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Supporting Meetings in Virtual Environments

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Introduction

This report describes the current status of the Digital Meeting Environments (DiME) project, a collaboration between CID, the Swedish Institute of Computer Science (SICS) and Telia Research. The purpose of the DiME project is to investigate different approaches for supporting formal meetings in virtual environments. A basic set of tools have been developed and evaluated informally by the project members and we are planning to perform a set of user studies in the near future to determine the validity of those results and to obtain design specifications for an extended tool set.

Design Philosophy

In an attempt to increase the sense of presence among the users (the feeling of being a participant in the virtual meeting) and their awareness of other meeting participants, our tools are designed to put as much content into the virtual environment as possible. We avoid presenting information locally, i.e. displaying content in windows on the user's dektop. By doing this, we believe that we can achieve two important goals:

- We make it easier to keep the user focused on the virtual environment.
- The activities of a user can be followed by other users in the virtual environment.

Design of the Environment

The design of the virtual meeting environment is not arbitrary. It attempts to solve a number of problems often encountered in virtual worlds. This section describes some of these problems and how we have attempted to solve them.

Room

For virtual meetings, we favor closed environments in the form of rooms rather than open areas. By limiting the freedom of movement of the users we can keep the meeting participants from getting lost and increase the sense of presence among them. We also enhance the feeling of belonging together, being part of a selected group.

By placing large transparent windows in the walls of the room, it becomes open and less restricted. This also allows the users to view their avatars from a third-person perspective – if the walls are opaque, the camera and avatar may become situated on opposite sides of a wall, causing the user to lose track of his or her avatar. However, because of the relative difficulty of navigation within the virtual environment, we had to design the room with large areas of empty space, to limit the risk of bumping into furniture and walls.

Chairs

We believe that there is an important tradeoff between how freely the users are allowed to move within the virtual environment and how difficult navigation is percieved to be. For example, to move an avatar to a chair and sit down may be difficult because of limited field of view and the lack of haptic feedback and gravitation. On the other hand, restricting all avatars to fixed positions makes navigation easier but can be percieved as limiting. We have tried to combine the advantages of both approaches by allowing the users to move freely through the environment, while at the same time making it possible to let the computer assist in moving avatars to key locations. The assistance consists of a *cut*, a term borrowed from the science of film. When the user selects a chair, the system starts to move the avatar towards the chair and then positions the avatar at the selected location instantly, much like a location cut in a film. The first few frames of movement are important to establish the fact that the user is repositioning the avatar – standard "teleportation" is often percieved as disorienting, both for users that views the scene from first-person perspective and third-person perspective.

Table

A table is a natural meeting place, a piece of furniture that people naturally gather around. It is also used as a placeholder for documents and other tools that are required for the meeting. In our environment, the table has an oval shape rather than a circular shape. The reason is that the (undistorted) field of view of virtual cameras is limited to about 45 degrees. If the virtual table is circular, it allows for very few avatars to be seen on-screen, unless it is very large. With an oval table, more avatars can be fit into the view.

Design of Tools

Checklist

The checklist, shown in figure 1, is a tool for managing meeting agendas and notes. It consists of four parts: an agenda with checkbuttons, a common notes area, an area for private notes, and a area to keep track of current meeting participants.
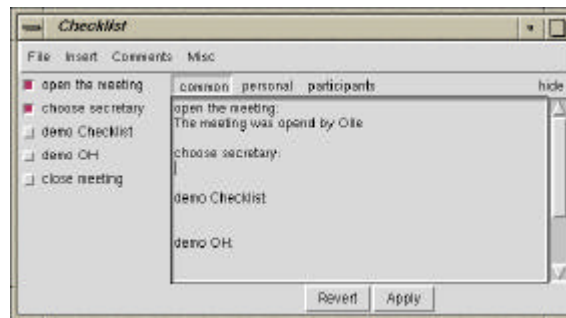

Figure 1. The checklist tool.

The agenda contains a number of checkbuttons with text labels that can hold the points on the agenda. When a user checks or unchecks an item it is immediately updated for the other users as well. Items can be added, changed, or removed during the meeting. The common notes area is used to enter meeting-wide text that can be distributed to and edited by all meeting participants immediately. The private notes area is similar, but the entered text isn't distributed. The participant list shows the current active meeting participants (i.e. those that have opened the checklist tool). A future addition to the checklist will be an automatic e-mail function that distributes the final meeting protocol to all users that participated in the meeting.

Slide projector

The slide projector, shown in figure 2, is used for presenting images within the virtual environment. A slide sorter dialog is opened by clicking on the yellow button. This dialog allows the user to add images in GIF or JPG format as slides. The image locations are specified as URLs. It is possible to load a user-specified text file containing lists of URLs to add to the presentation. The slide sorter dialog can also be used to change the order of the slides and to remove unwanted slides from the presentation. The green button steps forward one slide in the presentation and the red button steps backward one slide. If the presenter wants to move away from the slide projector during the presentation, a remote control for changing slides can be picked up by clicking on the blue button.

The slide projector control buttons are made invisible when the user moves away from the projector. This is done mainly to remove on-screen clutter, but also to avoid situations where other users than the presenter click on the buttons by mistake. Initial tests suggests that it is important to give the presenter a sense of control over his or her presentation. By removing the ability to change the current slide away from the projector (without holding the remote control), an increased sense of presentation ownership is obtained.

Figure 2. The slide projector.

The hardware limitiations in size and resolution of the physical display (i.e. the computer monitor) makes it unpractical for all meeting participants to view the slides on the display screen within the 3D environment – it either has to be very large or the participants have to remain close. A solution to this problem that is compatible with the design philosophy to keep as much information within the 3D environment itself, is to allow the users to pick up a set of "presentation notes" from the conference table. When this is done, the current slide appears in front of the user in the lower left corner of the view of the 3D world, as shown in figure 3. Other meeting participants can see the notes as a hovering paper, as shown in figure 4.

Figure 3. The user has picked up the presentation notes.

Figure 4. Presentation notes can be seen by other users.

WWW display wall

The display wall, shown in figure 5, is used to present WWW pages that are relevant to the current meeting. When clicking on one of the displays on the wall, the Netscape browser is pointed to the corresponding URL (if it is running on the user's workstation). In this way, meeting participants are given a facility for gathering around a relevant source of information and discuss it together. An alternative is to display the WWW page itself on the wall, which would allow users to directly point to interesting parts of the page and interact with it.

Figure 5. The display wall.

Design of Avatars

We have identified several problems related to avatar design. These include identification (which user is associated with a given avatar), navigation (what is the easiest way of controlling avatar movement), avatar activities (what is the best way to present the user's activities through the avatar), field of view issues, etc. This section describes our solutions to some of these problems.

Identifying Avatars

Since designing individual avatars is time-consuming, our first solution of the avatar identification problem was to add support for name tags to the virtual meeting software. A name tag is a word that floats above the avatar within the virtual environment. Later, site-specific avatars with different functionality was added to the system, making it easier to see from what site a given participants is from. How best to individualize avatars is an open problem that we intend to pursue at a later stage in the project.

Field of View

Upon request from a few project members, a facility for changing the field of view of the virtual camera was added. The field of view can be changed interactively by pulling at the slider. However, the feature is of limitied use because of the severe distortion that results from expanding the field of view to more than 45 degrees.

Avatar activities

Describing the activities of avatars is a difficult problem in all systems for building general virtual environments. Apart from the problem of how to separate an avatar's movement patterns from its general appearance, it is also time-consuming to specify different movement and functionality patterns for interacting with different kinds of objects within different worlds. This problem could be solved by allowing parts of the activity patterns to be defined by the objects rather than the avatars, but it is unclear how to do this in a simple and efficient manner.

For example, if a chair exists within the environment, should the avatar "know" about how to sit on chairs or should the chair be allowed to "tell" the avatar how to sit down? We are investigating the pros and cons of both approaches, aiming at identifying a commond ground where the responsibility of controlling avatar activities is shared between avatars and objects within the environment. The avatar, for example, could have a "soul", i.e. it might know something about chairs and that it is possible to sit on them. A chair might then be designed to provide further details about sitting down, i.e. its position and extents.

Tools for recreation and entertainment

Before, during, or after a formal meeting, some participants may want to meet informally. We are looking into different ways of supporting this, but one feasable approach is to provide special environments for entertainment and recreation. Since current commercial on-line computer games for multiple participants such as Quake or Ultima Online, have a high tempo, are combat-oriented and doesn't provide real-time sound transfer (i.e. only text chat is possible), they may make informal meetings and exchanges difficult. Our guess is that more relaxed environments where the users can choose to not take part in the actual entertainment will be beneficial. We have built one such environment, the chessworld.

Chessworld

The chessworld environment consists of a large chess board surrounded by a spectator arena, as shown in figure 6. Apart from the standard set of chess pieces, it also contains a fully functional chess clock and the ability to undo previous moves. Presently, it is not connected to a computerized chess server. The arena was built in such a way that both spectators and players get a good overview of the game. The chessworld also contains a portal for moving back to the meeting environment.

Figure 6. The chessworld.

Usability Testing

At the time of writing, the meeting tools are still under development and therefore, no formal user studies have been made. Most DiME project meetings are being held within the virtual meeting environment, with mixed results. The project members are normally distributed between three different physical locations (SICS, Telia and CID), which can be difficult when technical problems arise. However, by using the system in a "live" situation, important issues can be identified at an early stage in the design process. The meetings also guide the development of new tools. This, together with standard usability studies, provides a thorough tool development method.

Future work

We have reached a point in the project where user studies become important to evaluate the current meeting tools and to direct future tool development. This section describes two of usability studies that we are planning to do during the spring of 2000.

Environment Sounds

To increase the sense of presence within the virtual environment, we will work with sounds. Our hypothesis is that well-designed environment sounds will increase the sense of precense and awareness. We are investigating two types of sound: environment sounds and user sounds. The environment sounds originates from the environment itself. For example, if the meeting takes place in a building close to the sea, ocean sounds could be played in the backgroud. We will also investigate how the user's sense of presence changes if the environment sounds doesn't match the visual appearance of the virtual world. User sounds are sounds that originates from users. We are working with different approaches to allow users to announce their presence in the virtual environment through sounds, not only through sounds that are played when the user enters and exits the world, but also sounds that are played continously when the user is present within the environment.

Usability Studies

In this study, we will evaluate the usability of the current tool set. First, subjects will be trained to use the virtual environment tools. Then, the subjects will be asked to step through the agenda of a formal meeting. The usability evaluation will be based on contextual inquiry and a questionnaire.