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An Introduction to Virtual Reality Techniques and its Applications

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Abstract— This paper reviews the virtual reality techniques. Virtual Reality is a computer system used to create an artificial world in which the user has the impression of being in that world and with the ability to navigate through the world and manipulate objects in the world. Virtual Reality (VR) is a term that applies to computer simulated environments that can simulate physical presence in places in the real world, as well as in imaginary worlds. Most current virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special stereoscopic displays, but some simulations include additional sensory information, such as sound through speakers or headphones. Some advanced, haptic systems now include tactile information, generally known as force feedback, in medical and gaming applications. Virtual reality is used to describe a wide variety of applications commonly associated with immersive, highly visual, 3D environments. The development of CAD software, graphics hardware acceleration, and head mounted displays, database gloves, and miniaturization have helped popularize the notion. People often identify VR with head mounted displays and data suits. This paper review about Impact, Heritage and archaeology, Implementation and technologies used in Virtual reality are carried out.

Keywords— Virtual reality, Techniques, Haptic, Wired glove, Applications, Advantages.

I. INTRODUCTION

Virtual Reality (VR) is stimulating the user's senses in such a way that a computer generated world is experienced as real. In order to get a true illusion of reality, it is essential for the user to have influence on this virtual environment. All that has to be done in order to raise the illusion of being in or acting upon a virtual world or virtual environment, is providing a simulation of the interaction between human being and this real environment. This simulation is -at least- partly attained by means of Virtual Reality interfaces connected to a computer. Basically, a VR interface stimulates one of the human senses. This has not necessarily got to be as complex as it sounds, e.g. a PC-monitor stimulates the visual sense; a headphone stimulates the auditory sense. Consequently, these two kinds of interfaces are widely employed as Virtual Reality interfaces. The hardest part of simulating the interaction between human being and real environment is stimulating the tactile sense and the proprioceptive system. This can be done using a so-called haptic interface. This is a device configured to provide haptic information to a human. Just as a video interface allows the user to see a computer generated scene, a haptic interface permits the user to "feel" it. Haptic displays generate forces and motions, which are sensed through both touch and kinesthesia. Currently, there are two main kinds of haptic interfaces, namely the off-body interface and the on-body interface. The main difference is that the mass of the on-body interface is supported by the operator while the off-body interface rests on the floor. Nowadays, most commercially available devices are off-body. Virtual Reality technology can be usefully applied to a broad range of fields.

II. TYPES OF VIRTUAL REALITY

A major distinction of VR systems is the mode with which they interface to the user. This section describes some of the common modes used in VR systems.

A. Window on World Systems (WoW)

Some systems use a conventional computer monitor to display the visual world. This sometimes called Desktop VR or a Window on a World (WoW). This concept traces its lineage back through the entire history of computer graphics. In 1965, Ivan Sutherland laid out a research program for computer graphics in a paper called "The Ultimate Display" that has driven the field for the past nearly thirty years. "One must look at a display screen," he said, "as a window through which one beholds a virtual world. The challenge to computer graphics is to make the picture in the window look real, sound real and the objects act real."

B. Video Mapping

A variation of the WoW approach merges a video input of the user's silhouette with a 2D computer graphic. The user watches a monitor that shows his body's interaction with the world.

C. Immersive Systems

The ultimate VR systems completely immerse the user's personal viewpoint inside the virtual world. These "immersive" VR systems are often equipped with a Head Mounted Display (HMD). This is a helmet or a face mask that holds the visual and auditory displays. The helmet may be free ranging, tethered, or it might be attached to some sort of a boom armature. A nice variation of the immersive systems use multiple large projection displays to create a 'Cave' or room in which the viewer(s) stand.

An early implementation was called "The Closet Cathedral" for the ability to create the impression of an immense environment within a small physical space. The Holodeck used in the television series "Star Trek: The Next Generation" is afar term extrapolation of this technology.

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D. Telepresence

Telepresence is a variation on visualizing complete computer generated worlds. This technology links remote sensors in the real world with the senses of a human operator. The remote sensors might be located on a robot, or they might be on the ends of WALDO like tools. Fire fighters use remotely operated vehicles to handle some dangerous conditions. Surgeons are using very small instruments on cables to do surgery without cutting a major hole in their patients. The instruments have a small video camera at the business end. Robots equipped with telepresence systems have already changed the way deep sea and volcanic exploration is done. NASA plans to use telerobotics for space exploration. There is currently a joint US/Russian project researching telepresence for space rover exploration.

E. Mixed Reality

Merging the Telepresence and Virtual Reality systems gives the Mixed Reality or Seamless Simulation systems. Here the computer generated inputs are merged with telepresence inputs and/or the users view of the real world. A surgeon's view of a brain surgery is overlaid with images from earlier CAT scans and real-time ultrasound. A fighter pilot sees computer generated maps and data displays inside his fancy helmet visor or on cockpit displays.

The phrase "fish tank virtual reality" was used to describe a Canadian VR system. It combines a stereoscopic monitor display using liquid crystal shutter glasses with a mechanical head tracker. The resulting system is superior to simple stereo-WoW systems due to the motion parallax effects introduced by the head tracker.

F. Semi- Immersive

Most advanced flight, ship and vehicle simulators are semi-immersive. The cockpit, bridge, or driving seat is a physical model, whereas the view of the world outside is computer-generated.

III.DISADAVANTAGES OF VIRTUAL REALITY

The disadvantages of VR are numerous. The hardware needed to create a fully immersed VR experience is still cost prohibitive. The total cost of the machinery to create a VR system is still the same price as a new car, around $20,000. The technology for such an experience is still new and experimental. VR is becoming much more commonplace but programmers are still grappling with how to interact with virtual environments. The idea of escapism is common place among those that use VR environments and people often live in the virtual world instead of dealing with the real one. This happens even in the low quality and fairly hard to use VR environments that are online right now. One worry is that as VR environments become much higher quality and immersive, they will become attractive to those wishing to escape real life. Another concern is VR training. Training with a VR environment does not have the same consequences as training and working in the real world. This means that even if someone does well with simulated tasks in a VR environment, that person might not do well in the real world.

IV. ADVANTAGES OF VIRTUAL REALITY

Although the disadvantages of VR are numerous, so are the advantages. Many different fields can use VR as a way to train students without actually putting anyone in harm's way. This includes the fields of medicine, law enforcement, architecture and aviation. VR also helps those that can't get out of the house experience a much fuller life. These patients can explore the world through virtual environments like Second Life, a VR community on the Internet, exploring virtual cities as well as more fanciful environments like J.R.R. Tolkien's Middle Earth. VR also helps patients recover from stroke and other injuries. Doctors are using VR to help reteach muscle movement such as walking and grabbing as well as smaller physical movements such as pointing. The doctors use the malleable computerized environments to increase or decrease the motion needed to grab or move an object.

IV.METHODS OF VIRTUAL REALITY

A) Simulation Based Virtual Reality

The first method is simulation-based virtual reality. Driving simulators, for example, give the driver on board the impression that he/she is actually driving an actual vehicle by predicting vehicular motion caused by driver input and feeding back corresponding visual, motion, audio and proprioceptive cues to the driver.

The simulator normally consists of several systems as follows: a real-time vehicle simulation system performing real-time simulation of vehicle dynamics; motion, visual and audio systems reproducing vehicle motion, driving environment scenes and noise sensed by a driver during driving; a control force roading system acting as an interface between the driver and the simulator; an operator console for monitoring system operation; and system integration managing information and data transfer among subsystems and synchronization. The driving simulators have been used effectively for vehicle system development, safety improvement and human factor study.

B) Avatar-based Virtual Reality

With avatar image-based virtual reality, people can join the virtual environment in the form of real video as well as an avatar. The proposed image VR system can handle two types of users. One can participate in the 3D distributed virtual environment as form of either a conventional avatar or a real video. Background of the video is effectively eliminated to enhance the sense of reality. A user can select his/her own type of participation based on the system capability. Users with capture board and camera may select a video avatar while others select a conventional computer graphics-based avatar. Avatar image-based VR now provides pretty good interaction environment between human and computer far beyond the conventional desktop computer systems. High-speed networks become available with the advance of network technologies.

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C) Projector –based Virtual Reality

In projector-based virtual reality, modeling of the real environment plays a vital role in various virtual reality applications, such as robot navigation, construction modeling and airplane simulation. Image based virtual reality system is gaining popularity in computer graphics as well as computer vision communities. The reason is that is it provides more realism by using photo realistic images and the modeling procedure is rather simple. In generating realistic models, it is essential to accurately register acquired 3D data. Usually,camera is used for modeling small objects at a short distance.

D) Desktop-based Virtual Reality

Desktop-based virtual reality involves displaying a 3-dimensional virtual world on a regular desktop display without use of any specialized movement-tracking equipment. Many modern computer games can be used as an example, using various triggers, responsive characters, and other such interactive devices to make the user feel as though they are in a virtual world. A common criticism of this form of immersion is that there is no sense of peripheral vision, limiting the user's ability to know what is happening around them.

E) True Immersive Virtual Reality

Hypothetical virtual reality as immersive as consensus reality. Most likely to be produced using a Brain-computer interface. An intermediate stage may be produced by "Virtual Space" using a head-mounted display with head tracking and computer control of the image presented to the helmet.

V. CONCLUSION

Virtual reality is no longer hampered by the absence of appropriate hardware, but rather the absence of understanding about the medium and how to deal with its shortcomings. The sensory input missing from current virtual reality systems (e.g. the lack of haptic feedback) must be compensated for, in order to make these systems more accessible and usable to the general public. The methods presented in this paper provide the tools for overcoming these problems, providing a framework for creating better and more usable applications of the technology.

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