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Shared Experonments: Real-Time Realistic Social Sharing of Experiences and Environments

Ravi Vatrapu, Dan Suthers[1], Sam Joseph[1]

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[1] Laboratory for Interactive Learning Technologies

Department of Information and Computer Sciences

University of Hawaii at Manoa

1680 East-West RD

Copenhagen Business School
HANDELSHØJSKOLEN

Center for Applied ICT (CAICT)
Copenhagen Business School - Howitzvej 60 - 2000 Frederiksberg
URL http://www.cbs.dk/caict

Abstract

The Shared Experonments system provides interactive services for ubiquitous real-time interactive social sharing of experiences and environments. Designed and implemented for ubiquitous high-speed wireless environments, the Shared Experonments system provides synchronous ways and means for interactive social sharing of erstwhile personal experiences while one or more persons are in remote locations. Example scenarios include sharing of experiences with friends and family while off hiking or trekking, as well as business situations where a remote field worker must collaborate in real time with other field workers or head office. The Shared Experonments system integrates multiple realities and works in a variety of mixed reality modes and interactional settings, and crucially supports deixis from one environment to another.

Introduction

The rapid advances in information and communication technologies have brought about new possibilities in the social connectivity. Similarly, advances in mapping, imaging and tracking have opened up new capabilities for representing as well as interacting with environments. However, there has been little theoretically informed systematic empirical work that investigated the cross-fertilization of these two phenomena. The Shared Experonments system creates opportunities for the social sharing and collaborative interactions of experiences and environments. In the next few paragraphs, we briefly review the relevant theoretical notions.

In their review of the notion of presence in technology settings, Lombard and Ditton (1997), identified six interrelated concepts of presence as *social richness; realism; transportation; immersion; social actor within medium; and medium as social actor.* The Shared Experonments system's objective is to implement all of the above six notions of presence while emphasizing the notion of "Shared Collaborative TelePresence"; the ability for users to perceive deixis indicators registered to the appropriate part of the environment. Shared Collaborative TelePresence utilizes the productive tension between the future possibilities envisioned in "Beyond Being There" (Hollan & Stornetta, 1992) and the present realities documented by "Distance Matters" (Olson & Olson, 2002) to design and implement a set of intuitive controls for remote participation and collaboration.

Mark Poster's work on the relationship between technology and subjectivity from a critical theory and media studies perspective has posited the postmodern individual agent as an "information subject" (Poster & Aronowitz, 2001). In other words individuals are increasingly likely to experience the world in terms

of the information provided by the technology driven new media; as opposed to historically where people's experience of the world was in terms of first hand experiences and word of mouth. In the Shared Experonments system, the individual agent is conceived of as an "experiential subject" with more than mere informational needs. Poster's "information subject" is an individual defined by the information they have access to, while our "experiential subject" has access to experiences that are qualitatively different to the kind of information available to humans so far.

David Harvey has articulated the notion of "time-space compression" (Harvey, 1989) as a condition of human existence in the postmodern condition. With the advent of information and communication technologies (ICT); social networking websites like Orkut, My Space and Face Book; content sharing websites like Flickr and youtube; virtual worlds like Second Life and WoW, there is a "time-space-being compression". It is not just that the physical world has shrunk across time and space due to transportation technologies, it is also true that the intersubjective distance with friends, family, significant others and familiar strangers has compressed due to social technologies. As a communication technology, ICT compresses the intersubjective world but at the same time as an expressive technology it inflates the social world. For example, we are now mere seconds away from interacting with significant others compared to being miles and months apart in the past. At the same time the potential social realm now includes not only significant others but also familiar strangers, mutual acquaintances and general others. Figure 1 below presents Harvey's notion of time-space compression.

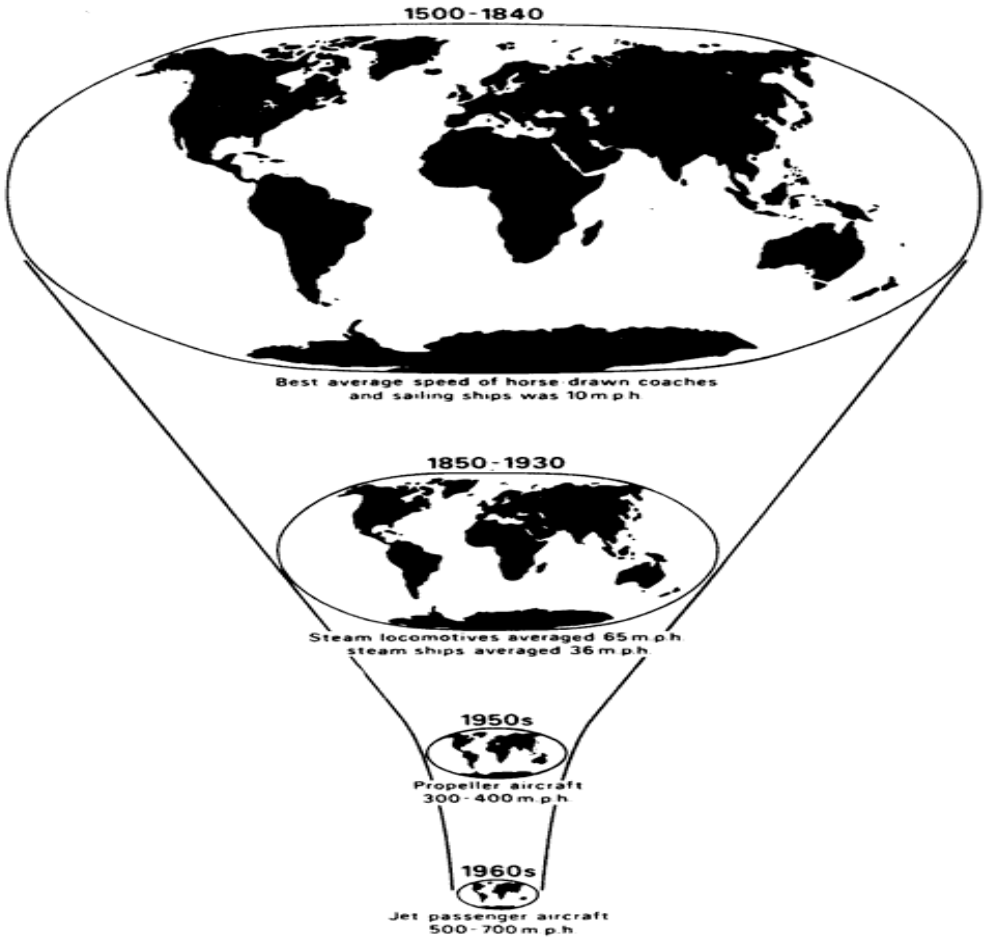


Figure 1:Time-Space Compression (Harvey, 1989)

Image Courtesy of (www.sunysb.edu/libmap/coordinates/seriesa/no3/harvey2.gif

Intersubjectivity is "The sharing of subjective states by two or more individuals." (Scheff 2006). The term is used in three ways.

1. Firstly, in its weakest sense it is used to refer to agreement. There is said to be intersubjectivity between people if they agree on a given set of meanings or definition of the situation.
2. Secondly, and somewhat more subtly it has been used to refer to the "common-sense," shared meanings constructed by people in their interactions with each other and used as an everyday resource to interpret the meaning of elements of social and cultural life. If people share common sense, then they share a definition of the situation.
3. Thirdly, the term has been used to refer to shared (or partially shared) divergences of meaning. Self-presentation, lying, practical jokes, and social emotions, for example, all entail not a shared definition of the situation, but partially shared divergences of

> meaning. Someone who is telling a lie is engaged in an intersubjective act because they are working with two different definitions of the situation. Lying is thus genuinely inter-subjective (in the sense of operating between two subjective definitions of reality).

Intersubjectivity emphasizes that shared cognition and consensus is essential in the shaping of our ideas and relations. Language is viewed as communal rather than private. Hence it is problematic to view the individual as partaking in a private world, which is once and for all defined.

Technological intersubjectivity refers to an interactional social relationship between two or more participants. This interactional social relationship emerges from a dynamic interplay between the functional association of the participants as communicators and the empathetic association of the participants as actors in a technology supported self-other relationship. Information and communication technologies (ICT) have changed the social texture of our relations with others and objects in fundamental ways that transcend technology mediation. Our interactions with others and objects are increasingly shaped by of technology, hence the construct of technological intersubjectivity.

Technology intersubjectivity can be experienced in terms of the quality of interaction between individuals over some technological medium. This is not simply quality in terms of audio or visual fidelity, but a measure of how well social interaction can be supported and maintained.

To extend what we said earlier, ICTs, transportation technologies and neo-geography together are creating a "time-space-being compression". The design of the Shared Experonments system is theoretically informed by this time-space-being compression. In the next section, related work is discussed.

Related Work

Context Watcher

Context Watcher (Koolwaaij et al., 2006) "mobile application that aims is to make automatic recording, storage, and usage of context information easy for the end-user[1]." ContextWatcher is a part of the MobiLife[2] project. The MobiLife project's stated objective was to "to bring advances in mobile

[1] http://www.istmobilife.org/index.php?option=com_content&task=view&id=70&Itemid=58

[2] http://www.ist-mobilife.org/

applications and services within the reach of users in their everyday life by innovating and deploying new applications and services based on the evolving capabilities of the 3G systems and beyond." Figure 2, below, taken from MobiLife website depicts the three "communication spheres" that are the focal areas for the MobiLife project.

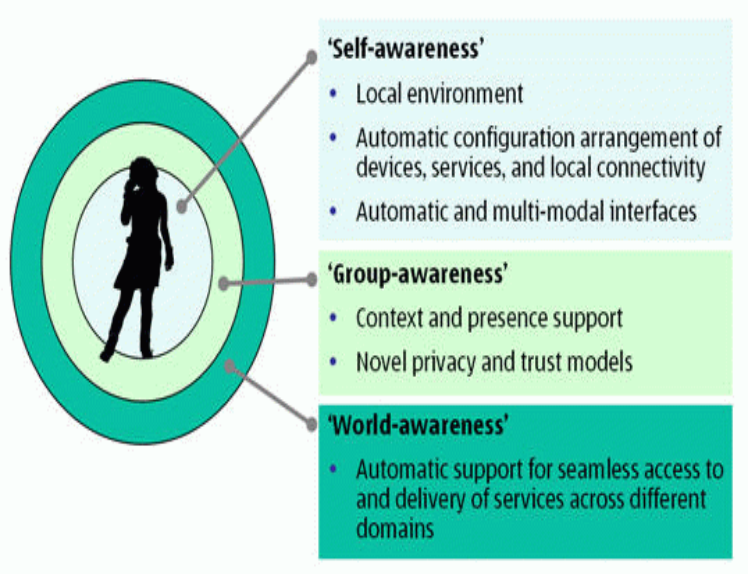


Figure 2: Communication Spheres (MobiLife Project)

The Shared Experonments has similar objectives as the MobiLife project but differs in the focus. Our focus is on the enabling the rich sharing of experience and facilitating unobtrusive communicative services to achieve social communion possibilities. Marshall McLuhan formulated technologies as extensions to human bodies (McLuhan, 1994). We formulate technologies as extensions to human minds. In that regard, the Single-User-Action solution offers a seamless integration of psyche and techne by offering an automated real-time integration of physical and virtual worlds.

Telepresence

Buxton (1992) proposed integrating shared task and person spaces as a solution to creating effective and efficient telepresence. Ishi and colleagues (Ishii, 1992; Ishii, Kobayashi, & Grudin, 1993)have developed a system that integrated shared workspaces and interpersonal spaces for remote collaboration. Figure 2 below presents the system architecture of Ishi and colleagues' Clearboard-1. Key innovations of this design include direct drawing of display screen, video see through of the remote participants, and a shared drawing orientation.

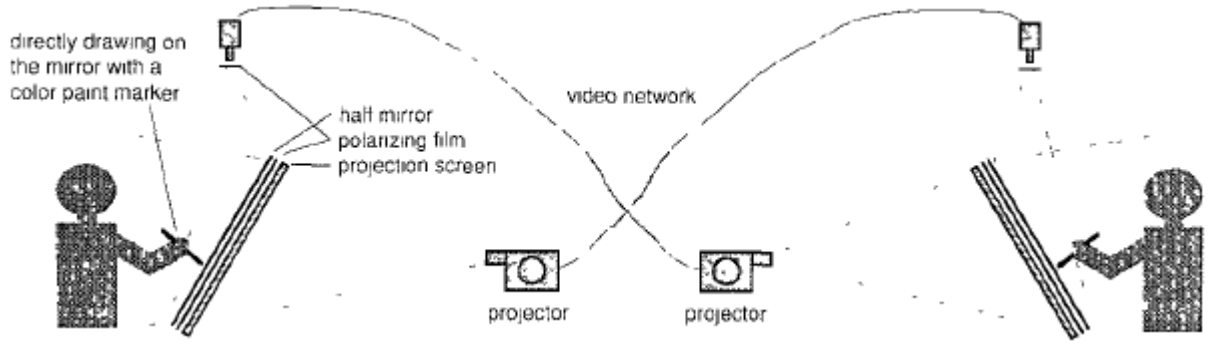
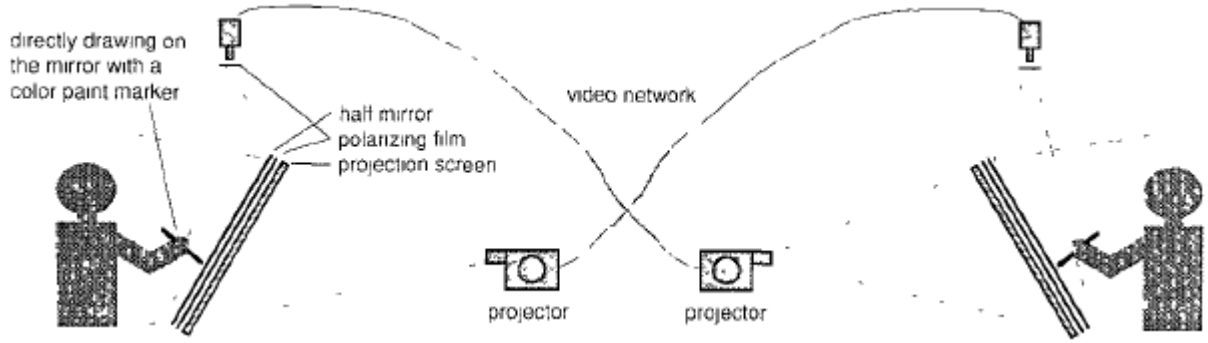


Figure 2: Clearboard-1 System Architecture, taken from (Ishii et al., 1993, p.357)

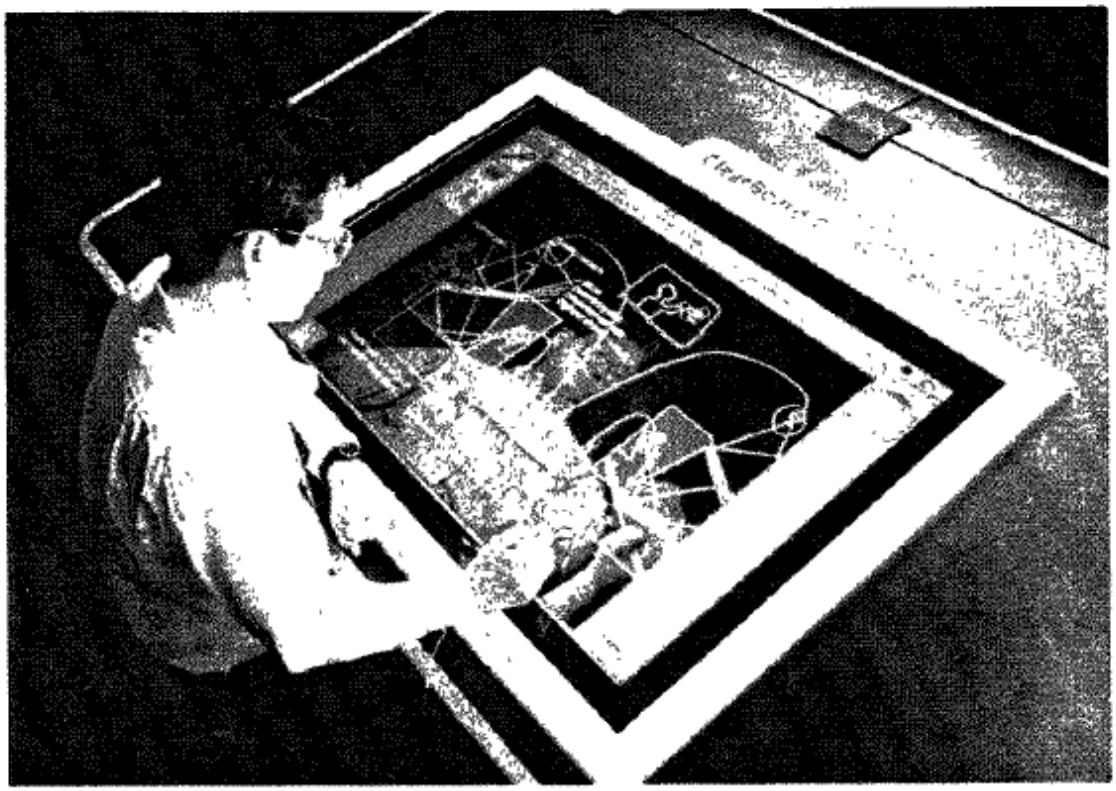
Based on experimental evaluation of Clearboard-1, Clearboard-2 was designed and implemented. Figure



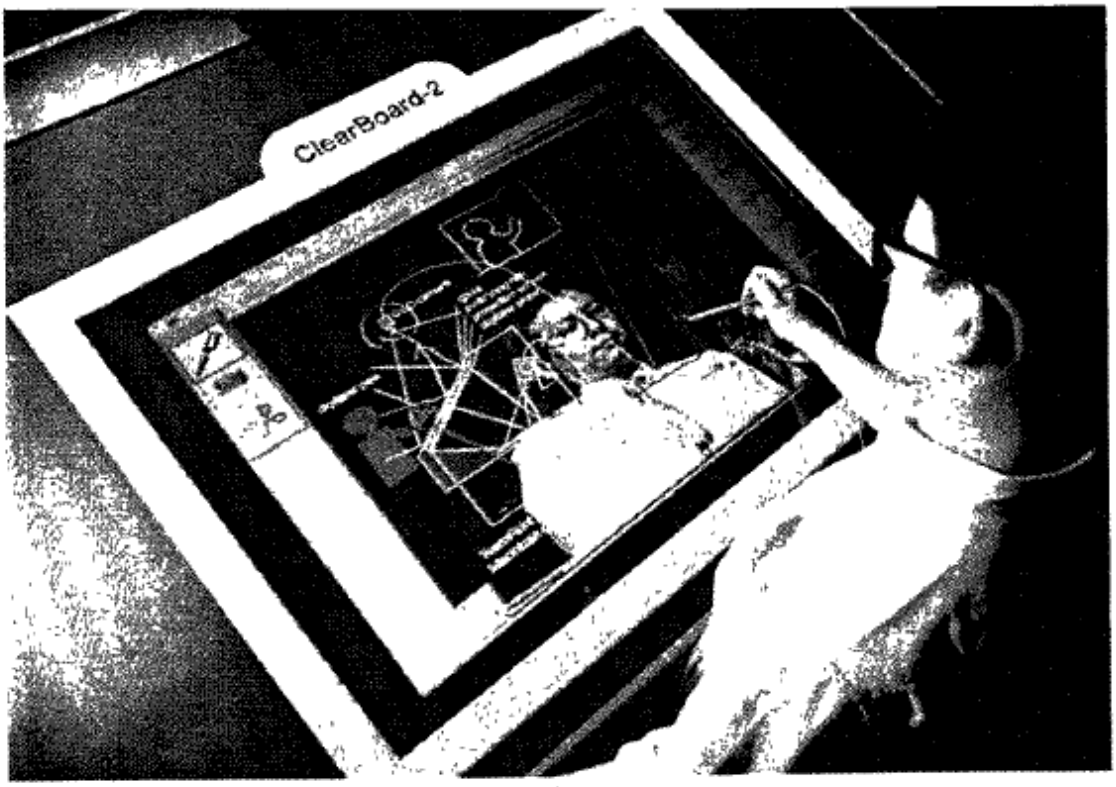
3 below presents the system architecture of the Clearboard-2.

Figure 3: Clearboard-2 System Architecture, taken from (Ishii et al., 1993, p.361)

The design innovations of the Clearboard-2 system include many collaborative editing and storing capabilities. Figure 4 below depicts the Clearboard-2 system in actual use.



(a)

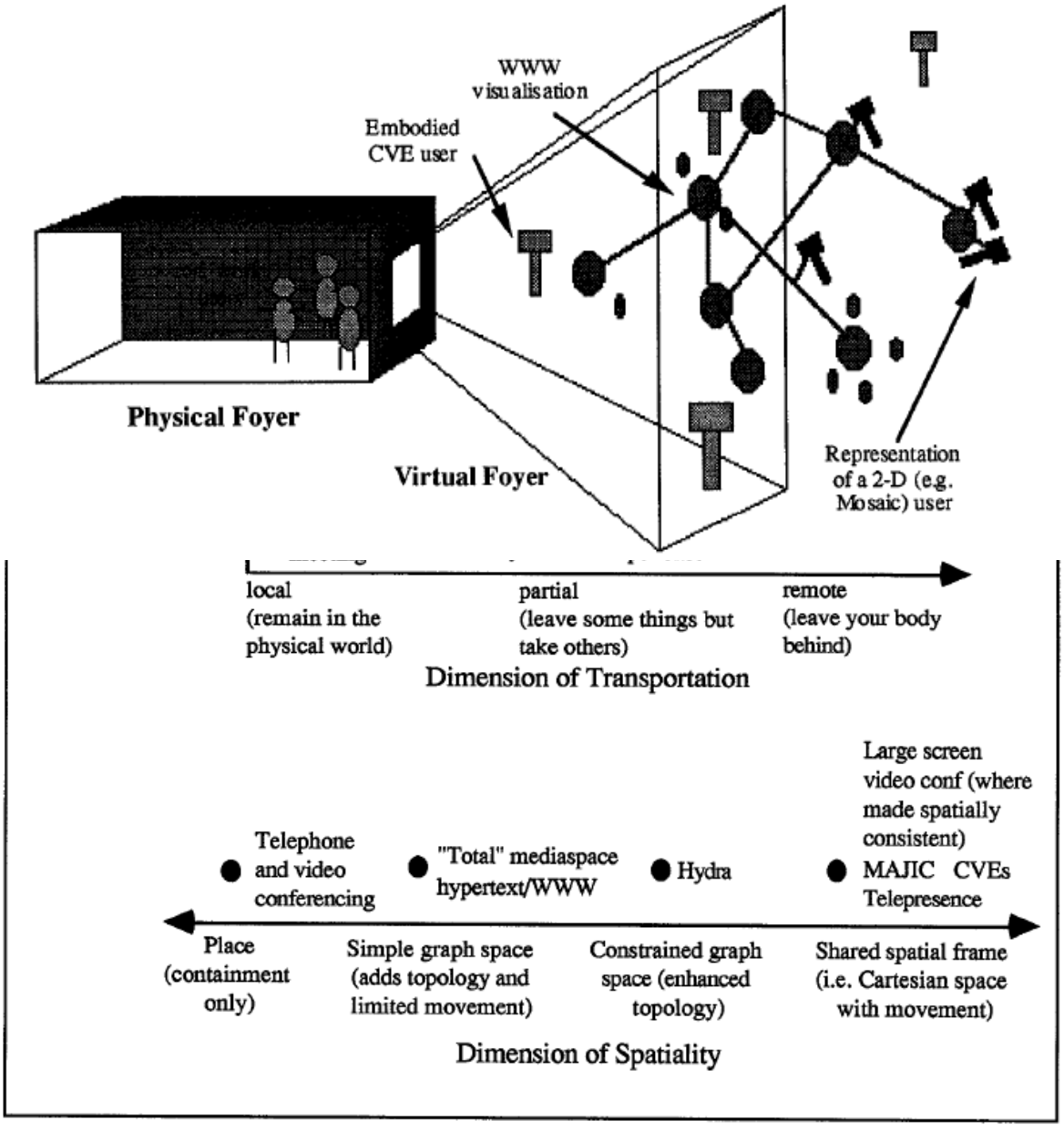


(b)

Figure 4: Clearboard system usage pictures, taken from (Ishii et al., 1993, p.363)

Büscher et al., (2000) implemented the concept in collaborative augmented reality environments. Further, the notion of Benford and colleagues have investigated the design and analysis of "shared spaces" in a variety of settings (Benford, Brown, Reynard, & Greenhalgh, 1996; Benford, Greenhalgh, Reynard, Brown, & Koleva, 1998). Figure 5 below presents a classification of shared spaces based on the dimensions of spatiality, artificiality and transportation

Figure 5: A Classification of Shared Spaces, taken from (Benford et al., 1996, p.80)



Based on the above classification of shared spaces Benford and colleagues have implemented a mixted reality system called "The Internet Foyer". The Internet Foyer combines "both local and remote and

synthetic and physical characteristics into a single system on an equal footing" (Benford et al., 1996, p.82). Figure 6 below depicts the functionality of the Internet Foyer.

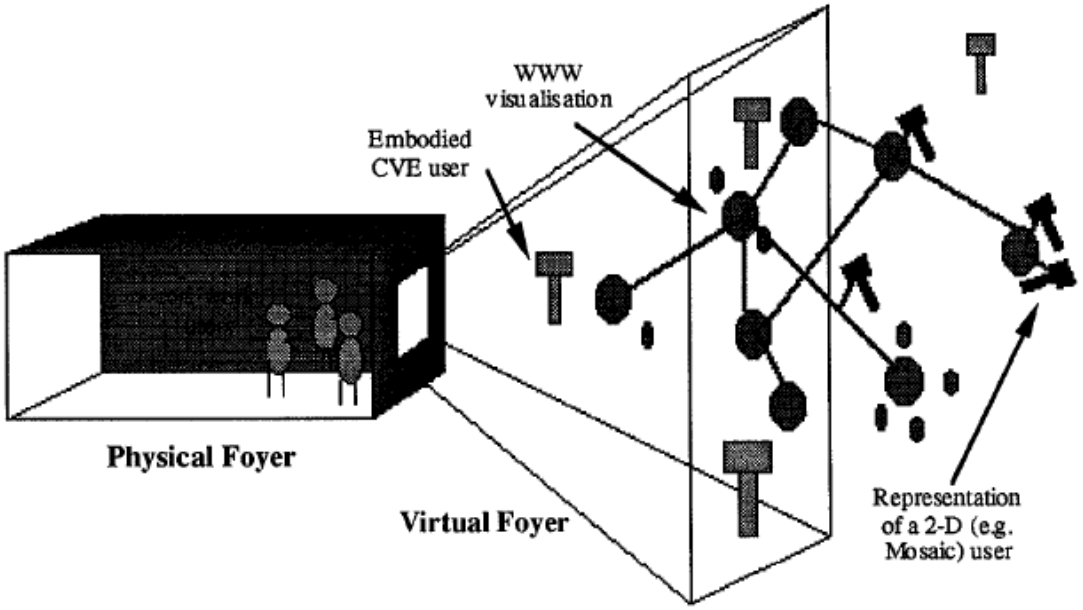


Figure 6: The Internet Foyer Functionality, taken from (Benford et al., 1996, p.83)

TeleDirection and Tele-Actor

The collaborative TeleDirection interface "allows a physically remote and geographically distributed audience to collaboratively control a shared remote resource" (Donath, Spiegel, Lee, Dobson, & Goldberg, 2001, p.331). The TeleDirection system consists of "contextualized user-driven goal setting and voting, an economy, and chat" (p.331). The TeleDirection system allows a TeleActor to act under the guidance of remote users who perceive a single live video feed of the TeleActor's environment. Figure 7 presents the Tele-direction interface.

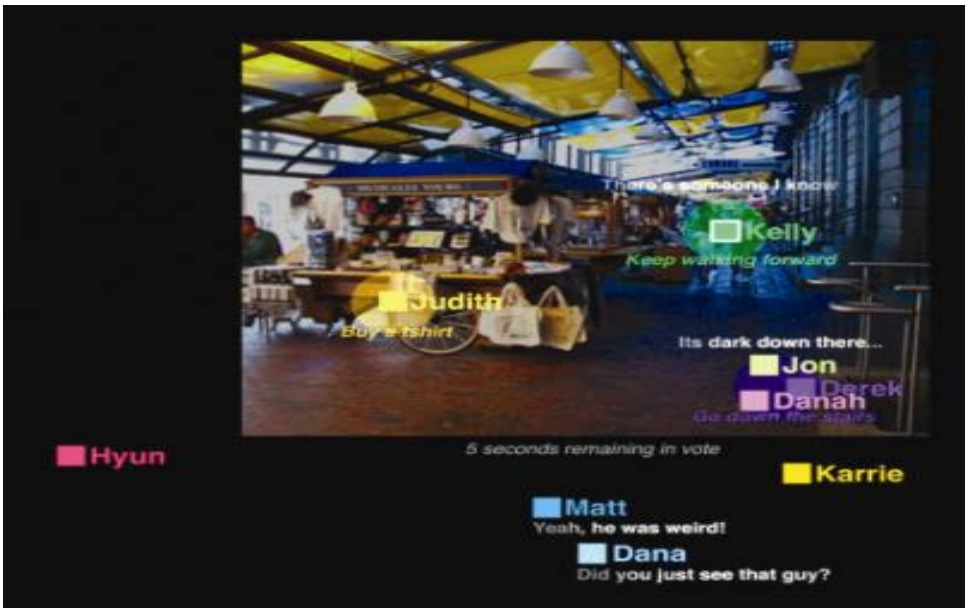


Figure 7 : The User Interface for Tele-Direction, taken from (Donath & Viégas, 2002, p.9)

A number of users were all able to see the TeleActors view through a video feed. Certain tasks were required and the multiple users voted on what actions the TeleActor should take in order to achieve them. Once an action had been selected this would be communicated to the TeleActor via chat. It does not appear that there was any explicit support for deixis in this application.

Figure 8: TeleActor Wearing Gear, taken from (Donath & Viégas, 2002, p.9)

Shared Collaborative TelePresence

Shared collaborative telepresence synthesizes the concepts of telepresence, tele-actor, and tele-direction. The key innovation that the Shared Experonments system provides is to support interactive collaborative telepresence. A mobile individual can stream back a high definition audio video feed from their environmental location. Another individual (control) either mobile or at a fixed location will be able to receive the video feed and be able to see what the mobile person can see. Control can then use a cursor or similar pointing device to indicate articles of interest in the video feed. The mobile person's heads up display will then show what the control is indicating, e.g. a disembodied hand with a finger pointing to the appropriate part of the environment. Two way voice communications would thus support interactions like the following

* [control]: "can you take a closer look at this (control gestures to artifact in mobile environment)"

* [mobile]: "how's this? (mobile moves closer to indicated artifact)"

* [control]: "much better, now can you move over here (indicates location) so we can see it from a different angle?"

In addition the deixis process should be able to work in both directions, i.e. allow users to switch roles of mobile and control. The challenge for this system is to support technological intersubjectivity at a level higher than that available through any other collaborative system running on existing technological medium.

Usage Scenarios

Each scenario is briefly described followed by an implementation analysis that includes a list of key functionalities, application services and key technologies.

Scenario #1: My Media

Bobby is a movie/games fanatic. He takes the Hawaii Mass Transit everyday to work and the ride takes about an hour. He has purchased a special pass for the D-BOX[3] seat equipped coach of the HMT. Bobby gets in the train, sits in the D-BOX seat, fingerprint in the system, dons on his HUD glasses. and plugs in his noise canceling high-definition earphones. Now he uses his HD movie pass to request for a live streaming of the Transformers movie. The movie is streamed in glorious 1920 x 1080p high definition

[3] http://www.d-box.com/

and the D-BOX codes are downloaded instantly. The D-BOX seat puts him in the middle of the action during the smooth train ride to his destination. While watching, Bobby used the Magic Ring tool to interact with the movie dynamic HD[4]. On his return journey, he watches the rest of the movie and remote plays a video game on PS# at home using his PSP.

Implementation analysis:

Application functionality

- HD Movies and HD Games
- HD Video, HD Audio, HD Motion

Services

- HD Movie Library
- HD Gaming Library
- D-BOX Motion Codes

Technologies

- WiMax
- 1920 x 1080p 120 Hz mini-HMD with noise canceling HD headphones
- D-BOX motion enabled seats

Scenario #2: Annotating My Place

Waikiki

You're on vacation at Waikiki beach. Walking along the crowded sands, you wonder what it would look like if you could dive underwater. Flip on your glasses and Annotated Earth, and you can soon access video shot under the water in front of you.

- High bandwidth streaming capability
- Like Google Earth, but with location-based customization and annotations

[4] http://www.dynamichd.de/

- Server-based organization and client-side interface for easy retrieval of desired annotations will be critical. Social filtering may apply

Berkeley

Now a tourist in Berkeley, you wonder about the historical events that took place there in the 1960's. Annotated Earth's indexing includes a time dimension: putting on your glasses you can go back into time to view video of police beating up hippies at the very spot you are standing.

Joining others at a virtual location

Isn't the Lake Lovely, Honey?

Dan gets to travel to many conferences and meetings around the world. His wife, Sharon, doesn't get much time off, so can't join. Sharon is jealous. Dan is at a lakeside resort in Hangzhou, China -- a favorite of the former Chairman Mao. Dan and his colleagues are having dinner at a lakeside pagoda as the moon rises over the willow trees ... how romantic, if only Sharon were here!
"Ding Ding! Sharon, your husband would like you to join him in Second Earth!"
Sharon puts on her high-resolution "Really There@ headset, selects her husband from her favorites list floating on the side of the screen, and says "join him." Sharon experiences herself rising and floating over to China, fast enough to be exciting but slow enough to not be disorienting, and lands next to Dan at Qiantang lake. Dan is seeing Sharon's avatar superimposed over his actually-present reality of the moonlight on the water, while Sharon is seeing live streaming video captured by Dan's Media Planet glasses.
"Isn't the lake lovely, Honey?"

- Obviously makes use of bandwidth.
- Live interaction is supported by the same infrastructure as Annotated Earth, simply by indexing the media annotation to the continuously updated present.
- The addition of avatar representations in either or both directions is optional. It may be enough to share live video and audio.
- Unclear whether it will make Sharon less jealous, or more!

This has other applications such as virtual meetings in business contexts, but there is a need to be careful about not falling into the trap of assuming that virtual presence is like physical presence.

Stalking the Elusive Laysan Finch

Hannah, avid amateur ornithologist, is excited because her son has been invited to participate on a scientific expedition to the remote and protected Northwestern Hawaiian Islands, and today (the evening in her time zone), he will be visiting Laysan Island, home of the Laysan Finch and Laysan Duck, two bird species found nowhere else on earth. Dan has just summoned Hannah to join him, virtually, on the island. Donning her Really There headset, Hannah selects and joins Dan. She immediately sees what Dan sees, captured and streamed to her via satellite from his field-hardened version of the Media Planet glasses. Whispering to each other so as not to scare the birds, Dan says, "We're near the saline lake and I found a little water hole. Look, it's a family of Laysan Finches getting a drink!" Hannah asks where, and Dan points using the shared collaborative telepresence deixis support. Hannah is now able to see the bird and quickly looks it up in the Better Bird Book and confirms the identification. Then, Dan slowly crawls on the ground towards the lake to get a close look at the Laysan Ducks grazing there.

Discussion

The Shared Experonments system integrates advances in augmented reality with innovations in social software and deeper understandings of social sciences. The Shared Experonments system is theoretically motivated by the notion of "technological intersubjectivity" (TI) (Vatrapu, 2007). TI refers to a technology supported interactional social relationship between users. Informed by the notion of technological intersubjectivity, in designing and prototyping the Shared Experonments system we are also empirically investigating the social consequences of ubiquitous Internet connectivity. For example, some applications of the Shared Experonments system (such as My Day) are specifically designed for unobtrusive recording and relaying of rich real-time ecological and social information with user-desired levels of interactivity. Other applications in the Shared Experonments system (such as Annotated Earth) are specifically designed to be fully interactive and immersive. The Shared Collaborative TelePresence service of the Shared Experonments system empowers the users with creative control of their physical environments. By dynamically resolving deictic expressions and gestures, the Shared Collaborative TelePresence service provides the familiar real-world interactional mechanisms in virtual reality, mixed reality and augmented reality settings. Potential applications are envisioned in computer supported cooperative work (CSCW), computer supported collaborative learning (CSCL), tourism, and travel. Appendix A presents the system architecture.

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Appendix A: System Architecture