Visual Communication Environment Using Virtual Space Technology

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Abstract

The new concept of the visual communication environment for human collaboration is proposed. A virtual space created by 3D computer graphics and video texture mapping technologies is applied to create a shared and interactive environment for multi-user visual telecommunication. Necessary functions for this service are described from the view point of seamless modality. A prototype system of this service concept is also introduced. The proposed system, based on a combination of video and CG communication, offers a useful, effective, and innovative environment.

1. Introduction

Virtual Reality, Artificial Reality and/or Tele-existence technologies are new powerful technologies that can be applied to create various new and useful visual telecommunication services[1].

The main feature of these applications are thought to be the establishment of a virtual space on the network. A shared and interactive virtual space for multiple users on a network is usually called "Cyberspace"[2].

Habitat[3], SIMNET[4] and DIVE[5] are thought to be the initial steps towards a future ideal Cyberspace. These virtual space services are based on information generated by computers. All the visual images of these system are made through computer graphics or animation, and are imaginary. The virtual worlds of these systems have no relation to the real world. Users of these systems create free and imaginary projections of themselves in virtual space. This feature of unlimited projection

seems very attractive for entertainment applications.

On the other hand, the usual communication tools, such as telephone or videophone, are based on real information, that is, real voice or real video images of real people's faces. These communication tools can, however, support the creation of imaginary images of locations, such as talking and sitting side by side, or forming a face to face environment. The location is imaginary, but the information itself are the real voices and real facial expressions of users.

In order to support human collaboration in business fields, such as satellite offices, satellite schools, or remote shopping, a virtual space based on real information appears necessary.

From this point of view, we propose the new concept of a visual communication environment for human collaboration using a virtual space created by 3D computer graphics and video texture mapping technologies. The proposed system consists of a combination of an imaginary location and real video images. Necessary conditions of this shared and interactive environment for multi-user visual telecommunication are considered.

2. Visual Communication Environment

2.1 Necessary Functions for Human Communication Environment

As human communication environments, the telephone, videophone, electronic mail are already widely introduced. However, compared with the communication environment in real space, that is concurrent communication in the same place, these existing communication tools were designed to adapt to narrow, partial and special communication modes. In another words, these tools respond to and solve the limited requirments of human communication. The following points are thought to be latent and essential needs for future communication environment. Visual communication environment has to respond to these necessary design conditions.

(1)Seamless interaction between real-time communication and stored data

There are two modes for human communication in real space; (a)real-time face-to-face communication and (b)interaction using stored information files, such as paper files, photographs, or databases. Human communication in real coexistent space supports both communication

modes in the same physical interface to real space. People feel no barrier when exchanging the mode of activities in real space. On the other hand, existing communication tools between remote people are designed to establish each service mode separately. When users change the mode of activity, the tools must first be changed to reestablish remote communication. They encounter a significant barrier during such changes. Seamless, smooth and frequent transitions between both communication activity mode is necessary.

(2)Seamlessness in planned and casual communication

From the view point of planning level, human communication activities are classified into two categories; (a)Planned communication and (b)casual communication. Regular meetings are planned; Date, place, purpose and members are agreed before the meeting. On the other hand, casual meetings occur unexpectedly in a elevator, on a road, or at a passageway. In casual communication, people recall topics or think of business after seeing the partner's face unexpectedly. Both planned and casual communication play important roles in our communication environment.

Existing communication tools are designed only for planned communication. The user must decide the partner(telephone number) and topics before making the telephone call. New communication tools for casual communication are necessary.

(3)Seamless between various multi media

Various multimedia such as voice, non-verbal gestures, drawings, eye movements, text, paper, etc. are used for communication in real space. Existing communication tools are designed for each media separately. The user has to change tools depending on the media and communication modes. Communication tools that can support various media continuously and consistently are necessary.

2.2 Video-based Virtual Space

The visual communication environment consists of (a)Human objects that express people in the virtual space, (b)Topical objects that transfer information in the virtual space, and (c)the virtual space that symbolizes the configuration of information structures. By introducing 3D perspective expressions, 3D computer graphics is very suitable to create

an understandable and imaginative virtual space.

In order to represent human objects and topical objects in the virtual space, video images are more useful and more expressive than computer animation(CG). As the video image taken by a camera represents a subset of the information of the real world, people can recognize the actual situation of the partner easily. So, the combination of a CG-based virtual space structure with video-based objects is highly suitable as the virtual space architecture.

The expression of human objects affects their role in communication. As a human object represent personal existence in the virtual space, we named it "virtualself". Whether a virtualself has an imaginary expression image or a real expression image is significantly different. If a virtualself has an imaginary expression, an artificial feeling would be occur. Many users would feel that the role of this virtualself was as a "persona" of oneself. Such a situation is very popular in Habitat[3]. For example, a male may act as a female in the virtual space.

On the other hand, If the virtualself employs a real video-based expression, the visual image of the virtualself represents the real situation of oneself. Many users would think that the role of this virtualself was as a copy or branch of oneself.

As described above, we propose a combination of CG-based virtual space structure and video-based objects as a new concept of shared and interactive virtual space system for multiple users. This architecture is realized through the linkage of distributed and synchronized CG model worlds and video, audio and data communication network.

3. Prototype System

In order to evaluate the proposed concept, a prototype system (named "InterSpace") was implemented using distributed personal computers and a system server.

3.1 System Configuration

The system configuration of the prototype system is shown in Figure1[6],[7]. Visual images of every terminal are created by the personal computers of each terminal. The PC generates an interactive virtual space structure using 3-dimensional graphics. Video images are captured by a camera, and video images are pasted onto CG models using texture mapping. The system server controls data and video communication

between the personal computers.

The prototype system works in the following manner:

(1)The model data of the shared virtual space is distributed to each terminal (personal computer) beforehand.

(2)Virtual positions of all users in the shared virtual space are assigned. Users can change and move their position in the shared virtual space as they move around within the space. The system server broadcasts changes in the position data of each user to all users, so, each user knows the positions of the other users.

(3)Each terminal generates a view image of the shared virtual space depending on the position and direction of virtual view of the user.

(4)Each terminal also generate virtual images of other users in the shared virtual space. The virtual image of each user is expressed using a CG image of a monolith that has a video image of each user pasted to its surface. The video image is captured by the camera at each terminal and is broadcast to all users. Each terminal generates virtual images of the other users using their position data and video images.

(5)Each user can move freely from place to place within the shared virtual space as he can in real space. If one becomes interested in objects or other users in the virtual space, information can be accessed or discussions can be started.

3.2 Application services and evaluation

Some examples of the visual images of this system are shown in Figures 2, 3, 4. Virtual rooms, virtual buildings, virtual squares are created in computers using 3 dimensional CG. Each user connected to the telecommunication network can move freely in this virtual space. The "Virtualself" image of each user is created in the virtual space as a monolith overlaid by a video image.

The prototype system ("InterSpace") has been evaluated in our laboratory. The proposed human communication interface, which was designed on the model of walking in real space, offers a lot of fun and enjoyment to many users. This kind of pleasure seems to be very important for new telecommunication services

4. Conclusion

The concept of a new visual communication environment has been proposed. The proposed system is a shared and interactive multi-user virtual space that consists of a CG-based virtual space structure and video-based objects. This combination cause an extremely flexible environment for remote human collaboration.

A prototype system has been realized and suggests the establishment of many new imaginative sevices.

The human interface of walking and interacting within the virtual space offers a new dimension to daily communication activities. This attractive feature should play an important role in future communication services.

Acknowledgment

The authors express their appreciation of Mr. Kishimoto of NTT Human Interface Lab. for encouraging this work.

References

[1]A.Tomono and F.Kishino: "", Vol.6, No.3, pp.358-369 (1991)(In Japanese)

[2]M.Benedikt: "Cyberspace: First Steps", MIT Press (1992)

[3]C.Morningstar and F.R.Farmer:"The Lessons of Lucasfilm's Habitat", ibid. pp.(1992)

[4]E.A.Alluisi:"The Development of Technology for Collective Training: SIMNET, a Case History", HUMAN FACTORS, Vol.33, No.3, pp.343-362 (1991)

[5]L.E.Fahlen, C.G.Brown, O.Stahl and C.Carlsson:"A Space Based Model for User Interaction in Shared Synthetic Environments", INTERCHI'93 Conference Proceedings pp.43-48(1993)

[6]G.Suzuki, S.Sugawara, Y.Nagashima and K.Watanabe:"A Study of Cyber-community", Technical Report of IEICE, IE92-120, (1992)(In Japanese)

[7]S.Sugawara, M.Moriuchi, S.Suzuki and G.Suzuki:"A Study of Virtual Space Communication", Technical Report of IEICE, HC92-66, (1992)(In Japanese)

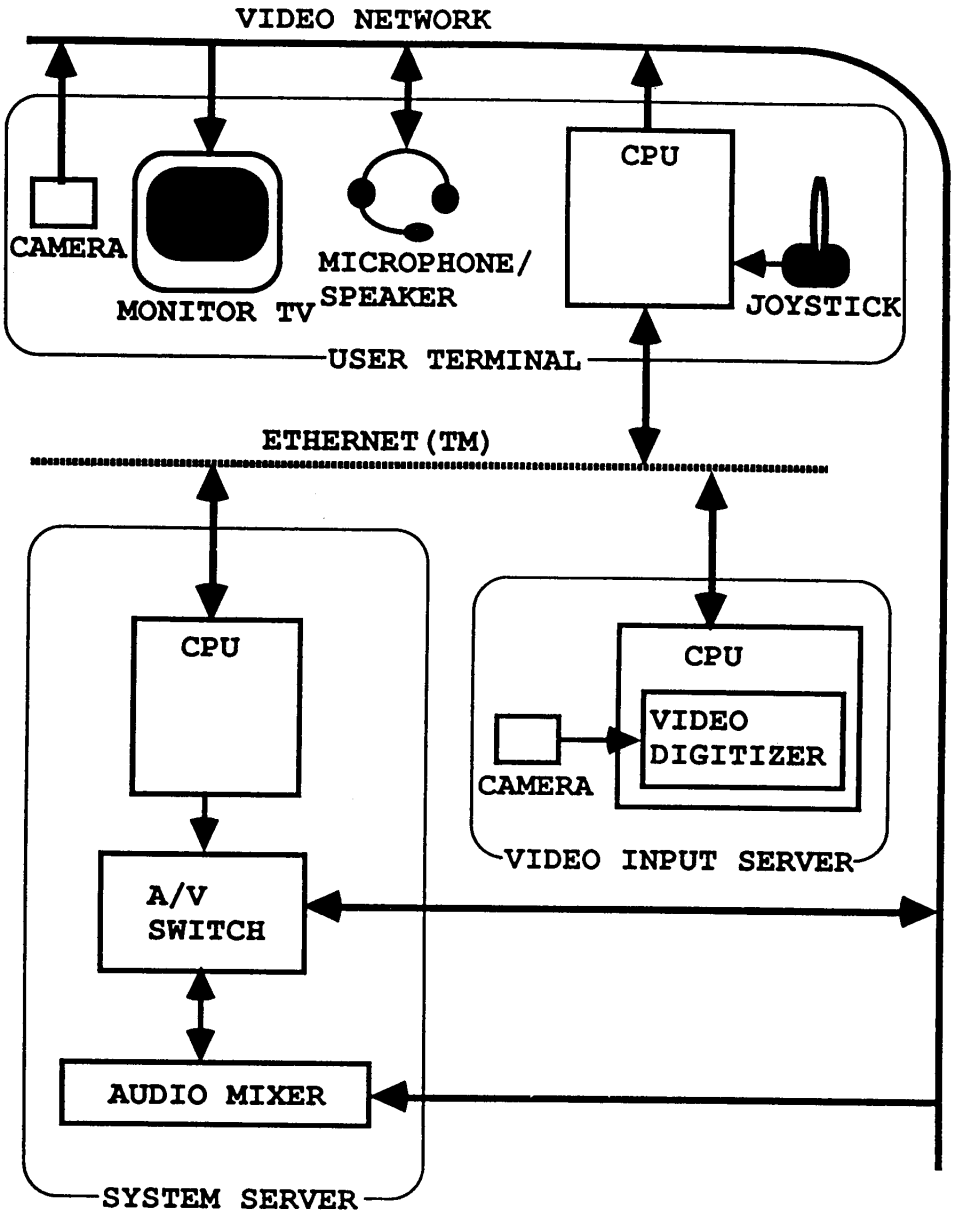

Fig. 1 InterSpace system configuration.

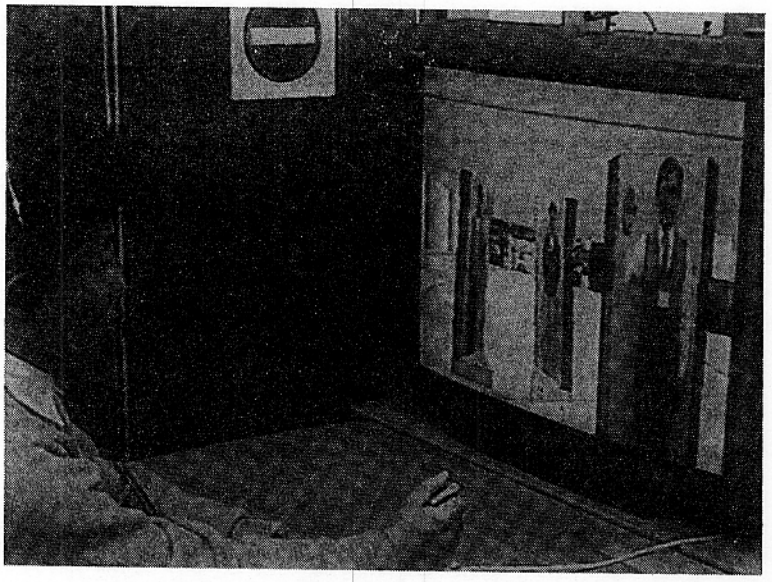

Fig. 2 An InterSpace Terminal showing Virtual-selves.

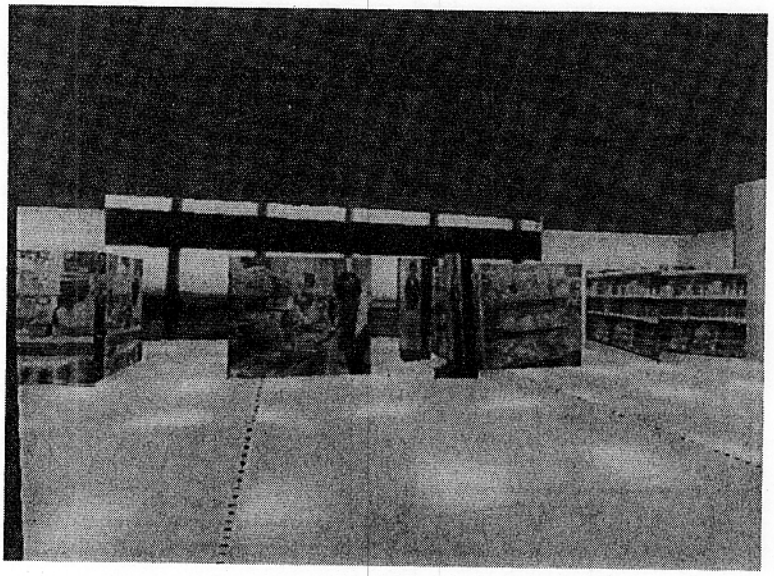

Fig. 3 Shops in InterSpace.

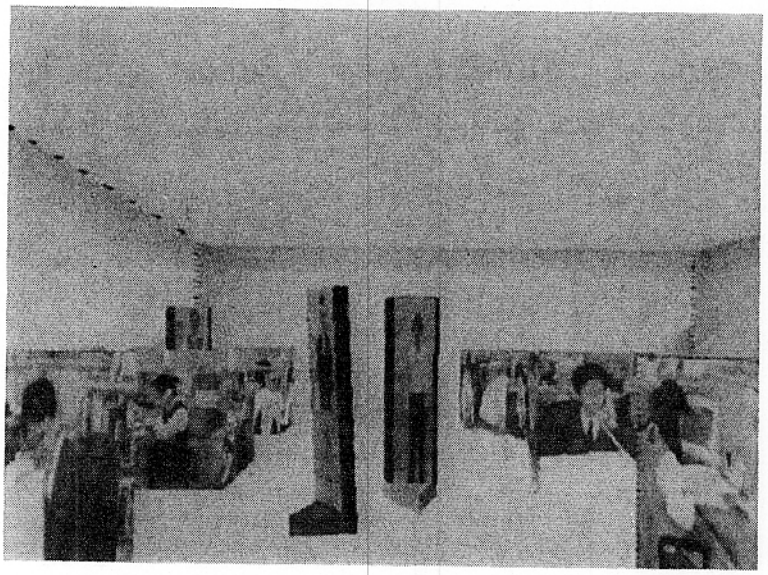

Fig. 4 Offices in InterSpace.