] into the design space. The design of the applications is directed by qualitative interviews.

2 Mobility and its Influence on Partnerships

To gain a basic understanding of the situation of distributed couples, we started with a review of literature about mobility in the European Union (EU) and surveys that specifically investigate the influence of mobility on partnerships. Current trends of the job situation in the EU show that mobility is an important requirement for professional development. A recent study [7] on mobility revealed that the lack of direct contact with family or friends is the main reason that discourages people from moving to another EU country (Fig. 1). Another study [10] identified five issues that are important for mobility. Expectations about relationship and family in respect to proximity, distance, togetherness, and personal freedom were the second most important issue. Two third of the participants stated that mobility had mainly negative impacts on the relationship. They argued that the need for intimate closeness and time spent together represent a disadvantage of job mobility. This can eventually lead to the end of the relationship. "Interactions that add to the consolidation of a relationship get a raw deal. There is no room for time to exchange experiences, discuss problems, ... or for spending time together" [10].

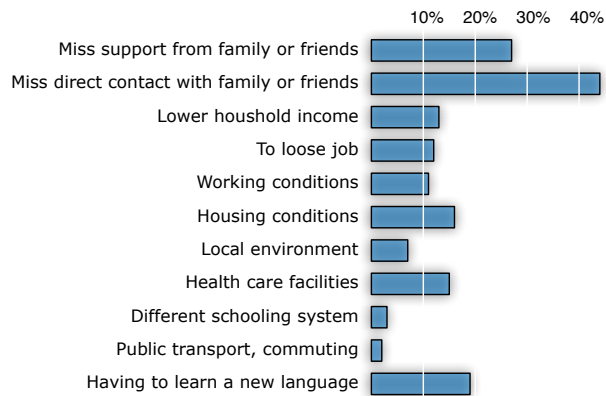[1]See the RemoteHome for an example: http://remotehome.org

Figure 1: Factors that discourage people to move to another EU country [7].

3   Motivation and Goal

The studies discussed above show that job mobility can have a negative impact on the quality of a relationship. The motivation of this work therefore is to investigate the potential of new technologies, specifically ambient projections, to improve the feeling of intimacy and togetherness over a distance. Our assumption is that applications that support emotional communication can counteract the lack of direct contact with family or friends (cf. Fig. 1). To verify this assumption we developed initial prototypes based on empirical data that can serve as technology probes [6].

4   Related Work

A variety of projects have been presented that address the research field discussed in this paper. Strong and Gaver [11] developed three prototypes that supported simple, implicit, and expressive communication. The first prototype, Feather, consists of a mobile picture frame and a feather. Lifting the picture frame while traveling triggers a fan at the home. The turning fan causes the feather to drift, giving the person at home a feeling of intimate connectedness. Scent is a variation of Feather. Interacting with the picture frame starts a heating element, which causes the vaporization of essential oil. The third prototype, Shaker, consists of two objects. Shaking one object causes subtle vibrations of the other object. The inTouch system [2] provides a physical link between distant people through tactile feedback. It also consists of two objects, each made of three rollers. When one of the rollers is rotated, the corresponding roll on the other object moves as well. This gives people the illusion that they interact with the same physical object over a distance.

Dodge [3] developed a computationally enhanced environment that supports emotional communication through aural, visual, and tactile modalities. The system consists of pillows that translate motion into heartbeat and physical presence into warmth. Dialogs and breathing are translated into movement of a curtain and visually enhanced through shadows. The Hug [5] is a similar system, based on a pillow, that translates a hug into heat and tactile vibration. It

was developed to support intimate communication between distributed family members.

Rüüg [12] is a plush rug that sends input from walking or sitting to a remote rug, which displays this input with color change. The system consists of heat-sensitive dye and heating-elements beneath the rug, thus providing a simple low-resolution display. It was developed to communicate presence and physical activity, thereby creating a sense of remote connectedness between close friends. Habitat [8] is an awareness system, which projects images of objects that are located on a table onto the table at the remote location. This short survey of existing projects suggests that there are two important design dimensions for systems that support remote awareness—embodiment and context of use. Entities for the first dimension are physical artifacts, computationally enhanced objects, and large-scale visualizations. The context of use can be one of the following: between distributed couples, close friends, or family members. Our work settles in the field of large-scale visualizations for distributed couples.

5   Design Interviews

Based on the analysis of related research projects we created design sketches of ceiling-based approaches for remote awareness. The goal of the design interviews was to evaluate those sketches and to collect design requirements and ideas for the final applications. The interviews also included open questions about current ways of communicating with a distant partner. We recruited 6 interview partners (3 female), aged between 22 and 36 years. Due to problems of reachability, we had to conduct two interviews via phone and two via an online platform. Two interviews were conducted face-to-face. For the remote interviews we set up a web page[2], which contained the design sketches (see Fig. 2 for an example).

All interview partners lived in a long-distance relationship. Two of them even lived on different continents. We interviewed both, mobile and non-mobile people. They saw their partner from one time per week to every three months. One of the participants used a variety of communication technologies, including phone, SMS, e-mails, and letters. The others either used e-mails or their phones to communicate with each other, depending on the available infrastructure and expenses of the respective service. SMS and letters were only rarely used (a few times a month). All participants expressed a desire for more communication. Three of them said that they would like to have video phones, so that they could see their partner. Overall, participants were most interested to receive information about the mood of their partner. This was followed by the desire of being able to send a non-verbal expression of thinking at each other. Activity and location awareness were of minor interest.

All participants except one rated the design sketches on a 5-point likert scale. The design sketch, which showed an application that provides the user with an awareness of the partner's current mood (sketch 5) was most appreciated.

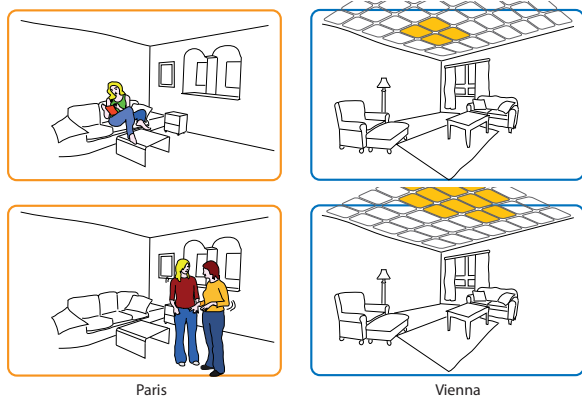[2]http://deco.inso.tuwien.ac.at/∼martin/ceiling/ (in german)

Figure 2: A design sketch for an emotional communication application, in which patterns of activity are displayed by panels mounted onto the ceiling.

This also correlates with the results from above concerning the ranking of non-verbal kinds of information. The possibility to send text messages, which are displayed on the ceiling (sketch 6) was rated second, followed by an application that supported interaction (sketch 7) over a distance. The other design sketches (activity (sketch 1), location (sketch 2), and sound awareness (sketches 3 and 4), and a ceiling-based variation of Habitat [8] (sketch 8)) were less attractive for our participants.

Though our study involved only five people, results show some shared tendencies towards certain applications. However, we identified also subtle differences between participants concerning specific applications. For example, sketch 8 was rejected by all but one. We see the reason for these variations in the fact that relationships are built upon different expectations. Intimate communication between couples depends on the individual characteristics of the partners. An investigation of these characteristics is problematic since "there is no generally accepted language for describing and discussing intimacy" [15]. Participants were mostly skeptical when we asked them whether they would like to use one of the applications. A reason for this is probably that it is difficult to imagine how the applications would look like, when installed inside a room. Some of the participants stated that they felt uncertain about the perception of a ceiling-based visualization and they were afraid that they might be distracted in their primary task. As one participant stated, "I would like to try it, how this is actually experienced." She further said, that some of the applications would increase the curiosity to know what the other person is currently doing, since the information is displayed in an abstract manner. An interesting result was that an awareness of the current mood of the partner can trigger an explicit action. "You know how the partner feels and you can act accordingly and call him etc."

A strong opinion against sketches 1, 2, 3, and 4 was that the participants were worried about having the feeling of surveillance. This contradicts the findings of another study, in which an ambient display was evaluated, which showed

the presence of a distant person through a light [13]. We see the reason for this in the fact that this study involved family households. The factor of surveillance obviously is of more serious concern between couples, as one participant stated "Looks like surveillance. If the partner has someone visiting and one becomes aware of this, then you're rather curious who is visiting and why." This also explains why sketches 5, 6, and 7 received a higher rating than the others.

6 Implementation of the Prototype

Based on our preliminary study, we selected sketch 5, which suggests the projection of patterns of light onto the ceiling in correlation with the mood of the the distant partner, for further development into a prototype. This is currently accomplished by using two projectors for output and a tangible interface for input. This approach was selected because it is difficult to measure the mood of a person. Furthermore, this was not the focus of our project. Thus, we provide users with a physical cube that features labels on each side, corresponding to certain emotional states, such as neutral, relaxed, angry, tired, surprised, happy, and communicative. We used a Phidgets[3] RFID reader and incorporated RFID tags into the sides of the cube. The entire application is implemented in Java. We currently work on a version that is set up in our office environment, which allows us to evaluate the technology before we install it in people's homes. In the first version, each emotional state is represented by a specific color [9] and a pattern. The visualization fades over time if there is no occurrence of a new event in order to avoid the transfer of wrong information. One of the participants from the study mentioned this as a potential source for misinterpretation that could lead to confusion. Furthermore, three participants were worried that they might be distracted from a constant projection.

In addition we develop a prototype that implements the concept of sketch 7, which was rated third. This application enables interaction over a distance in an entertaining way: The user can throw a ball at panels at the ceiling, creating patterns of light. This concept supports simple and implicit non-verbal communication [11] and was highly appreciated by the participants. This prototype will give us the possibility to further explore this domain. We currently investigate tracking techniques that allow detecting the position where the ball hits the ceiling.

The design and implementation of the present applications were guided by the design nuggets formulated by Agamanolis [1]. Additionally, we incorporated general design principles for ambient displays [14].

7 Conclusion and Future Work

We presented results of an empirical study about the use of communication technologies in long-distance relationships. We further described the current implementation of initial proof-of-concept prototypes. The main result from the study was that people are reluctant against applications that might give them the feeling of being surveilled.

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[3]http://www.phidgets.com

While many systems have been developed that support remote awareness for couples, there is still a lack of empirical data for this field. Vetere et al. [15] have derived a thematic understanding of intimacy and the use of technologies for emotional communication from empirical work. However, there is still a long way to go and further empirical studies are necessary to better understand how technology can be adopted to support intimate acts. Remote awareness technologies will never be able to replace the experience of physical presence or face-to-face communication. They can however enrich the experience of communicating and living together over a distance.

While applications for location, activity, or sound awareness appear to be inappropriate approaches for couples, there seems to be a potential of such systems for interfamily communication. One of the participants, who works abroad, told us that once during a family meeting his parents turned on the headset and he could listen to their dialogs via Skype while working. He did not actually participate in their communication but experienced their virtual presence at the periphery of his perception.

Ceiling-based systems that communicate the emotional state of the distant partner have the highest probability of being accepted. People were also interested in applications that both entertain and give them a feeling of remote awareness at the same time. The prototypes developed in this project can only serve as proof-of-concept implementations. For a wider application in a real context we are still lacking technologies such as energy-efficient large-scale interactive wallpapers.

We currently see two possible directions for further research. In the course of the on-going project we plan to evaluate the prototypes with people from the study. At the same time we plan to conduct a bigger qualitative study about mobile people in relationships to learn more about the problems of remoteness. We also intend to compare ceiling-based applications to hand-held objects that provide a tactile sense of remote awareness. We hope to receive results about preferences as well as advantages and disadvantages of both approaches. Another possible direction would be the investigation of ceiling-based applications that support an awareness of remote presence in the context of families.

References

[1] Stefan Agamanolis. *Designing Displays for Human Connectedness*, chapter 16, pages 387–409. Springer Netherlands, 2003.

[2] Scott Brave and Andrew Dahley. inTouch: a medium for haptic interpersonal communication. In *Extended abstracts of CHI'97*, pages 363–364. ACM Press, 1997.

[3] Chris Dodge. The bed: a medium for intimate communication. In *Extended abstracts of CHI'97*, pages 371–372. ACM Press, 1997.

[4] R. Etter, C. Röcker, and D. Gilgen. Supporting emotional communication between multiple users in intel-

ligent home environments. In *Proc. of IE'06*, pages 41–50, 2006.

[5] Francine Gemperle, Carl Disalvo, Jodi Forlizzi, and Willy Yonkers. The Hug: a new form for communication. In *Proc. of DUX'03*, pages 1–4. ACM Press, 2003.

[6] Hilary Hutchinson, Wendy Mackay, Bo Westerlund, Benjamin B. Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, Nicolas Roussel, and Björn Eiderböck. Technology probes: inspiring design for and with families. In *Proc. of CHI'03*, pages 17–24. ACM Press, 2003.

[7] Hubert Krieger. Long distance mobility within the EU. Technical report, European Foundation for the Improvement of Living and Working Conditions, 2006.

[8] Dipak Patel and Stefan Agamanolis. Habitat: Awareness of life rhythms over a distance using networked furniture. In *Adjunct Proc. of UbiComp 2003*, 2003.

[9] Alfredo J. Sánchez, Ingrid Kirschning, Juan C. Palacio, and Yulia Ostróvskaya. Towards mood-oriented interfaces for synchronous interaction. In *Proc. of CLIHC'05*, pages 1–7. ACM Press, 2005.

[10] Norbert F. Schneider, Ruth Limmer, and Kerstin Ruckdeschel. *Mobil, flexibel, gebunden. Familie und Beruf in der mobilen Gesellschaft (Mobile, flexible, bounded. Family and job in the mobile society.)*. Campus Verlag, 2002.

[11] Rob Strong and Bill Gaver. Feather, scent, and shaker: Supporting simple intimacy. In *Proc. of CSCW'96*, 1996.

[12] Adriana Thompson, Aurelia Friedland, and Jenny Cargiuolo. Rüüg: long-distance communication. In *Extended abstracts of CHI'05*, pages 1829–1832. ACM Press, 2005.

[13] Konrad Tollmar and Joakim Persson. Understanding remote presence. In *Proc. of NordiCHI'02*, pages 41–50. ACM Press, 2002.

[14] Martin Tomitsch, Karin Kappel, Andreas Lehner, and Thomas Grechenig. Towards a taxonomy for ambient information systems. In *Proc. of the Pervasive 2007 Workshop on the Issues of Designing and Evaluating Ambient Information Systems*, 2007.

[15] Frank Vetere, Martin R. Gibbs, Jesper Kjeldskov, Steve Howard, Florian Mueller, Sonja Pedell, Karen Mecoles, and Marcus Bunyan. Mediating intimacy: designing technologies to support strong-tie relationships. In *Proc. of CHI'05*, pages 471–480. ACM Press, 2005.