

UNDERSTANDING AND CONSTRUCTING SHARED SPACES FOR SUPPORTING INFORMAL INTERACTION AT A DISTANCE

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Abstract. This paper discusses the support of informal interaction at a distance using shared space approach. From examining existing examples, we identified critical issues and suggested that a lack of sense of shared space might be the cause of these issues. In order to understand how sense of shared space is supported in these systems, this paper introduces a taxonomy of mediated shared space for informal interaction whose categories are classified based on the degree to which the sense of shared space is supported.

Keywords. Informal interaction; shared space; collaborative virtual environment.

1. Introduction

Informal interaction such as having a short conversation after encounter in hallway, chatting after the meeting, gossiping during break time is acknowledged to be an important factor in organizational outcomes (Mackay, 1999; Isaacs et al, 1997). When people are co-located or together in a single building, physical proximity increases the probability of frequent encounters among them thus they can maintain their casual conversations day by day. Nowadays, collaborative works are widespread with geographically distributed teams and co-workers. With such physical distance, informal interaction among team members is unable to occur as usual. In order to maintain the benefit of informal interaction, researchers have developed a variety of methods which employ video-based technologies, virtual reality technologies, locator technologies, ubiquitous technologies, etc. to enable

informal interaction among geographically distributed people. Although these technologies have provided essential mechanisms conducive for informal interaction to take place naturally, some problems are still reported.

This paper is interested in the cause of the problems and how to address them. First, we examine research projects developed for supporting informal interaction at a distance and the major issues that emerged from these systems. Second, we identify the causes from which the problems are actually rooted by analyzing the problems based on some grounded literature. We suggest that, the problems of these systems are caused by lacking a sense of shared space. Thirdly, we re-examine and categorize technical methods for supporting informal interaction at a distance towards shared space approach. A taxonomy of mediated shared space for informal interaction is introduced whose categories are classified based on the degree to which the sense of shared space is supported. This work helps to have a better understanding of how the sense of shared space is supported by corresponding technologies and can be a reference to develop new approaches based on the characteristics of each category.

2. Informal interaction at a distance and its issues

2.1. DEFINITION

Kraut et al (1990) defined informal interaction as “conversations take place at the time, with the participants, and about the topics at hand.” Based on the way in which people interact, E.Campbell and A.Campbell (1988) defined informal communication as “relatively unstructured information exchanges that tend to occur in face-to-face encounters during “off-task” moments.” In general, informal interaction is spontaneous and often occurs by chance when people encounter each other. The conversation could be unintended (spontaneous and opportunistic interaction) or intended based on the initiator but it is not scheduled in advance by both parties.

2.2. SUPPORTING INFORMAL INTERACTION AT A DISTANCE

When people are scattered at geographically distributed locations, physical distance disables the opportunities for chance encounter among them thus their interaction are totally mediated by technologies. General communication technologies facilitating this need include telephone, video conferencing, instant messaging and voice chat (Skype). However, it has been reported that in using these technologies, communication is less frequent, sometimes delayed in sending and receiving messages, and more effortful (Kraut et

al, 2002; Mackay, 1999). Above all others, these systems do not provide informal information such as peripheral awareness, chance encounter with which people are encouraged to come into contact and communicate. In order to maintain the benefit of informal interaction when people are physically separated, researchers have developed a variety of ways in order to imitate the actual situations for informal interaction to occur. They are:

Video-based Technologies. In general, video-based technologies make use of audio-video channel to be aware of people's presence and the degree to which people are available for communication; and to mimic face-to-face communication. In particular, each application employs different mechanism to facilitate informal interaction in its own way. For example VideoWindow (Fish et al, 1990) used video connection as a shared window for informal communication between two public lounges; Cruiser (Root, 1988) and Montage (Tang and Rua, 1994) employed the notion of "walking through a hallway and glance into open offices to see who was there" in which the virtual hallway is actually a path that contains a set of locations (offices, common areas, etc.) which the user might visit. RAVE (Gaver et al, 1992), Portholes (Dourish and Bly, 1992) and OfficeWalker (Obata and Sasaki, 1998) employed overview model to create "virtual shared offices" where people can keep a peripheral awareness of people and activities in a variety of places indefinitely through a matrix of slowly scanned continuous video images.

3D Virtual Reality Technologies. 3D Virtual reality technologies make use of 3D multi-users virtual environments or 3D collaborative virtual environments (CVEs) as shared virtual environments for geographically distributed people to socialize, interact and communicate. Each user is represented in terms of an avatar and able to populate, navigate and interact with others within a virtual environment. Typical 3D environments include Contact Space (Phillip and Andrew, 2000), FreeWalk (Nakanishi et al, 1998) and Valentine (Honda et al, 1999).

Locator Technologies. Locator technologies make use of positioning trackers such as active badges to track the staff's current location information in realtime (Want et al, 1992). A typical application of locator technologies for informal interaction is ActiveMap in which images of people's faces are superimposed over their latest tracked positions on the 2D map thus help people to engage in more intended interactions (McCarthy and Meidel, 1999).

Ubiquitous Media. Ubiquitous media takes the notion of media spaces one step further in which technologies are invisible and integrated into general ecology of workplace. Ambient Agoras (Streitz et al, 2007) is a smart environment which is developed to support awareness for informal communication, coordination and collaboration among distributed teams. It

uses the notion of ambient display and lightweight awareness mobile device for creating environment populated artifacts. The environment contains three artifacts: Personal Aura, Hello.Wall and View Port. Personal Aura is a mobile artifact for controlling user's appearance such as visibility or social role (project manager, regular member, etc.) in the remote environment. Hello.Wall is a 2D ambient display wall in which light patterns are used to display mood, activities, presence and interest of the remote teams. And View Port is a personal mobile device which is used to display personal information that is shown and stored in the Hello.Wall.

2.3. CRITICAL ISSUES OF THESE SYSTEMS

In daily life, informal interaction often occurs in two phases in turn: *awareness then engagement*. In other words, before people engage in a conversation, they must be aware of each other's presence and availability. Research projects have imitated the two phases in their systems for supporting informal interaction at a distance, however, critical issues also emerged from the two phases because of the nature of the supporting technologies. Two typical issues are: privacy violations and intrusiveness; and lack of engagement.

Privacy violations and intrusiveness concern the level of control to which people are accessed by others. Experimental results of Cruiser revealed that the method for initiating communication was abrupt and intrusive. The "glancing to other office" feature for being aware of other's availability caused a sudden image of the caller on the recipient's screen, thus, it might violate recipient's privacy and interrupt his/her current activities (Obata and Sasaki, 1998). Moreover, the caller's image placed the recipient in the zone for conversation (50cm-150cm) (Nishide, 1985) that urged the recipient to respond even when it was not welcome. Privacy violations and intrusiveness were also found in CVEs such as FreeWalk when an individual barged into a group of people talking among themselves.

Lack of engagement concerns the low possibility of an encounter leading to communication. Evaluation on the use of video-based technologies reports that spontaneous interactions did occur across these video connections, however, they occurred less frequently than in actual situation where people spontaneously encounter each other in a physical environment. The probability that an encounter will lead to communication is therefore reduced (Fish et al, 1992). Similarly, spontaneous encounter also occurred in CVEs environment while participants were moving. However, occurrence of conversation in 3D space was scarce since participants enjoyed moving in 3D virtual space more (Nakanishi et al, 1998). Lack of engagement is also reported in the evaluation of the Hello.Wall artefact. Although Hello.Wall used abstract patterns

for illustrating presence and awareness of remote team in order to reduce distractions and privacy concerns, the artefact did not attract any attention of people who were not the research participants although they were around the Hello.Wall.

2.4. SHARED SPACE APPROACH

According to Gaver (1992), shared space is described as an “encompassing space” which “is rich with perceptual information about objects and events that can be explored and manipulated”. By being co-located or being together in a shared space, people are able to encounter each other frequently thus the repeated encounters may lead to communication (Kraut et al, 2002). Additionally, spatial frame pushes people into a mutual recognition zone (Nishide, 1985) by which people are able to be aware of others’ presence and availability before approaching them for a conversation. Also, the space designated for informal communication such as cafeteria, break area may attract and hold people together in one location thus extend the opportunity for them to interact (Fayard and Weeks, 2007).

To account for the issues in 2.3, “mediated interactions between people via technology are prone to breakdown due to inadequate feedback about what information one is broadcasting and ability to control one’s accessibility to others” (Bellotti et al 1993). Obata and Sasaki (1998) claimed that such breakdown also occurs due to “a lacking sense of distance” among users in the network so that people are urged to respond to the conversation at a close distance and cannot ignore it. In conjunction with this criticism, Kraut et al (2002) shown that interruption and loss of privacy in video-based systems are due to the metaphor of physical proximity for initiating communication that sometimes caused unwelcome conversations. We suggest that the problems in section 2.3 occur due to lack of the actual sense of shared space for informal interaction.

3. Taxonomy of mediated shared spaces for informal interaction

This section examines and categorizes technical methods for supporting informal interaction at a distance towards shared space approach. From this categorization, we locate four major categories according to the degree to which the sense of shared space is supported. There are two motivations behind this classification. First, it helps to understand the degree for supporting shared space and the degree of corresponding technologies for supporting informal interaction so that others could utilize appropriate type of mediated shared space and supporting technologies for their research purpose. Second,

it allows us to identify the gaps emerging from each type of shared space thus enables new spatial approach to develop based on these gaps.

3.1. TAXONOMY BASED ON TECHNICAL METHODS

There are two typical categories of shared space in this taxonomy - shared physical spaces and shared virtual spaces (Figure 1).

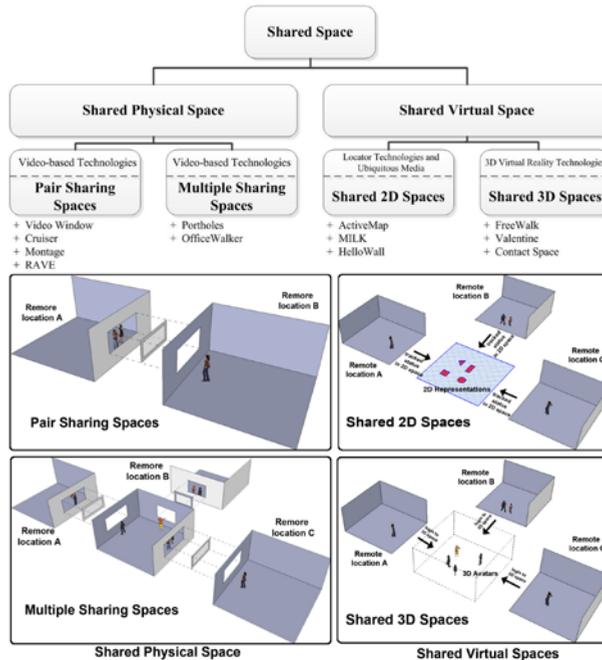


Figure 1: Taxonomy of shared spaces based on technical methods for informal interaction

Shared Physical Spaces. The shared spaces are created by using video-based technologies to connect two or more physical spaces in which one or more cameras are used to capture the scene of one location and display it on a screen located at other remote location. In this way, people in one physical space can view another physical space through a video screen in real-time. The video screen acts as a window to share the real scene between the two separate spaces so that inhabitants of these spaces will have the feeling that the other remote space is just behind the screen. The video screen could be a large screen such as projection screen or large TV, a desktop screen or even a handphone screen. People are able to communicate in face-to-face manner through the screen and serendipitous encounter may happen when people take a glance over the screen and is aware of someone's availability at the other

side. The larger the screen the more sense of shared space is supported since a very wide image can convey a heightened sense of realism (Fish et al, 1990). Since people can use one or more screens to connect with one or multiple remote locations at the same time, thus, the shared-physical-spaces category could be divided into two sub categories: pair sharing spaces and multiple sharing spaces. Pair sharing space is created by establishing video connection between two physical spaces. It can be used for private communication if the two physical spaces are individual's office spaces. Typical examples of pair sharing spaces are RAVE, VideoWindow, Cruiser and Montage. Multiple sharing spaces are created by establishing video connection between one physical space to many physical spaces. In this way, one physical environment shares its space with many other physical environments and vice versa. Typical examples of multiple sharing spaces are Portholes and OfficeWalker.

Shared Virtual Spaces. The shared spaces are created by enabling geographically distributed people to populate in a multi-users virtual environment. Each user has his/her embodiment representing for his/her presence in the environment. E.g. users of Contact Space and Valentine are represented as graphical avatars; FreeWalk users are represented as moveable pyramids embedded with real-time video of user's face on one side of the pyramid; users of ActiveMap and MILK are represented by the real photo of his/her face placed at his/her current position on the 2D office layout; and in Hello.Wall users are represented as individual patterns. We can group these shared virtual spaces into shared 2D and 3D spaces. In the shared 2D spaces, users' embodiments are displayed on a 2D surface such as an office layout or a designed surface in which the information of users' current location and availability for communication are provided for intended informal communication. Typical examples of 2D surface spaces are ActiveMap, Hello.Wall, and MILK. In the shared 3D spaces, geographically distributed people share a 3D virtual environment which supports spatial cues and structure, enabling people to navigate and interact naturally. Representative examples of shared 3D spaces are Contact Space, FreeWalk and Valentine.

3.2. CLASSIFICATION OF SHARED SPACES ACCORDING TO PERIPHERAL AWARENESS AND INTERACTIONAL POSSIBILITY

By being in a shared environment people can be mutually aware of their surroundings (peripheral awareness) such as what is going on, "who is around, what sorts of things they are doing, whether they are relatively busy or can be engaged" (Gaver, 1992). Upon the availability of people, one could approach and interact with his/her counterparts (interactional possibility). Therefore, we locate the four categories according to two dimensions -- the degree of

supporting “peripheral awareness” and the degree of supporting “interactional possibility” (Figure 2).

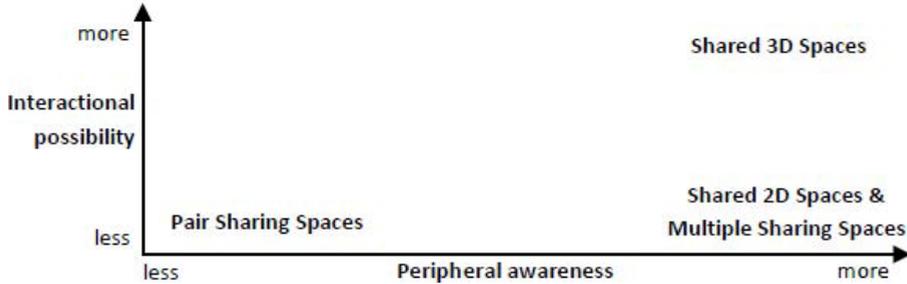


Figure 2: Classification of shared spaces for informal interaction according to the degree of shared space

Peripheral awareness. This dimension concerns the degree of being together in a shared environment through the opportunities to see and be aware of presence and availability of people who are geographically distributed in a non-obstructive way. In pair sharing spaces, peripheral awareness is less supported since the connection is only supported for two physical spaces. Moreover, the shared scene is restricted by camera range thus whatever out of the camera frame is unable to be seen. E.g. although VideoWindow provides a big screen to allow nearly the whole lounge area to be seen together with people thus support a great sense of shared space between the two remote lounges, however, some people often tried to strike up the conversation by moving close to the screen. It caused their head to move out of the camera range thus they could not be recognized by people at the other side (Kraut et al, 1990). With multiple video connections, multiple sharing spaces support a better peripheral awareness among people in various places through multiple screens. Similarly, the information in a shared 2D surface supports awareness at a glance through the information of presence, location and availability status of different people.

Interactional possibility. This dimension concerns the degree of being together in a shared environment through the possibility of approaching, participating and interacting or ignoring a meeting in the shared environment. Video-based technologies support interaction by providing “always open” audio-video link for quick interaction. However, evaluation of these systems showed that interaction occurred only among those who are already connected. Others are unable to join existing connections since there was no way to interrupt or override the existing links (Isaacs et al, 1997). Therefore, the categories of pair sharing spaces and multiple sharing spaces are placed

towards supporting less interaction. Similarly, although the shared 2D spaces are obvious and intuitive to indicate the updated information of people for intended interaction, interaction may not occur since people do not wish to wear the location tracker due to privacy issue (Carlsson and Hagsand, 1993). Interaction possibility is well supported in 3D virtual reality technologies since participants are able to freely populate, navigate, and communicate as well as socialize in one virtual spatial frame using real world metaphors.

4. Conclusion

This paper has discussed supporting informal interaction at a distance, a way towards shared space approach. We have introduced a taxonomy of mediated share spaces based on the existing technological approaches, for an understanding of the degree for supporting shared space and the degree for supporting informal interaction of these technologies. It is our hope that this taxonomy would be useful for research works which require a sense of shared space for informal interaction. Although this classification is for informal interaction, it could be suitable for any collaboration-at-a-distance purposes. Though in figure 2, shared 3D space is classified as an ideal shared space that meets the requirement of peripheral awareness and interaction possibility, interaction in shared 3D space is meaningful only if virtual workers are around and involved in the activities of the virtual world. Since virtual workers are not logged onto the virtual world all the time, thus, to some extent, the likelihood for informal interaction to occur in CVEs is not as high as in real life where their co-workers are around and can easily engage in a conversation when they encounter each other. Therefore, in our next stage of work, we will develop a model of shared physical-virtual spaces in which the integration of physical and virtual environment will overcome this limitation.

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