Networked Multimedia Support for Informal Collaboration

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Introduction

As part of a general research investigation into the use of technology in socially organised work at EuroPARC, we have, over the last five years or so, been studying the use of networked multimedia environments, or *media spaces*, in supporting work group collaboration. We have built a media space, the Ravenscoft Audio/Video Environment (RAVE), and used it in support of our own workplace activities for a number of years (Gaver et al., 1992).

When visitors to our lab encounter this technology for the first time, their immediate reaction is often to presume that its primary use is that described by the phrase "desktop videoconferencing"; that is, that the technology is used to support direct interactions and meetings held remotely between participants connected by the media space. However, our experience has been that primary value of the technology has not been the explicit "conferencing" of that sort, but rather the way in which patterns of *informal contact* and *passive awareness* can be supported.

These forms of communication are quite different to the traditional desktop conferencing model. They are often spontaneous and opportunistic, rather than prearranged; they are lightweight to initiate, and often involve little more than information sharing rather than being organised around an explicit task. There is often no clear boundary between being in communication with and being cut off from others. The many informal and frequently unfocused practices are both natural and valuable in maintaining group cohesion and synergy. We therefore feel that it is important that multimedia communication systems provide support for these as well as more traditional formal and focused ones. This paper describes a number of aspects of informal communication which our media space technology facilitates, together with some of the benefits and problems which accompany it.

The RAVE Technology

Our investigations have been concerned, not merely with the development of multimedia technology, but also with developing an understanding of how that technology is used in workplace settings. As a result, the technology on which our media space is based has remained quite simple, whilst a sophisticated culture of practices has grown up around it.

The audio and video network itself uses baseband transmission within our heavily-wired building. The cabling connects each office with a central electronic switching hub. The switching facility is controlled by a management system running on a UNIX workstation. This system, called IIIF (Buxton and Moran, 1991), provides a basic switching service over an arbitrary topology, and a certain amount of device control, as well as addressing naming and clustering issues for the devices which make up individual video "nodes". Each node comprises a CCD video camera, a video monitor, omnidirectional microphone, audio mixer and speakers. Video activity, then, is quite separate from workstation activity; the workstation is used to control services and to interact with applications, but not to capture, display or transmit multimedia information directly.

On top of this switching service, we provide a special service called Godard, which manages connections at the user level and provides feedback information and protection control for users of the media space. Above Godard are the client applications with which users interact directly, and which provide access of various sorts within Godard's connection management framework.

Maintaining Privacy through Connections Management

The primary function of Godard, the connections manager, is to address issues of protection and privacy. While it is essential that these issues be addressed, either technically or socially, in any environment where media spaces are used, it is also important to understand the relation between the way in which protection is achieved and the kinds of behaviours which can be engaged in by the users of a media space. Godard addresses privacy concerns by managing facilities for *protection* (controlling what connections can be made, and when), *feedback* (providing timely information on the process of connections within the environment) and *control* (user management of ongoing connections).

The Godard protection model is based on two fundamental concepts: *services* and *agents*. All connections are instances of particular services, which are essentially styles of connection with different properties. Examples of services within RAVE are "glance" (one-way video-only connection of a few seconds' duration) and "office-share" (extended two-way audio and video connection between two offices). When users make a connection to each other, they do it by requesting the use of a particular service which the system offers to them. Services, then, serve to delimit the space of connection from the initiator's point of view.

From the recipient's point of view, each connection request is handled by an *agent*, is a semi-autonomous process which fields connection requests on a user's behalf and processes them according to the preferences which the user has specified. Preferences are controlled through service properties, which describe the desired behaviour of the service for each user. Properties may specify the conditions under which connection requests are to be accepted or rejected (say, from specific users), or feedback mechanisms (such as audio signals used to indicate service activity (Gaver, 1991)).

It is interesting to note that, as our environment has developed, it has often been the feedback mechanisms, rather than the stronger access control mechanisms, which have been used to regulate activity in the media space (Dourish, 1993). Rather than making it impossible for another user to connect in particular circumstances, the feedback mechanisms can be used so that both parties will know that connection activities are "made visible" in a timely way and signalled to the recipient. The result is that *social, rather than technological factors, can be used to regulate access in particular environments*, providing users with more flexible ways to manage their activities.

Distributed Awareness Services

Early on in our experiences with using the media space technology in our everyday working activities, we noted that the most common use of the technology was not for explicit face-to-face video conferences, but rather for disengaged, long-term connections especially to public areas such as our common room. These connections would allow media space users to maintain an informal, passive awareness of activities around the building. Essentially, this activity is very like the informal information-gathering which goes on in physical environments and allows people to maintain a background awareness of ongoing activity and to manage informal communication. The sounds of photocopiers and printers, or of snatches of hallway conversation, are resources which we use in maintaining this awareness. We thus became interested in whether we could use media spaces explicitly in support of this activity; and further, whether distributed media space technology could provide a common focus for this information in distributed working groups which don't share a physical environment.

The result of this exploration was the Portholes system (Dourish and Bly, 1992). Portholes is a media space application which periodically grabs low-resolution still-frame images from participating media space nodes (public areas, offices, etc) and redistributes them to Portholes users, providing a snapshot of activity in the media space. Images are refreshed every five minutes or so. The Portholes servers which collect and manage these slow-scan images can communicate amongst themselves to share information and images; and thus different media spaces distributed geographically can be linked in the same "awareness space".

Portholes has been in everyday use since 1991, linking EuroPARC's RAVE media space with the media space in Xerox's Palo Alto Research Center (PARC), 7000 miles away. This has enabled members of these two research groups, who would otherwise have limited opportunities for contact, to be continually accessible to each other. Even the low-resolution images which Portholes uses are sufficient to show people working alone or in meetings, looking cheerful or glum, etc. The familiarity which builds up in such situations contributes generally to a shared sense of community and encourages informal contact. In order to facilitate this, the Portholes client provides the means to use the images as an interface into other communication facilities. Thus, the technology supports the patterns of informal communication and contact which support cohesion and collaboration in work groups, even at a considerable distance.

Long-Term Two Way Connections: a Social Phenomenon

The RAVE media space distinguishes between two services which are technologically very similar. Both "vphone" and "office-share" connections are two-way audio and video connections between office nodes. We distinguish between them because they are used in very different ways. A vphone connection, like a phone call, is typically short and focused. An office-share, on the other hand, is of much longer duration (days, weeks, months, years...) and isn't focused around a particular topic. It's more like sharing an office with someone.

We have looked at the patterns of communication which emerge in office-share connections which last for years (Dourish et al., 1994). One particularly notable aspect of long-term connections of this sort is the way in which other people in the immediate working environment come to use it. It is not uncommon to see a semi-permanent connection between two offices become a resource for other individuals wishing to communicate with the office-share partners. People will go to the office of one partner in order to talk to the other across the connection. Similarly, people talking to a local partner will generally greet or acknowledge the remote partner. In other words, members of the work group relate to the connected offices as if they were a single, shared office. They appreciate that the technology is linking two spaces, rather than two individuals. This is an important issue in terms of the way in which people interact, since "space" (and control over it) is a critical factor in managing access and regulating communication.

The continuous audio accessibility we have observed in some long-term office-share connections is another critical factor in supporting informal communication. The audio connection can be used to initiate conversation very easily, leading to patterns of very lightweight interaction. Similarly, due to the kinds of technology involved, sounds can be projected by speakers into the immediate vicinity, or other loud sounds nearby can be picked up by the microphone, leading to an effect we have dubbed "virtual neighbourhoods".

The Problems of Disembodiment and Dissociation

We have described the way in which multimedia communication environments can support informal as well as formal communication. The Godard system on which much of our media space infrastructure rests is designed to address privacy issues in connection control and management. However, it does not address a number of problems emphasised by the lightweight and extended nature of a number of these informal practices. We have been looking at the issues of privacy and presentation in these sorts of ubiquitous, immersive environments (Bellotti and Sellen, 1993).

Two particular classes of problem in managing self-presentation in these environments are disembodiment and dissociation. Disembodiment refers to the separation between people and their representations in the media space. The separation of my speech from the audio which is received remotely is an example of disembodiment; I have no control over, or feedback about, the volume which has been selected at the other end, so that I might unwittingly end up sounding much too loud or too quiet. Dissociation, on the other hand, refers to the way that actions in the media space are not attributable to their initiators. For instance, when a person speaks to a colleague across an office-share connection, but stands "off camera", the sound of their voice may not be easily recognisable and, since its source does not correspond with a physical and identifiable presence it may then be dissociated from the person speaking. The listener has no way to explore the space and make the association again which often means that they are unsure as to how to respond to this unrecognised presence, other than by asking the speaker to identify him- or herself.

These effects can lead to confusion over self-presentation and hence a set of privacy problems which are often quite inadvertent. We have been developing a framework to help us understand the issues which arise in these situations with an eye to the way in which technologies are developed and deployed.

Summary

Work group collaboration is supported not only by formal communication but also by a rich set of informal communicative practices. Conversations in hallways and around the coffee machine have long been recognised as important contributors to organisational information sharing and collaborative work. Part of our research has been the ways in which technology can support these informal practices as well as the formal ones.

We have outlined a number of ways in which our media space supports informal communication and collaboration. We have also described some of the issues which emerge when this style of communication is supported by our technology. As we continue to explore the application of these technologies to a wider variety of working situations (Pagani and Mackay, 1993), and as technological developments lead us towards widely deployed multimedia communications (Casner and Deering, 1988) and "ubiquitous computing" environments (Weiser, 1991), these issues will become increasingly important for the developers of networked multimedia systems.

References

Bellotti and Sellen, 1993: *Designing for Privacy in Ubiquitous Computing Environments*. Proc. European Conference on Computer-Supported Cooperative Work, Milan, 1993.

Buxton and Moran, 1991: *EuroPARC's Integrated, Interactive, Intermedia Facility: Early Experiences*. Proc. IFIP Conference on Multi-User Interfaces, Heraclion, Crete, 1991.

Casner and Deering, 1988: *The First IETF Audiocast*. SIGCOMM Communications Review, 1988.

Dourish, 1991: *Godard: An Architecture for Flexible A/V Services in a Media Space*. Rank Xerox EuroPARC Technical Report, 1991.

Dourish and Bly, 1992: *Portholes: Supporting Awareness in Distributed Work Groups*. Proc. Conference on Human Factors in Computing Systems CHI'92, Monterey, 1992.

Dourish, 1993: *Culture and Control in a Media Space*. Proc. European Conference on Computer-Supported Cooperative Work, Milan, 1993.

Dourish, Adler, Bellotti and Henderson, 1994: *Your Place or Mine? Learning from the Long-Term Use of Video Communication*, Rank Xerox EuroPARC Technical Report, 1994.

Gaver, 1991: *Sound Support for Collaboration*. Proc. European Conference on Computer-Supported Cooperative Work, Amsterdam, 1991.

Gaver et al., 1993: *Realising a Video Environment: EuroPARC's RAVE System*. Proc. Conference on Human Factors in Computing Systems CHI'92, Monterey, 1992.

Pagani and Mackay, 1993: *Taking Media Spaces into the Real World*. Proc. European Conference on Computer-Supported Cooperative Work, Milan, 1993.

Weiser, 1991: *Computing in the 21st Century*. Scientific American, September 1991.