Combining research strategies in interaction design of communication systems for the home

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ABSTRACT
The goal of my research is to design *multi-scale video-mediated communication systems* for the home, that provide synchronous and asynchronous communication between households and also support a smooth transition from peripheral awareness to focused communication. This position paper describes our research strategy and presents the prototypes we have designed.

Categories and Subject Descriptors
H.4.3 [Communications Applications]: Computer conferencing, teleconferencing, and videoconferencing.

General Terms
Design, Human Factors.

Keywords
Video-mediated communication, variable degree of engagement, home communication.

INTRODUCTION
The past few years have seen an explosion of communication and digital imaging technologies in the home, yet video-mediated communication systems remain rare. One problem is that most such systems were designed for work settings, and only support short, synchronous and highly-engaged face-to-face interaction, Mediaspaces [1] provide an alternative, emphasizing the value of long-term video links and allow informal interaction and casual awareness among participants.

In our research, we design *multi-scale video-mediated communication systems* for the home. These systems support a wide range of video communications, from casual asynchronous awareness to synchronous face-to-face interactions. This research requires a deeper understanding of communication practices in the home and careful consideration of privacy issues. In particular, earlier fieldwork [4] has shown that users want to control their degree of engagement with each other, even when communicating with close family and friends. They want to negotiate how they appear to others and reserve the option of withdrawing at any time.

We introduce the concept of *multi-scale communication* [6], which allows a variable degree of engagement among participants and fluid transitions between each level. Some nonvideo-based applications already have this feature. For example, instant messaging makes it easy for users to indicate their current "status" and to adapt the remote conversation to their local context. IM also supports transparent transitions between synchronous and asynchronous communication. Existing video systems, such as video phones and video conferencing systems, lack this ability to move seamlessly from loosely-coupled to highly-coupled interaction.

METHODOLOGY
Our research methodology involves triangulation [5] among "different research strategies, each of which forces a trade-off among different threats to validity", to avoid fundamental problems of complex communication situations. These strategies include observation in the field, technology probes [4], and participatory design workshops [5] to influence the design of prototypes that we develop and capture the context of users. We are also exploring a theory of multi-scale communication systems, which frame a generalizable characterization of video-mediated communication. And we will test this theory with longitudinal field studies.

The technology probes [4] approach allows simultaneously to test the technology in situ, introduce a new prototype which can influence the behavior of users, collect ethnographic and use data and inspire users by provoking the reflection on their everyday life and communication. Similar to technology probes, our prototypes are ambiguous, flexible, open-ended and designed for unanticipated changes, instead of being built for a determinated task. Our focus is on how the user will adopt our systems, will transform them and create personal communications codes. In contrast with evaluation of collaboration in work settings which focuses on task completion, researchers from project centered on the home settings insist on the importance of playfulness [5] and aesthetics [8]. Measuring these subjective criteria is one of the main difficulties in evaluating our communication systems prototypes at home.

We are working on a research project, funded by a major telephone company, and held the first of a series of participatory design workshops on domestic communication. This helped us to identify a variety of user's problems and needs, and confirmed the importance for them of coordination [7] between and within households and emotional involvement in communication at home. This workshop helped me also to understand and design our prototypes for the values of the domestic communication systems users. We have analyzed the ideas proposed by users in a more quantitative way, which allowed us to identify the nature of

the information suited to loosely coupled communication situations. Users proposed systems that automatically convey activity, context and location information, but reserved the possibility of explicitly controlling this information.

Pêle-Mêle

My first prototype, Pêle-Mêle [3] is a multiparty video communication system. It supports informal communication by providing awareness of others activity and by helping users to share images of their everyday life, and allows in the same time to communicate through a focused way. As a multi-scale communication, PêleMêle supports a variable degree of engagement among participants. It is designed for closeknit groups of families and friends, to use at home.

The system works in two main phases: it first automatically detects "interesting" situations and allows users to adjust the ''interest'' themselves. It then uses spatial and temporal composition techniques to display at appropriate level of detail. Pêle-Mêle consists of a screen with a video camera connected to a small hidden computer. The screen first displays an overview of all the places it is connected to and then presents a more detailed view of the places where someone is currently communicating. Each representation of a place may combines both live and recorded images that show previous activity. The layout of all the images is shared among Pêle-Mêle instances on a strict WYSIWIS (what-you-see-is-what-you-get) basis [3].

Pêle-Mêle analyses what local users are doing using basic detection techniques and classifies each activity as: *away*, *available* and *engaged*. The activity level observed at each place determines the nature of the video images that represent it: for *away* level, the place is represented by filtered images that illustrate its past; for *available* level, the place is represented by video clips that show its past and a filtered live stream that illustrates its present; for *engaged* level, the place is represented by video clips and a live stream that simultaneously show both its past and present.

Spatial and temporal filters are used, for example, to degrade or delay images to mitigate privacy concerns, or to compose them over time to increase the understanding of each other's activities. Combined with the screen layout, filters help users to perceive the differences between activity levels. Live images from people engaged in a communication are overlaid in the middle of the screen, while images of other available people are shown on the periphery of the display. Smooth animated transitions between these representations ease perception and understanding the state changes. Time is represented by the z axis. Thus, recorded video clips slowly shrink and drift toward the center of the screen to represent the passage of time.

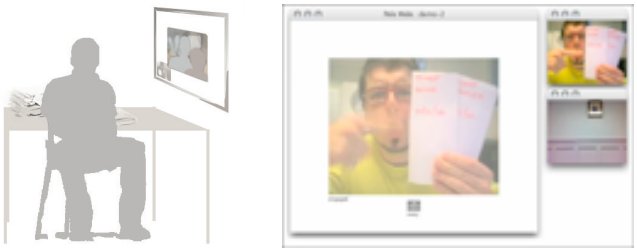

Figure 1. PêleMêle prototype sketch and screen capture.

Informal testing indicates that users quickly perceive the three levels of engagement currently supported by the system. The layout, the auditory feedback and the animations help them perceive the transitions, and they quickly understand how these transitions can be triggered by simple movements. The effectiveness of the spatial and temporal filters in mitigating privacy concerns and supporting better awareness over time is more difficult to assess. Long term use and participatory (re)design workshops will help us get user feedback on these important issues and improve the system in the future to better meet the domestic users needs.

ACTUAL WORK

PêleMêle prototype supports informal communication through three different ways. The first is synchronous way, which implicate focused interactions between users. The second is asynchronous communication, which is perceived as an ambient way of being aware of and present with others. The third way is building a common context of shared pictures, like pictures of users life recorded by the system or messages explicitly left by the users themselves.

Inspired by the workshop participant ideas and by our first prototyping experience, we have designed three other prototypes, one for each of these three aspects of informal communication: Mirror Table, Past-Summarizing Machine and Picture Sharer.

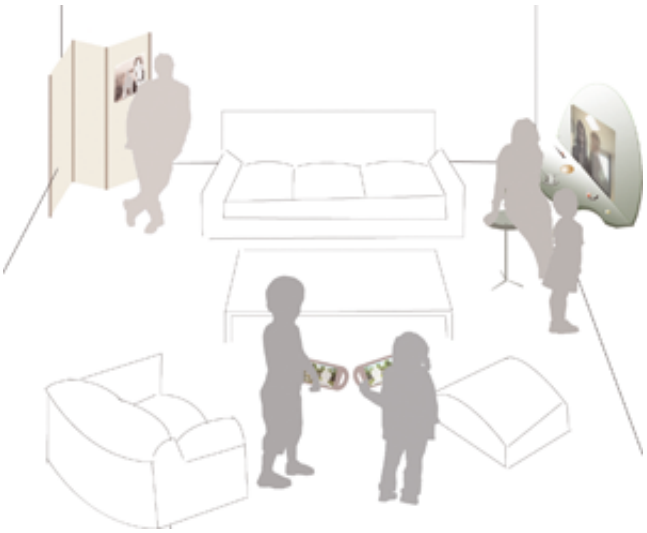

Figure 2. The three prototypes placed in a home setting.

These three image-based communication prototypes are multi-scale systems that support variable levels of engagement and awareness. They are designed to encourage the user to explore and adapt the communication to his needs. With these prototypes, we aim to identify interaction patterns, and to validate and precise multi-scale communication theoretical concepts.

MirrorTable

MirrorTable is a multiparty video communication system designed to encourage spontaneous communication. It uses a dressing table mirror that is actually a screen, with sensors, sliders and leds integrated into the table and a chair equipped with sensors.

When the user sits on the chair or touches an object on the desk, the led lights up. In addition, a video connection is established by chance between available sites. Users can control the detail level of the transmitted video stream, using sliders. When the detail level is high, users can superimpose their faces and obtain an audio connection to enrich the image-based communication.

In the MirrorTable prototype, we are interested in studying patterns of the explicit use of detail reduction in synchronous video communication. We are also interested in comparing chance connections with user-controlled connections.

Past-Summarizing Machine

The Past-Summarizing Machine displays images and videos of previous activities that occurred in the past, to maintain awareness of others. Couples or closeknit family members may stay in touch with each other by exchanging pictures that capture daily activities or important events.

This prototype uses a screen equipped with a video camera connected to a small computer. It records everything in front of the camera and analyses activity in the video stream. When a person approach to the screen, the system plays all recorded clips and displays pictures from each site, at a variable speed depending on the recorded activity level. When there is a great deal of activity, full videos are played at normal frame rates. When activity levels are low, photos taken from time to time are shown instead. Users can move smoothly these two extremes, permitting a continuous scale of temporal details.

The Past-Summarizig Machine prototype, will help us to study users exploration of their and others previous recorded activities.

Picture Sharer

Picture Sharer is designed to display digital photos and video clips and to talk about them with a distant person. This prototype includes a small mobile tablet computer equipped with pressure sensitive handles that glow, and a reversible camera at the top. Picture Sharer can be used like a camera but it is more adapted to show rather than to take images.

At one site, a user touches the prototype's handles, which makes the handles at the other sites glow. The user can then visualize photos and videos that are shared among all sites. If another user takes another Picture Sharer, a video communication link is established. Each user can see his and the other's live video streams superimposed. The user can control the transparency of the picture through pressure on the handles. As in MirrorTable prototype, an audio connection can enrich the video based communication. Picture Sharer uses image-based communication and the visual perception of hand pressure to communicate emotional reactions.

For this last prototype, we want to determinate the importance of emotions and the role of sharing a common context of photos in helping users to keep in touch with each other's.

CONCLUSION

We have completed the implementation of the Pêle-Mêle system and in the early stages of evaluating it. We have also begun development on the *Mirror Table*, *Past-Summarizing Machine* and *Picture Sharer* prototypes.

I would like to participate to this workshop to present and discuss my research and design methodology, which combines multi-scale theory and field methods. My position is that each design and evaluation methodology has advantages and weaknesses. For my research, I need to balance the tradeoff between a generalizable theoretical characterization of video-mediated communication and a specific understanding of domestic practices and routines. I am particularly interested in discussing which design methods are appropriate for evaluating image-based communication systems in the home settings. I am interested also by discussing which evaluation methods are appropriate for defining, with the user, levels of detail a multi-scale communication system should use.

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