4—3 Multi-Screen Vitrual Reality System : VROOM

– Hi-Resolution and four-screen Stereo Image Projection System –

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Abstract

In this paper, we report a system specifications of Hi-resolution and four-screen stereo image projection system which was established in VBL(Venture Business Laboratory) at Tokyo Institute of Technology on 3rd July 1996. The system is $3m \times 3m \times 2.2m$ rectangular parallelepiped composed of three 150inch side screens and floor. Host computers can generate virtual environments in real-time and four projecters project these images to the screens. Viewers are, therefore, surrounded by these screens and an illusion of immersion can be created. Because, the views of users are completely covered with the projection images and many kinds of interactive devices can be used in this system. Moreover, many users can have experience the virtual environments at the same time.

Usually, this kind of system uses hi-performance graphics workstations for host computers. This system, however, has two kinds of host computers to create images. One is SGI(Silicon Graphics, Inc.) Onyx with 3 Reality Engines. The other system is 4 personal computers. Because hi-performance and low price graphics accelerators for personal computer have been developed in these years, the abilities of VR(Virtual Reality) systems based on personal computers should be investigated.

1 Introduction

An illusion of immersion must be created to make VR(Virtual Reality) world. In order to create the illusion of immersion, it is necessary to prepare a display system which completely surrounds the views of users. Many kinds of displays have been developed such as HMD(Head Mounted Display), BOOM(Binocular omni-oriented monitor), Responsive workbench[7][8], VR Cove[9], Virtual Reality Showcase[10], Power Wall[11], Virtual workbench[12], Immersadesk[2], Infinity Wall[2] and CAVE(CAVE Automatic Virtual Environment) [2][5][4].

In this paper, we report a system specifications for generating immersive virtual environments which was established in VBL(Venture Business Laboratory) at Tokyo Institute of Technology on 3rd July 1996. This system is built based on the CAVE. The system is $3m \times 3m \times 2.2m$ rectangular parallelepiped composed of three 150inch side screens and floor. This system has two kinds of host computers which are SGI(Silicon Graphics, Inc.) Onyx with three Reality Engines and four personal computers set. Usually, SGI Onyxes with Reality Engines are

used for host computer. However, the personal computers set is also employed in our system. Because hi-performance and low price graphics accelerators for personal computers have been developed in these years and the abilities of VR(Virtual Reality) systems based on personal computers should be investigated.

In this system, the host computers can generate immersive 3 dimensional virtual environments in real-time and projectors project these images to the screens. The views of users are completely surrounded by the system and many kinds of interactive devices such as position sensors, data glove, 3D joy stick and so on are can be used. Moreover, 3D audio system makes immersive sounds in the system.

In section2, necessities and effectiveness of VR environments generation systems are explained. Our system specifications are denoted at section3 in detail. Finally, feature works related with this projection system are discussed in section4.

2 VR environments generation system

In virtual environments, an illusion of immersion affects viewers using wide-field presentation system in which imaginary surrounds the viewers. 3D input devices are also necessary to interact the environments. Moreover, 3D audio system has to provide more immersive environments. Although many kinds of displays for Virtual Environments are proposed[2],[6], the CAVE[2] can create the most immersive virtual environments in these displays. The CAVE premiered at the ACM SIGGRAPH'92 in 1992 and twelve CAVE systems was established in the world[3] except for our system, but these systems are little bit differents for each other.

The features of CAVE like system are described as follows;

(1-1) Many person can try the virtual environment at the same time.

(1-2) Life-sized images can be projected, because the system is room-sized.

(1-3) So, the system space is very large, viewer can move there.

(1-4) The system has 3D stereo image projection and 3D autido environment.

(1-5) The system can project hi-resolution 3D stereo image in real-time.

Moreover, in order to interact to the virtual environment, several input devices are prepared such as position tracking sensor, data glove, pointing device, 3D mouse and so on.

These systems can be used for many kinds of applications as follows;

(2-1) Scientific visualization

(2-2) Tele-existence, Telepresence

(2-3) Tele-communication

(2-4) Simulation & Training

(2-5) Engineering

(2-5) Entertainment

3 System specifications

Fig.2 illustrates a system configuration of the Hi-resolution and multiscreen stereo image projection system. Our system equipments are listed in Fig.1.

The system is 3 m × 3 m × 2.2 m rectangular parallelepiped composed of three 150inch side screens and floor. The system appearance is shown in Fig.3 and Fig.4. Four hi-resolution stereo projectors are employeed for this system. Each projector projects images for each screens.

In our system, we have two kinds of host computers. One is graphics workstation, SGI Onyx with three Reality Engines. The graphics workstation can generate hi-resolution 3D stereo image in real-time. The maximum resolution is 1280 × 1024 pixels for each screen. The other host computer is four personal computers. A state of operating host personal computers is shown in Fig.5. Usually, hi-performance graphics workstations are used for these real-time virtual environments generation systems. Many kinds of hi-performance and low price graphics accelerators are, however, developed in these year, it

becomes to be able to use personal computers for the virtual environments generation systems. Therefore, we should investigate the abilities of personal computers with graphics accelerators for VR systems.

In this system, the host computers can generate immersive 3 dimensional virtual environments in real-time and projectors project these images to the screens. The views of users are completely surrounded by the system and many kinds of interactive devices such as position sensors, data glove, 3D joy stick and so on are can be used. Moreover, 3D audio system makes immersive sounds in the system.

4 Feature works

We introduce hi-resolution and four-screen stereo image projection system which was established in VBL(Venture Business Laboratory) at Tokyo Institute of Technology, JAPAN. This system is just only installed in VBL, so we must set up the environments for virtual reality projection system. There are many problems to solve to make the system for virtual reality projection system. Some of our future plans are described as follows;

(1) How to control the images projected to the multiscreens with PC(Personal Computers)?

(2) How to accelerate rendering time with PC?

(3) How to project pictures of actual events for this system?

(4) How to take pictures of actual events for this system?

(5) How to share virtual reality environments using several virtual reality projection systems?

(6) How does the projected image impress the viewers?

References

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[2] EVL(Electronic Visualization Laboratory)'s, University of Illinois at Chicago, Home page, URL: http://evlweb.eecs.uic.edu/EVL/VR/systems.html

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[9] URL: http://www.vrex.com:90/professional/vrcove.htm

[10] URL: http://www.sgi.com/Headlines/1996/May/trc.html

[11] URL: http://www.lcse.umn.edu/powerwall/powerwall.html

[12] URL: http://ciemed.iss.nus.sg/research/3dinterfaces/ 3dinterfaces.html

- **Host computers**
  - **Graphics workstation** × 1
    Onyx RE2 Rack, 4 × 200MHz R4400, 3 × Reality Engine (SGI)
  - **VR controller** × 4
    P5-133 (Geteway2000)

- **Projection system**
  - **Projecter** × 4
    Marquee8500LC/3D (Electrohome)
  - **Screen** × 3 (front and both sides)
    150inch (3048mm × 2286mm)
  - **3D controller** × 4
    CrystalEyes 3D Controller, 3D-CU2 (Flovel)
  - **Liquid crystal shutter glass** × 5
    CrystalEyes2 (StereoGraphics)
  - **Video switcher** × 4
    Marquee Signal Switcher (Electrohome)

- **Interactive devices**
  - **3D positioning sensor** × 1
    3SPACE Fastrack (Polhemus)
  - **Deta glove** × 1
    Super Glove (Nissho electronics corporation)
  - **3D audio sarver** × 1
    Acoustetron II (CrystalRiverEngineering)
  - **3D mouse** × 1
    Space Mouse (Logitech)
  - **3D joy stick** × 1
    CyberWand (InWorld)

Figure 1: System equipments list.

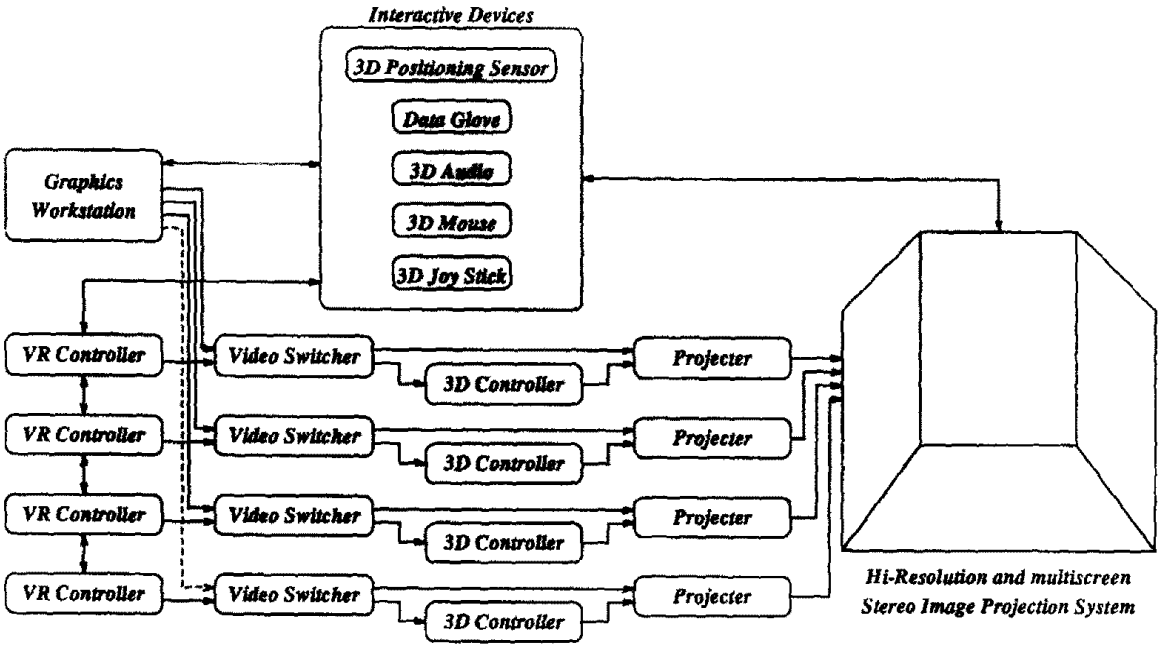

Figure 2: System construction of Hi-resolution and multiscreen stereo image projection system.

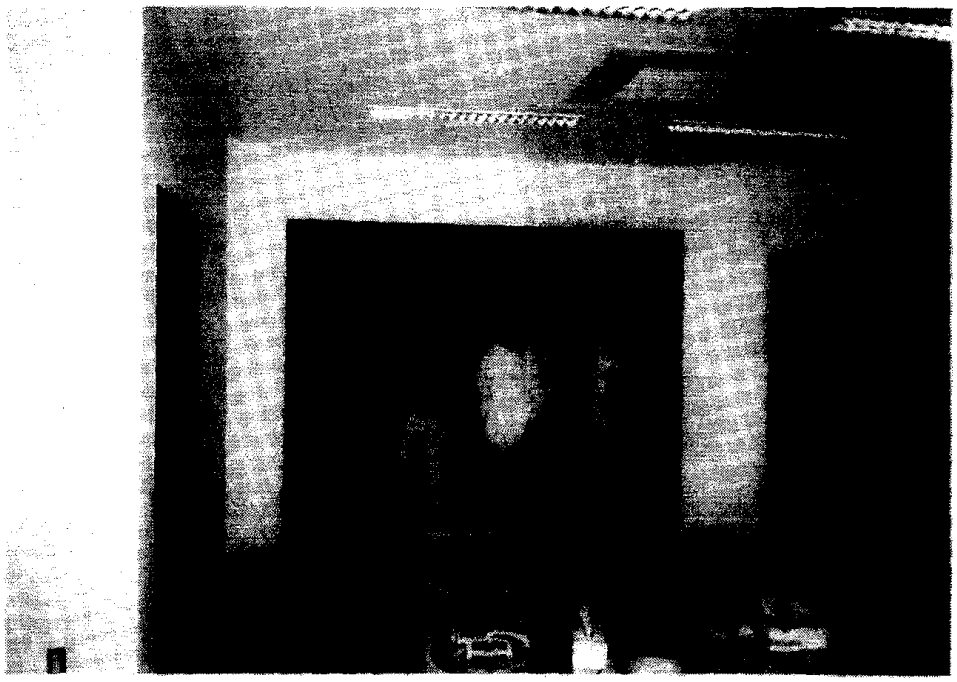

Figure 3: A states of using VROOM.

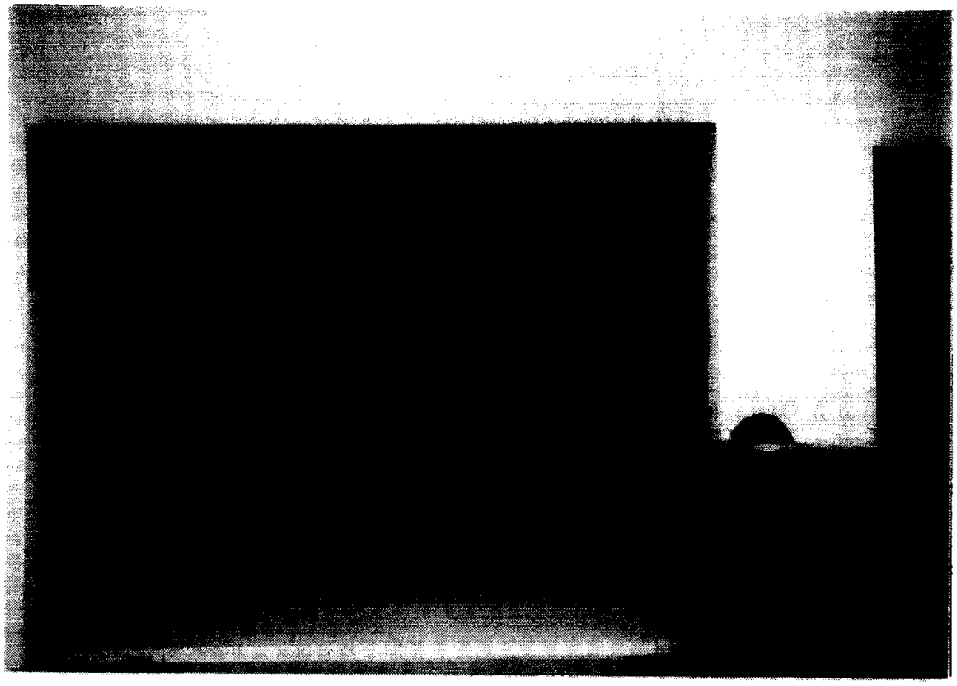

Figure 4: A states of using VROOM.

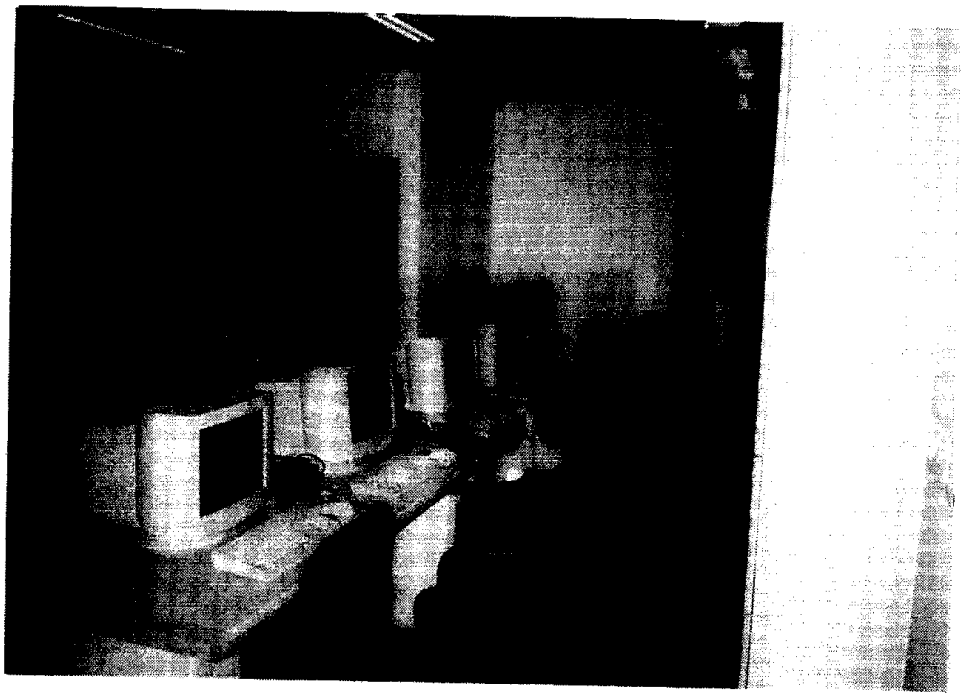

Figure 5: A state of operating host computers.