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Abstract: Shared 3D environments are investigated as a means of providing information for supporting awareness and the feeling of co-presence in distance work. The aim of this work-in-progress is to develop work environments for distance work that help reduce social isolation and stress and increase work efficiency when working at a distance. Both social and ergonomic demands of the work situation will be taken into account.

Introduction

In traditional workplaces there is continual, mutual awareness of co-workers' activities as well as rich opportunities for informal communication and spontaneous meetings. This contributes both to productivity and to well being because of better coordination of work activities and support of social processes in the workplace. In distance work, however, these dimensions are largely missing, which contributes to social isolation, increased stress and reduced efficiency. The aim of the current project, which is in its initial stage, is to develop work environments for distance work that satisfy both social and ergonomic demands.

Providing Information for Awareness and Co-presence

A basic problem is to identify information that supports awareness [Dourish & Belotti 1992] and co-presence: the feeling of mutual, social presence, of simultaneously being in the same place. That information also has to be presented in a way that it does not intrude on foreground tasks, but serves as a background and a context. It must be sufficiently rich, but at the same time not violate privacy. A straightforward approach is to provide open video- and/or sound channels between participants. However, there are a number of disadvantages for continual use, such as high bandwidth requirements and violation of privacy. An opposite approach is to provide symbolic information, e.g., ambientROOM [Ishii et al. 1998]. However, the mapping of information is arbitrary and representations could become too artificial. Both approaches also lack the important notion of a common place. A third possibility, then, that has only recently begun to be investigated for this purpose, e.g., [Broll et. al 1999], is to use a shared 3D-, digital environment (DE) for supporting awareness and co-presence.

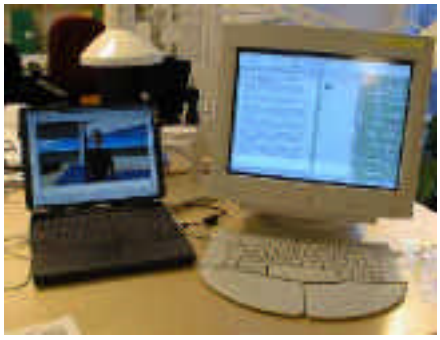
3D-, Shared Digital Environments

3D-, shared DEs, which are currently available over the Internet, can provide rich information without the surveillance aspect of desktop video. Rendered, but possibly realistic avatar representations of participants provide a straightforward mechanism for action filtering, to show only information that is pertinent to the situation. Because all participants are represented in the same environment a natural shared space for co-presence as well as for exchanging task-related information is provided. However, unlike most approaches to shared DEs, here the DE is not intended to supply the primary means for task-oriented, focused communication and collaboration, but to be a complement to other means.

Early User Studies

The Active Worlds technology [Active Worlds, 1999] was used for the initial mock-ups. A first informal study took place as part of a course requirement, where students' were building a shared DE for a virtual exhibition and meeting place. A group of three students were working together at a distant location and the tutors' task was to give advice, when requested, by means of the built-in text chat, or by telephone. Initially the tutor, using a 17" screen, experienced problems with screen estate and found the DE intrusive. A portable computer with a 12"

screen was then added, placed on the side and used for presenting the DE (fig.1). Students who needed help could attract attention by simply "walking up" to the tutors' avatar in the DE, filling the tutors' screen with their own avatar.



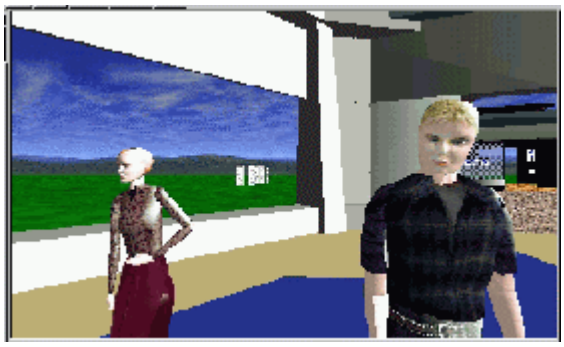


Figure 1: In the picture to the left a prototype workplace setup is shown. The picture to the right shows one participants' view of an interior of a DE with two other participants, represented by personal Avatars.

This kind of setup was found to provide a natural, efficient and non-disruptive way of keeping in touch and initiating communication. An informal evaluation showed that the DE induced a strong feeling of co-presence, but that awareness of actual activities at the distant site was lacking, due to limitations of the technology. The same observation was made in another study, where five informal text-chat meetings between three to four participants, and lasting between 15 and 30 minutes, were held in a DE. A short questionnaire was issued to the participants. They all agreed that the feeling of co-presence in the DE was high, but that there was a lack of information in the DE about real-world events.

Future Work

Solutions involving DEs obviously require an efficient coupling from events in the real world to the DE. Video image analysis and sensors are being investigated for this purpose. A related question concerns avatar design: how should users be represented and what do avatars need to be able to express? A flexible, ergonomic workplace along the lines of the simple prototype shown in fig. 1 is being developed in collaboration with TCO, using multiple flat-panel displays. Large-scale projections will also be investigated. Long-term user testing involving functional prototypes in at least three locations will be performed.

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