

Ambient Telepresence

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Abstract

Ambient Telepresence is introduced as a method to give someone the feeling that someone else is present while that person is in fact not co-located. In contrast to other telepresence approaches, ambient telepresence is focused on mediating background activity to promote a peripheral sense of presence. A remote person's handling of everyday objects is mapped to an ambient presentation in the local work environment, based on ubiquitous computing and context-awareness technologies, allowing people at different locations to experience the ambient presence of others. For experimentation, we have developed *MediaCups*, coffee cups in our office environment equipped with sensor, computing and communication facilities.

Introduction

Telepresence is an important field in CSCW research. Video conferencing systems and multi user dungeons (MUDs) establish shared media spaces [2] and enable telepresence as an explicit interaction between two or more humans located in different places. Additionally, ongoing research investigates integration of telepresence systems in offices and meeting rooms. For instance, the ActiveOffice project at the University of Toronto [3] considers telepresence systems as part of the physical work environment, and focuses on the creation and integration of non-intrusive telepresence technologies, such as videoconferencing and shared whiteboards.

These telepresence systems, however, do not take subtle background activity into account, but focus on explicit foreground activity. Our research is complementary, investigating technologies for *ambient telepresence*. An ambient presence is a presence perceived in the background or periphery, in contrast to foreground remote presence as found in video conferencing. Ambient presence is also in contrast to virtual presence as in Collaborative Virtual Environments (CVEs). Ambient presence concentrates on use of physical media that are normally perceived as background. We understand ambient telepresence as complementary to direct telepresence methods, utilizing features of physical presence that humans are not consciously aware of.

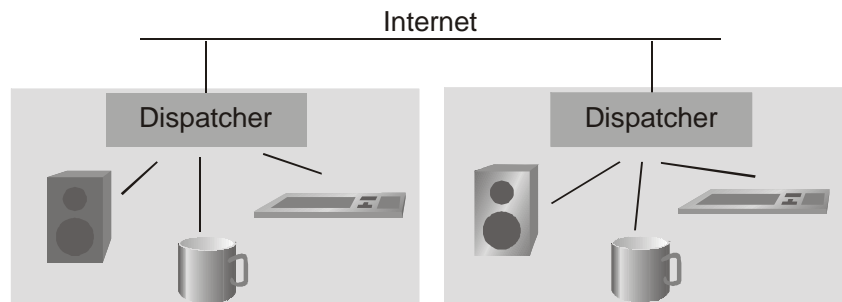


Figure 1

1996 Ishii coined the term ambient media and ghostly presence [7] and presented AmbientRoom [12] as a first experiment for research on ambient media. AmbientRoom demonstrates how ambient media can be created and how several ambient media can work together. Examples for ambient media used in the AmbientRoom are water ripples, light patches and sounds. In these examples ambient media are used for peripheral representation of activity in the virtual world, such as network traffic. Ambient

media were also used, probably rather as a joke, to convey a sense of presence of a remote hamster: the motion speed of a hamster in his wheel located at a remote laboratory was transferred over the network and interpreted at the destination as a vibration parameter of an object (here a physical icon (phicon)[7]) in the AmbientRoom.

We extend the concept of shared workspaces to also contain objects in the work environment that are not directly associated with the tasks at hand, especially small non-intrusive artifacts of everyday live (ambient media). In an ambient telepresence system, activity applied to such an ambient media object in the environment is translated to other representation forms that are similar or deductible from the activity and suited for remote reproduction. Most of this activity does not follow a task in the sense of cooperative work but are only “random” movements; some of them express the personality or state of a person (e.g. being nervous), some other depend on tasks of a person (e.g. keyboard hit). For example a movement of an object is translated to a sound that is typical for the movement of the object. Such a sound or any other representation suited for peripheral perception is transferred to a remote location to contribute to an ambient presence which can be based on a multiplicity of ambient media.

Figure 1 shows an example scenario, where objects and ambient media output devices (here a speaker) at two distinct locations are interconnected through the internet. The prerequisite for such a scenario is a kind of “computerized” environment as promoted in the ubiquitous computing vision [11]. In [6] we discussed how such computerized environments enable the use of physical objects as mediators in human-to-human communication. Here we discuss how they enable ambient telepresence as a peripheral human-to-human link.

Ambient Telepresence

Before we present in more detail how ambient telepresence can be implemented we provide a generic definition:

Ambient Telepresence is a method to give someone the feeling that someone else is present while they are not co-located.

Ambient Telepresence transfers information about background activity from one location (say, location 1) to another (location 2) to give a person at location 2 the feeling of the presence of a person at location 1. Physical activity at location 1 is detected as an event and then transferred to a distant location (Figure 2). At location 2 the event is transformed to a peripheral presentation, i.e. a presentation that does not monopolize attention but rather blends into the work environment. The Ambient telepresence system interconnects two physical locations with the help of a computer network; barriers of the physical world are overcome using the virtual world, mixing the capabilities of both worlds.

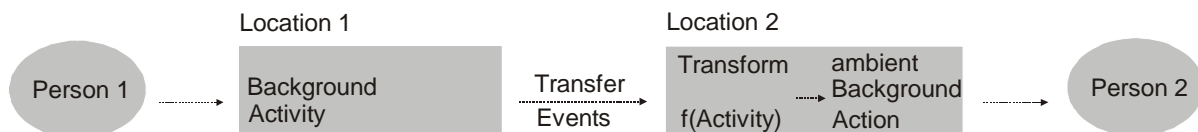


Figure 2

Our investigation of ambient telepresence is focused on technical issues such as how to detect background activity and how to produce ambient presentations, rather than psychological aspects which need to be addressed in complementary studies. To explore ambient telepresence an example scenario was constructed. In this first setup, movement of everyday objects are tracked and interpreted as activity, e.g. movements of a coffee cup¹ or a key hit of your keyboard are interpreted as activity. Such activity is transferred as event to a remote location and there transformed to a (meaningful) noise: a click sound for a keyboard hit, the sound of a moving mouse, the noise of cup put down on the

¹ should also work with tea ;-)

table and the scratching noise of a cup moved on a surface. These noises are then made audible by a speaker system at the remote place. Sound as used in this example is one possible peripheral representation; others may be visual background cues or other physical effects. Also, while in this example sounds directly associated with certain movements were chosen, transformation of object movements to less “meaningful” noise can also be considered. Example uses of ambient media actually tend to argue in favour of a large degree of abstraction from information source to ambient presentation [12]. Usability studies will be required to assess whether seemingly natural or rather arbitrary transformations from remote activity to local ambient presentation are preferable.

An interesting application area for ambient telepresence are shared workspaces. Models for shared workspaces often concentrate on explicit handling of shared media and related issues of coordination, allowing people to work on the same objects. Awareness in shared workspaces [4] focuses on activities that are linked to the aim of the (collaboration) task. Ambient telepresence can be complementary in building a shared context that is not bound to particular task. One aspect of such a context is social awareness as described in [8], which could be constructed using the proposed ambient telepresence model. Ambient telepresence may contribute for instance to colleague-awareness in more subtle ways than for instance filtered images [13]. One can also speculate about usage for keeping remotely in touch. For instance, the feel of sharing an office can be held up during sessions of remote work. This usual and liked background noise can also lead to a higher intrinsic motivation according to findings in psychology [4]. As another example consider background activities that carry implicit meaning. For instance closing a door often means that someone does not want to be interrupted in his work [3]. In remote collaborative work, ambient telepresence may be used to convey such activities to be used as cues in social coordination of remote collaboration. A (maybe) interesting aspect of ambient telepresence is the simulation of synchronous presence when in effect activities occur at different times, for instance for people working in different time zones.



Figure 3

In our ambient telepresence setup, detection of the movements and transfer of related events is accomplished by computer technology embedded in the work environment and in particular in everyday objects. An environment equipped with functionality similar to those described in the vision of ubiquitous computing is inevitable, and in addition technologies for context-awareness are prerequisite [9]. Three conditions have to be fulfilled: First, many objects in the environments have to be computerized. Secondly, these objects have to be interconnected and/or connected to the environment. Thirdly, these connections and computerization have to be unobtrusive to the person at either end.

Example: MediaCup

In our setup, we have equipped some objects in our work environment with computing power and communication facilities. The experimental work environment consists of two interconnected offices, both containing computerized objects. Our first example for a computerized object is a cup enhanced

with some sensors and an infrared transmitter for wireless communication; we call this cup *MediaCup* (Figure 3). Every *MediaCup* contains the personal ID of his owner, so all *MediaCups* in the environment can be separated from each other. Activities as movement of the *MediaCups* can be detected. An acceleration sensor in combination with a small microprocessor at the *MediaCup* detects special kind of movements, e.g. of putting down the *MediaCup* onto a table or rotation of the *MediaCup*. This information is transferred via IrDA signals to a receiver and from there to a Dispatcher component [1]. This Dispatcher component delivers the activity events from the *MediaCup* to every subscribed remote Dispatcher component. The remote Dispatcher component decides how to interpret these events and forwards an appropriate (transformed) event to an object. In this example both Dispatchers are installed onto computers in the environment that are interconnected through the Internet. The activity of the *MediaCup* is interpreted on the remote Dispatcher as typical sounds according to a mapping as shown in Table 1. Additionally keyboard and mouse activity is watched and interpreted as sounds.

MediaCup rotate	Hard rubbing sound
MediaCup put down	Hard clack noise
Keyboard hit	Key click noise

Table 1

Communication between the different parts of the system is realized through events (Figure 4). Both activity to and from Objects is transmitted as events, and also the communication between dispatchers of object activity is realized facilitating events. Objects that take part in the system are responsible by themselves how to coordinate multiple events coming from different sources. The method to resolve conflicts between competing events depends highly on the kind of the event output: In our example events are interpreted as audio sounds. Because audio outputs can be overlapping, no concurrency control is needed. Most ambient output media as sound and light effects allow concurrent access without the need for a coordination method. Because the example ambient telepresence system as presented here uses such media, the system provides no generic method for resolving conflicts.

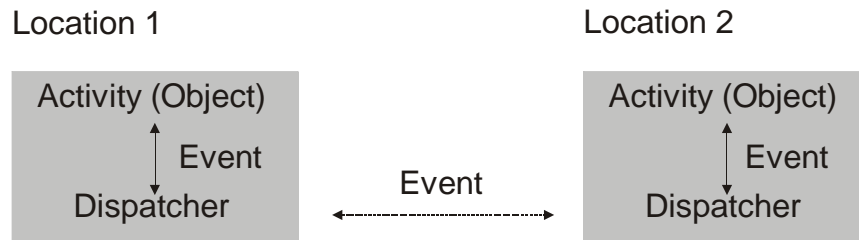


Figure 4

Summary and Outlook

Today we are at the beginning of exciting new ways to generate presence of persons at distant places. In this paper we have introduced the concept of ambient telepresence, applying ambient media for remote awareness. Further we have described a general model for generating remote presence from handling everyday objects in work environments, and presented a small setup for experimentation based on computerized cups. How this ambient telepresence technology can work in detail is subject to ongoing experiments, which are primarily aimed at learning about suitable transformation of activity to remote peripheral representation.

Based on the investigated technology we can envision scenarios such as groups of people spontaneously connected by an ambient telepresence, also people carrying the presence of a loved one around with them, and colleagues being socially aware of each other no matter where they work.

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