4—2 Virtual Reality Interface for Realistic Communication Services

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Abstract

In this paper, we present a VR-based interface method which provides users more natural, realistic, and interactive communication and collaboration tool.

Since most services in the communication systems matches with the services in the real world, the best understanding would be achieved when the communication services are represented in accordance with the services in the real world. However, conventional text-based interface and 2D GUI cannot provide such reality to the users.

In this paper, we discuss VR-based interface to overcome such difficulty and introduce one instance of communication system using the VR-based realistic interface, what we call Virtual Village, which we are currently developing. This application might be applied to education in virtual space, desktop conferencing system, and entertainment such as MUD or the games in the distributed environment, etc.

1. Introduction

With the increase in the number of non-professional PC users, human-centered user interface has become an important issue. While computer communication becomes popular with the spread of PCs and the development of related hardwares, most communication services provided are limited to text-based interfaces or GUI(Graphic User Interface), which are unable to deliver the clear and exact meaning of the service to the users. Therefore, users should learn to adapt themselves to the cyber environment of communication that is totally different from the real world.

VR(Virtual Reality) is a user interface technology that provides users with cyber environment similar as the real world. Basically expressed in three-dimensional graphic world, VE(Virtual Environment) offers a feeling of reality to the users. In other words, the VR interface in communication services promises to the users an environment they are more familiar with.

In MDVEs(Multi-user Distributed Virtual Environments), numbers of users can work together by sharing the VEs scattered in the network. To achieve such a function a great quantity of packet should be transmitted, namely l:n or n:m packet transmission is needed. Therefore, network bandwidth and latency are important issues for MDVE.

The existing MDVEs include NPSNET (Naval Postgraduate School NET), DIVE (Distributed Interactive Virtual Environment) and Green Space[1][6][7]. In particular, the DIS(Distributed Interactive Simulation) protocol used in NPSNET reduces the number of packets by dead-reckoning and by transmitting the user's state to only those users in the AOI(Area Of Interest) located in his sight. However, as users in VEs as well as the real world do not act according to the Newtonian laws, it is difficult to predict other's movements by dead-reckoning. And it is hard to define clearly the AOI in the cyber space by dividing in regular hexagon cells.

VVS(Virtual Village System) is a MDVE that clearly figures out the AOI in the communication service and defines the interactions in the room-shaped AOI among users in terms of LOD(Level Of Detail). VVS is an integrated system that unites weak interactive VE for many users and strong interactive VE among a small number of users, who are fully connected and exchange all events and messages. Unnecessary packet transmissions are thus eliminated in VEs that do not require strong interaction among users.

2. VVS: Virtual Village System

Most communication services have static information such as system configuration, and dynamic information such as reference materials or users' state. In text-based interface and GUI environment, centralized communication model is used, with the server managing all information and transmitting them because the amount of static information is small. But in the VE expressed in three-dimensional graphic model, we have no choice but to use distributed communica-tion model in order to achieve VR interface shared by many people, because the amount of information is huge.

Following are the ways to know other person's state and maintain the dynamic information in a system shared by many users.

- Request directly other person's state.
- Announce the change in one's state when it occurs.

In the existing text-based interface and GUI environments, the former has been used; in the VE interface using three-dimensional visual information, the latter is the good way to let others know about one's state. It is as if in the real world people get information on other people's states without being aware of it.

In general, the more people participate in a service, the less interaction there is among users, and strong interactive services are intended for a small group of users. Such phenomenon can be found in the real world: for instance, there is little interactive among the crowd of people walking in the street. In other words, in multi-user VE participated by many users, information on changes in other person's state has no meaning.

In VVS interactions among users are divided as follows according to the degree :

- strong-interaction : in a small group, user's state should be known precisely. All messages transmitted are shared.
- weak-interaction: in a medium-sized group, when it is not necessary to know exact state of others, the dynamic information that is predicted by certain behaviors for each user is maintained.
- false-interaction: in a big group where the only meaningful information on others is their presence, other user's movement is not informed at all, or is falsely described.

Each room in VVS provides one of the above interactions by LOD according to the number of users. Talk or Chat is implemented by strong interactive VE whereby all information used is transmitted to all users in small room, while in case of searching information or referring to materials, VEs are expressed either in weak-interaction or in false-interaction depending on the number of users.

Consequently, rooms in VVS can be classified in accordance with the degree in interaction. For example, if you want to represent a cafe, a table is a separate room that offers strong-interaction to all around the table. In this setting, information on other tables or the hall is of little, if any, importance : therefore, a false-interaction method offers a scene with numerous people moving about inside the cafe.

3. System Architecture

3.1 Virtual Village Map

Virtual Village Map is expressed in n-ary tree as shown in Figure 1. Each node on the Map represents a closed world. The non-terminal node is the exterior to the closed world, while the terminal node indicates the inside. Non-terminal nodes play the role of manager of children nodes, and maintain information on users.

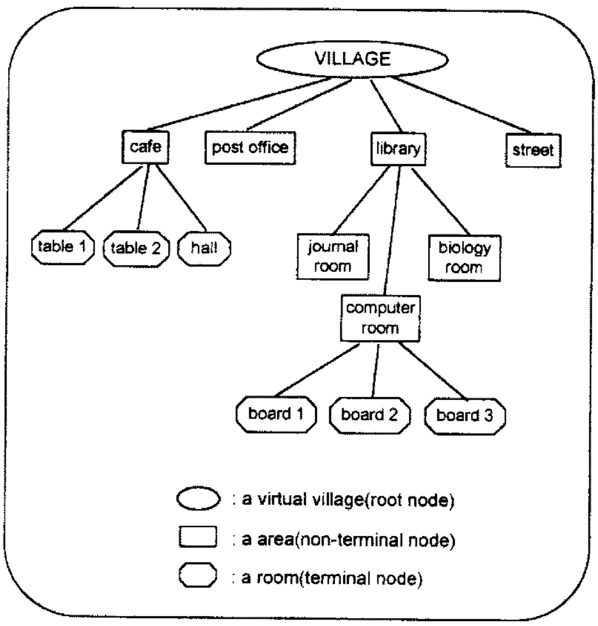

Figure.1 Virtual Village Map

The room expressed as terminal node is the basic unit of AOI. It is shared by users and offers the available services. Users can get information through such services, interact with other users, buy or sell things.

3.2 Avatar

The user is the dynamic node connected to terminal node in the Map, where the connection is not fixed or static. The user is expressed as three-dimensional model "avatar": it is visible or invisible according to the connection; the shape may be in greater detail or falsely described depending on the characteristics of the related room. In VE, avatar indicates the user's presence, identity, gesture, facial expression and action. In VVS dynamic object and agent are expressed as dynamic nodes just as users, and have three-dimensional graphic model suitable for each of their functions.

3.3 Geometric Connection Graph

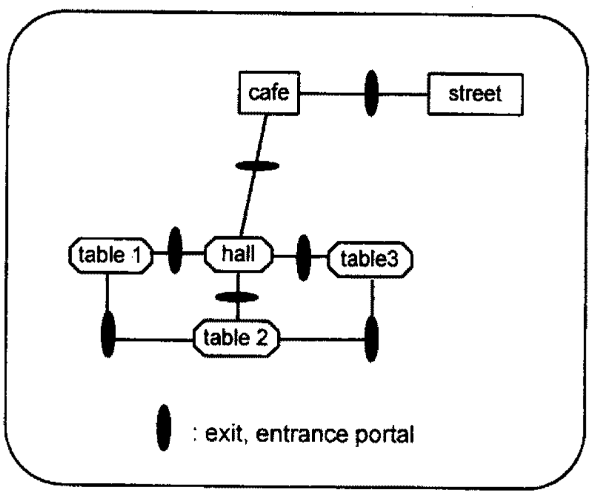

Figure 2. Virtual Portal Map

The user is always on one terminal node, and goes through a portal in order to move to other terminal node. Figure 2. shows the linking of portals inside a subtree. Each node on the Map has exit-portals and entrance-portals: the user passes through the path that links these portals. The nodes update the user's information each time he passes through, and determine the level of interaction based on that information.

3.4 Agents

In VE, visual and auditory information are not satisfactory offered in comparison to the real world, nor is it easy to manipulate avatars as the user wishes. It is very difficult to navigate in the three-dimensional cyber space and at the same time execute the desirable task. Therefore, to make sure one gets the various communications services perfectly, helping "agents" are needed. VVS offers following agents that help the user understand his state and interact with other users.

- agent announcing one's present state
- agent announcing the present state of the room
- agent announcing the present state of a particular user

In addition, various agents, such as e-mail agent, schedule agent, information retrieval agent, task execution agent, are provided for the convenience of the user.

4. Experiment

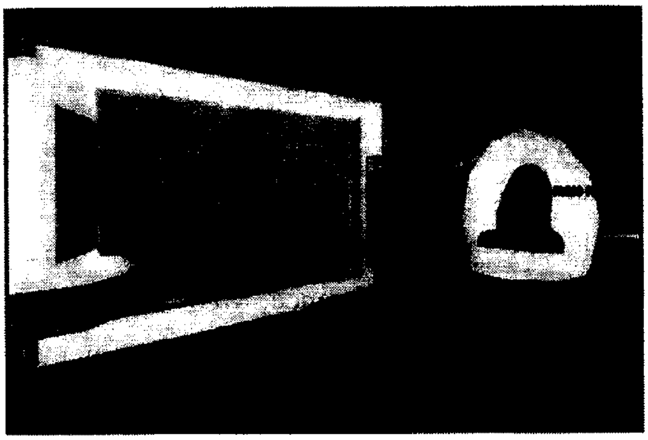

Figure 3. A Conferencing Room

Figure 3. is a room in VVS, where a girl introduces Mars' Rover to a man using the prepared materials, and a new user is coming into. In this conferencing room, all messages and actions are transmitted to all users. That's an AOI unit in VVS which provides strong interactions.

5. Summary & Future work

VVS is the MDVE that takes into account interactions generally made among users and utilizes the maximum of network bandwidth. In VVS each room is defined as an AOI, and the needed degree of interaction is expressed in terms of LOD. The static information is represented in the form of Virtual Village Map, and users, agents and dynamic objects are implemented as moving nodes that are linked to the terminal nodes of the Map.

Materials provided in communication services are represented as functions of the room.

The system is being implemented in MS Windows 95 environment. The result of this study will naturally be expanded to VR interface for the applications such as education, teleconference, MUD, etc. VVS offers the necessary action environments of IA(Intelligent Agents), too.

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