Sharing and immersing applications in a 3D virtual inhabited world

José Marques Soares, Patrick Horain, André Bideau

GET / INT / EPH - Intermedia
9 rue Charles Fourier, 91011 Evry CEDEX France
{Jose_Marques.Soares,Patrick.Horain,Andre.Bideau}@int-evry.fr

Abstract

In a remote computer-mediated collaboration, co-workers have a limited perception of each other. Virtual humans can be used to increase interaction by immersion in 3D collaborative virtual environment. We discuss solutions to immerse shared 2D applications in a 3D world and to represent user actions on the application as avatar actions in the 3D virtual immersive inhabited world.

Introduction

In a remote computer-mediated collaboration, co-workers have a limited perception of each other: they loose the sense of immersion. To deal with this problem, some collaborative environments as NetMeeting [1] use videoconferencing. Leung [2] claims that these systems lack the sense of immersion because every participant sees others in separate windows and doesn't know who is acting.

In order to improve the group perception, users can be represented as avatars in a 3D virtual world. The 2D application can be mapped in the 3D world and shared among users in distributed virtual environments. For example, VReng [3] uses VNC [4] to provide a virtual board on which 2D application is shown. Unfortunately, in VReng users actions on the 2D-interface application are not associated with avatars actions. Another problem is that the 2D interface is usually poorly viewed and manipulated in 3D worlds. To bypass this limitation, NetICE [5] allow user to leave temporarily the 3D interface to interact with the 2D application.

We have developed a shared environment that allows direct manipulation of the 2D interface and where actions of users on the 2D application are reproduced by avatars in a 3D virtual inhabited world.

An immersive interface

The interface we propose has two separate areas: an *application space* and an *immersive inhabited space*. The *application space* is a high quality view of the 2D interface of the shared application on which users can directly interact. The *immersive inhabited space* is a virtual multi-user 3D world containing a virtual board on which the *application space* is mapped. Each user is represented with a humanoid avatar in the virtual world. Avatars in the *immersive inhabited space* reproduce user actions on the *application space*.

Users can look at *immersive inhabited space* and see who is acting. The active avatar is positioned in front of the board and follows with its hand the event position associated to the user's actions in the 2D-interface application. In the case of mono-user applications, only one user can be active at a time. Other users can raise their hand to show they are willing to interact.

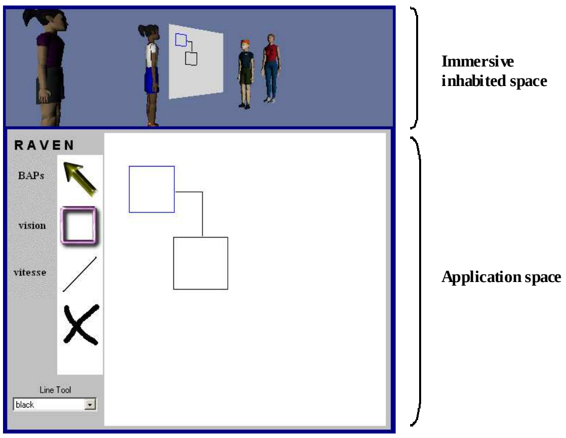

Figure 1 – Whiteboard

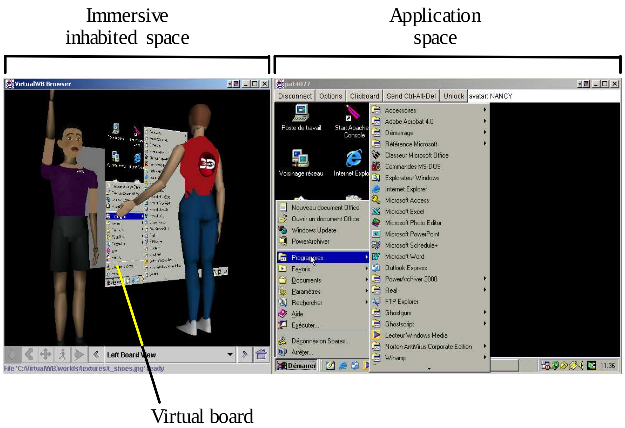

Figure 2 – VNC Client

The architecture

We have developed two prototypes: one uses a multi-user whiteboard application (Figure 1) while the other allows to share and immerse any standard mono-user application by using a VNC client (Figure 2). The two prototypes rely on client server based architectures. The *immersive inhabited space* is a VRML world where H-ANIM [6] standard avatars represent users. Actions triggered by users on a 2D application are sent to the server. If this action changes the state of the system, the server distributes the necessary messages to all the connected clients, which in turn animate the humanoid avatars.

All the animations are controlled in the Java client program. Avatar arm movements are calculated by inverse kinematics based on the IKAN library [7, 8]. To calculate the rotation matrices applied on arm joins, this algorithm uses a set of 3D co-ordinates parameters: the point of contact on the board, the avatar global position and the arm articulation positions.

In the whiteboard prototype, the avatar touches the vertices of the object being drawn to simulate the actions of the active participant on the 2D-interface. The communication between an applet Java and a VRML world is made with the External Authoring Interface (EAI) [9].

In the second prototype, the hand of the active avatar follows the mouse on the virtual board to simulate actions of the active participant on the *application space*. For this, we have extended a standard VNC client to allow the virtual board in the *immersive inhabited space* to receive image copies of the *applicative space* window when it changes. We use Java3D in this prototype to update more efficiently the image mapped on the virtual board and Xj3D [10] to load the VRML world and to animate the avatars.

See [11] for further implementation details.

Conclusion

In order to increase the sense of collaboration among co-workers sharing a 2D-application, we have developed a platform in which user interactions are reproduced in a 3D virtual world. We propose to augment the usual shared application space with a 2D+3D-hybrid environment where users can see other participants acting in the shared workspace. Thus we can improve the sense of immersion while preserving the 2D-interface ergonomy and allowing comprehensive 3D views of the environment.

As a perspective, we plan to integrate a computer vision interface for gesture acquisition [12]. Distant restitution of user gestures will allow non-verbal communication [13] among users and increase the sense of immersion. This might be used in collaborative scenarios that integrate a physical whiteboard client in the virtual world. Video projection and a wireless pen such as MIMIO [14] can achieve this. Besides representing the interactions with 2D interfaces, we intend to include users natural gestures realised out of the physical whiteboard.

References

[1] Microsoft Corporation, *NetMeeting Home*, http:www.microsoft.com/windows/netmeeting

[2] W. H. Leung & T. Chen, *Creating a Multiuser 3-D Virtual Environment*, IEEE Signal Processing Magazine, **18**, May 2001, pp. 9-16.

[3] P. Dax, *VREng Virtual Reality Engine*, http://www.infres.enst.fr/net/vreng.

[4] AT&T Laboratories, *VNC - Virtual Network Computing*, http://www.uk.research.att.com/vnc.

[5] Advanced Multimedia Processing Lab, Carnegie Mellon, *Projet NetICE.* http://amp.ece.cmu.edu/projects/NetICE/

[6] Humanoid Animation Working Group, *H-Anim specification* - http://H-Anim.org

[7] Center for Human Modelling and Simulation, University of Pennsylvania, *IKAN: Inverse Kinematics using ANalytical Methods*, http://hms.upenn.edu/software/ik/ik.html

[8] D. Tolani; A. Goswami; N. Badler, *Real-time inverse kinematics techniques for anthropomorphic limbs*, Graphical Models, Vol. 62, No. 5, 2000

[9] *The Virtual Reality Modeling Language (External Authoring Interface)* ISO/IEC FDIS 14772-2:2002, http://www.web3d.org/technicalinfo/specifications/eai/index.html

[10] *Xj3D Open Source VRML/X3D Toolkit*, http://www.web3d.org/TaskGroups/source/xj3d.html

[11] J. M. Soares, P. Horain, A. Bideau, *Partage d'applications et immersion dans un monde 3D virtuel habité*, Sciences, Electroniques, Technologies de l' Information et des Télécommunications, SETIT2003,Sousse, Tunisie, March, 2003

[12] P. Horain, M. Bomb, *3D Model Based Gesture Acquisition Using a Single Camera*, IEEE Workshop on Applications of Computer Vision (WACV 2002), Orlando, Florida, December, 3-4, 2002

[13] A. Vuilleme-Guye; T. K. Capin; I. Pandzic; N. Thalman; D. Thalman, *Nonverbal Communication Interface for Collaborative Virtual Environments*, Virtual Reality J., vol.4, pp. 49-59, 1999

[14] Virtual Ink Corporation, *MIMIO products*, http://www.mimio.com/index.shtml