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Virtually enhancing the perception of user actions

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Abstract

This paper proposes using virtual reality to enhance the perception of actions by distant users on a shared application. Here, distance may refer either to space (*e.g.* in a remote synchronous collaboration) or time (*e.g.* during playback of recorded actions). Our approach consists in immersing the application in a virtual inhabited 3D space and mimicking user actions by animating avatars. We illustrate this approach with two applications, the one for remote collaboration on a shared application and the other to playback recorded sequences of user actions. We suggest this could be a low cost enhancement for telepresence.

Key words: Avatars, animation, collaborative virtual environments, application sharing, telepresence.

1. Introduction

Computer supported collaborative work environments usually offer limited perception of actions by other users. In this paper, we propose to enhance the perception of "who's doing what" during a collaborative session. We consider either remote computer supported collaborative work, so bridging space distance, or replaying some recorded sequence of actions, so bridging time distance.

We propose to augment collaboration with gesture communication by virtual reality. Gestures help focusing attention on objects of interest. Seeing somebody manipulating an object, rather than just observing the result, may help perceiving that action. Finally, distant restitution of user gestures in a collaborative virtual environment allows non-verbal communication [1].

We describe a virtual environment to immerse a shared 2D application in an inhabited world. Distant users are represented with animated avatars acting on the application. We also discuss some usages.

2. Application sharing with avatar animation

Multipoint videoconferencing-based collaborative applications allow gesture communication but require broadband networks. Such systems poorly support immersion because each user appears in a separate window and it is difficult to know who is acting [2].

Group perception can be improved by immersing the shared application into a virtual multi-user 3D world. In NetICE [3], each user is represented with a humanoid avatar standing by the application mapped on a board in the virtual world. Unfortunately, users' actions on the application are not associated with avatar animation. A further limitation is that the application board is usually poorly readable in the 3D world, so NetICE requires switching between the 3D interface and the 2D application view.

We propose to enhance perception of who is doing what by animating avatars in the collaborative virtual environment to mimic user actions on the application space. The active avatar stands in front of the board and follows with its hand the event position associated to the user's actions in the application window. In the case of single user applications, non-active users willing to interact raise a hand to show their request.

Furthermore, perceiving other participants should be preserved even while acting on the application window. Thus, we have developed a hybrid interface with two parts: an application space that is a high quality view of the application that can be directly manipulated, and an immersive inhabited space that is the virtual meeting place gathering participants and the application they share (Fig. 1).

We have developed a prototype based on open source VNC [4] for shared remote access to an application. The immersive inhabited space is a VRML model with H-ANIM [5] avatars that are displayed in custom clients based on the Xj3D free software [6]. A custom events server collects user actions on the shared application and forwards them to remote clients, which in turn locally

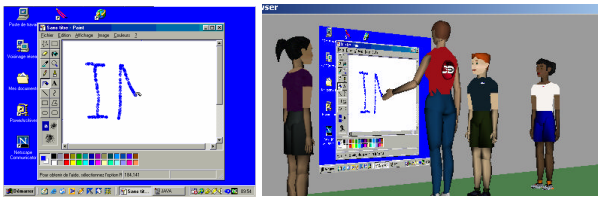

Fig. 1: Collaboration in a virtual inhabited world: user actions on the shared application are displayed with computed avatar animation.

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animate avatars. The IKAN inverse kinematics library [7] provides computing arm movements of the active avatars so that its hand on the virtual board follows the mouse track on the application. Implementation details are discussed in our previous paper [8]. Some demonstration videos are available at http://www-eph.int-evry.fr/~horain/MarquesSoares.

3. Annotation playback with avatars

Distance to events may as well refer to time rather than space, *e.g.* when reviewing a conference or a lecture from recorded slides, annotations and voice. Electronic documents with animations and synchronized audio can be recorded *e.g.* with SVG or XML [9] for later review.

We propose to enhance the perception of reviving such an event with a virtual playback. The electronic documents being reviewed can be immersed in a virtual inhabited space (*e.g.* a classroom) with avatars drawing users' annotations on them. Annotations can be any type of graphical overlay that appears on a document, like scribbling, encircling or highlighting lecture slides.

We have derived a standalone application from the above collaborative environment to represent the possibly multiple contributors (*e.g.* teacher and students) with avatars facing a board and mimicking users' actions. The SVG format supports document as time-stamped images, text and graphics including annotations as paths with attributes that allow encoding some author identity. We have used the open source Apache Batik toolkit [10] for core SVG browsing. A parser synchronously outputs the annotation coordinates to animate the 3D avatars by inverse kinematics and the graphics mapped on a virtual board.

4. Conclusion and perspectives

We have described an approach to enhance collaborative work or playback presentations by displaying user actions on a shared application as avatar actions in a 3D virtual world. It achieves gesture-based communication with little bandwidth or storage by animating avatars on the fly from application events. The system runs on consumer PCs.

The collaborative version augmented with voice over IP was briefly tested at INT for remote learning. A lecture was given jointly by 2 teachers in 2 classrooms, each teacher with a group of students. Rather than using 2 cameras and a broadband video communication, the slides and virtual world were shared through our system and video projected in both rooms. A large majority of students stated they would volunteer to attend again lectures with that technology [11].

More than just an artefact extra communication channel, the collaboration system can also be the basis for remote perception of the real world. Consider video projecting the shared application window and capturing user's actions on the projection board with a wireless pen system such as a mimio [12]. The virtual view appears to be close to the real scene (Fig. 2). This could be a basis for remote presence with low cost equipment for enhanced collaboration around a physical board.

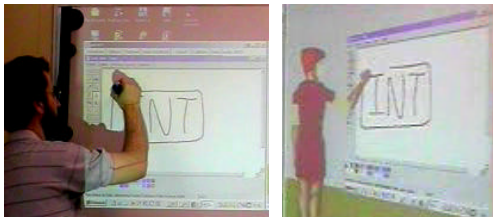

Fig. 2: Remote virtual animation from an augmented board.

The shared applications we used were 2D so far, but we are considering an extension for collaborative 3D visualization. Also, making avatars look like the users they represent would allow a straightforward association in a more user-friendly system. Finally, off-the-screen gestures may also be valuable for communication, so we are developing a motion capture interface by real time single-view marker-free computer vision to remotely control avatars [11].

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