Multimedia Virtual Laboratory

Tetsuro Ogi, Toshio Yamada, Koichi Hirota & Michitaka Hirose

Gifu MVL Research Center, TAO

IML, The University of Tokyo, 2-11-16, Yayoi, Bunkyo-ku, Tokyo, Japan

tetsu@iml.u-tokyo.ac.jp

Abstract: The Gifu MVL Research Center was founded in 1999 at the twin sites of the University of Tokyo and the Gifu Technoplaza. Both sites are equipped with large-screen immersive projection displays, known as CABIN and COSMOS respectively, and they are connected through the Japan Gigabit Network. The objective of the Research Center is the development of a distributed virtual laboratory over the broadband wide area network, focussing on communication and server technologies. This paper briefly summarizes the research activities at the Center.

Keywords: multimedia virtual laboratory, virtual reality, gigabit network

1 Introduction

The concept of a multimedia virtual laboratory (MVL) is that of a distributed virtual environment in which remote researchers, research equipment and information can be connected via the broadband network as if they were in a common workspace. For example, in the multimedia virtual laboratory, a computer scientist, an experimental engineer and a designer in remote locations can work co-operatively via the network to design a new product. In order to realize this concept, the Gifu MVL Research Center of the Telecommunications Advancement Organization of Japan was founded at the University of Tokyo and the Gifu Technoplaza in 1999, and the study team based there has been formed to include researchers from industrial, academic and governmental bodies.

2 Research Environment

The large-screen immersive projection displays CABIN and COSMOS are installed and used at the University of Tokyo and at the Gifu Technoplaza (Figure 1). These are CAVE-like multi-screen displays, which have five and six screens respectively, and which are connected via the Japan Gigabit Network. In addition, supercomputers and file servers are also connected into this networked environment. The objective of this Research Center is the development of a distributed virtual laboratory over the broadband network, focusing on communication and server technologies.

Figure 1: COSMOS at the Gifu Technoplaza

3 Communication Technology

3.1 Video Avatar Communication

In the field of communication technology, we are investigating post-GUI human interface devices and suitable methodologies for collaborative work in the multimedia virtual laboratory. For example, video avatar technology has been developed to realistically represent the humans form in the shared virtual world. A video avatar is constructed by capturing the live video image of the remote

user and superimposing it on the virtual world in real-time. In this process, the segmentation of the user's figure from the background and the modeling of the geometrical user's shape are key issues. By transmitting the video avatar mutually through the network, remote users can communicate with a high quality of presence (Figure 2).

Figure 2: Video avatar communication

3.2 Multi-modal Communication

In order to realize the high presence collaboration in the shared virtual world, it is necessary for multi-modal information, such as auditory and haptic sensations, to be shared between remote sites. This study examines methods of integrating various aspects of these sensations with the visual information, accumulating all of the available information in the multi-modal server, and then shaing it in real-time.

For example, a wearable force-display known as HapticGEAR was developed in order to allow users to experience haptic sensation within the immersive projection display. This device uses tensioned strings to represents the reaction force from a virtual object. By using this device in CABIN and COSMOS, remote users can collaborate effectively by transmitting haptic sensation in the shared virtual world.

4 Server Technology

4.1 Database Server

Examples of the server technology that has been built for us on the gigabit network include a database server and a simulation server. A database server is used to construct an image-based virtual world or to access information in the shared virtual world.

For example, we developed a database interface that enables the user in the virtual world to access multimedia data through the network (Figure 3). By employing this system, a user can retrieve and manage data in the three-dimensional virtual world by utilizing an office metaphor. In particular, an effective method for browsing data in the immersive virtual environment is examined.

Figure 3: Database interface using office metaphor

4.2 Simulation Server

A simulation server was installed on the gigabit network in order to access a supercomputer interactively from the virtual world, and a fast calculation algorithm was developed.

For example, the parallel prediction method outputs the deformation of a virtual object by using the non-linear finite element method in real-time. This method predicts the user's motion and works out several possibilities before they occur, using massive parallel computing capability. When the boundary condition is given, the data nearest to it is selected from the calculated results and the deformation is outputted interactively. This method can be applied to virtual experiment by interactively visualizing the simulation data in the shared virtual world.

5 Conclusions

This paper describes the overall concept of the multimedia virtual laboratory and also several research activities conducted in the Gifu MVL Research Center, such as communication and server technologies.

More details can be found on the following web-site:

http://www.gifumvl.tao.go.jp/