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WATCHING THE WORLD BY VIRTUAL REALITY SIMULATION AND VIRTUAL REALITY FUTURE IMPORTANCE IN ENGINEERING SCIENCES

By Abdulhamid Albokhader

Abstract

Better planning and effective execution are very necessary for successful completion of a project. For well-structured progression, the basic requirements as well as the complexities are always considered before initialization. Technology advancements have enabled people to visualize the things as they really exist. In Engineering, the design specifications, prototypes and samples can be thoroughly studied and understood with the help of virtual reality (VR) technology. This paper explains the detailed historical background, operation, latest advancements and importance of virtual reality in real life. Experimental data structures are described by tables for better understanding and a conclusion is made on the basis of future aspects as well as the improvements in engineering.

Introduction

It is a common observation that the world has progressed in the past few decades due to high emergence of technology. Among these technologies, Virtual reality is an important one. In this technology, 3D animated features are incorporated to provide a real impact. This technology helps in enhancing the mental abilities of human beings. In order to test this fact, different experiments have also been done which have confirmed it. Its different systems are Window on

World, immersive system, tele-presence and mixed reality. This paper investigates its applications and scope in the future with the help of undertaking experiment.

1-Background & Motivation

Virtual reality is the technology of the new modern world but finds its roots in the early nineties. Its origins are found in "The Ultimate Dis-

play," a scientific seminar conducted by Ivan Sutherland, that opened up a new world of simulated engineering. The idea was then initiated by John Linier, who was the Chief Executive Officer (CEO) of VPL Research industries back in 1984. The company itself was manufacturer of gloves, goggles and numerous other VR related products (Sutherland, The ultimate display., 1965).

2-Theory

Computer communities often use terms like Virtual reality & Virtual communications. 3D animated models combined with real looking interactive graphics connected with real time display makes the basis of Virtual reality (H. Fuchs, 1992), This combination enables to view the 3D world in real time with six degrees of freedom. It can be called as the clone of Physical reality (Schweber, 1995).

Implementation

Enhancing the perception of 3D depth is the key point in VR related calculations. The human brain builds rules depending upon the past experiences, like we know how far the sky is from us; although we don't know the exact height, we can sense the altitude is quite high. Similarly, touching things, feeling their physical approach all are governed by our brain. This imagination is captured while designing VR related accessories.

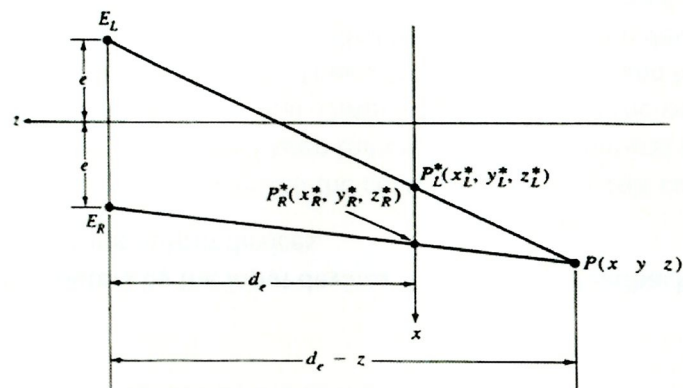
In a virtual environment, the brain makes some expectations for the moving objects using the laws of physics along with past experiences. The artificial generated shading and texture enables to determine the exact depth and distance of particular object. Whenever the virtual signs do not resonate with the brain's expectations, we feel bewildered or revolted. In fact, the human brains very much complex

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than even the most complicated computer; scientists are doing research in order to find out which cues are most important to prioritize during virtual stimulation (Stansfield, 2000).

Usually three types of perceptions are necessary for VR simulation: visual perception, sound perception, position force and touch perception. Visual Perception includes depth perception, accuracy and critical fusion frequency. Stereoscopy is the method for imagination of depth, however human eyes are 6.3cm (approx.) apart; the geometric benefits for objects located 30 meter apart are lost. Hence some primary and secondary cues are necessary for visual perception. The following figure shows the stereographic perception at $z = 0$:



Stereographic perception onto $z = 0$

The figure is a view illustrating the state of image projection of point $P(x, y, z)$ on the basis of the centers of projection at the viewing point P_L of the upper eye and the viewing point P_R of the lower eyes, and it provides point of Stereographic perception at Z .

The complete horizontal view of human eyes without moving the head is 180° and vertical vision is 120°. When total field is not necessary, 90-

110 degrees are enough for a complete horizontal vision. This makes the basis of depth perception. Audio devices work better within the audible range of 1000-4000 Hz. VR audible devices involve generation of stimulus using location dependent filters.

Types of VR Systems

There are several VR systems and they differ with each other on the basis of the different ways they communicate with the user. These systems include Window on World, immersive system, tele-presence and mixed reality. Window on World is perfect for the medical applications. Tele-presence can be used to simulate undersea explorations, bomb disposal practices and drone training. Mixed reality brings together computer generated inputs along with previous tele-presence inputs to form a final visualization.

Experiment

An experiment was performed using special input, output hardware devices along with special drivers. It included head mounted display, tracker and a manipulation device (three-dimensional mouse, data glove etc.). A volunteer was equipped with all the necessary devices

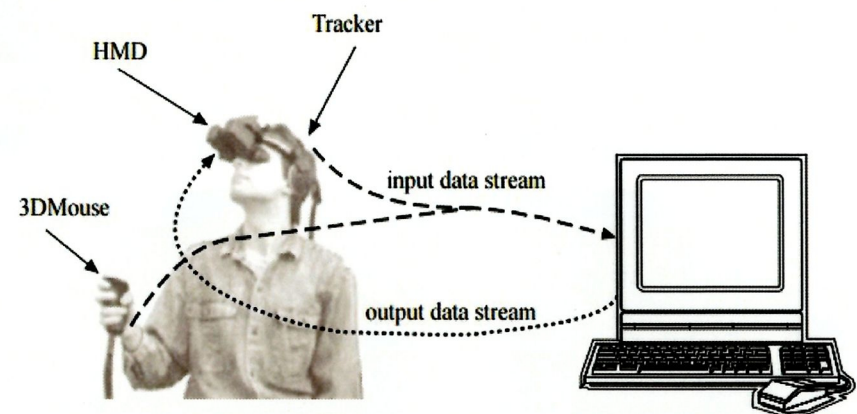
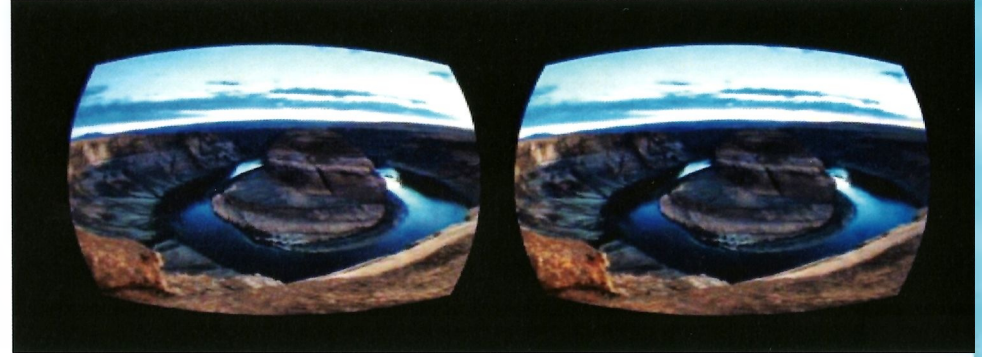
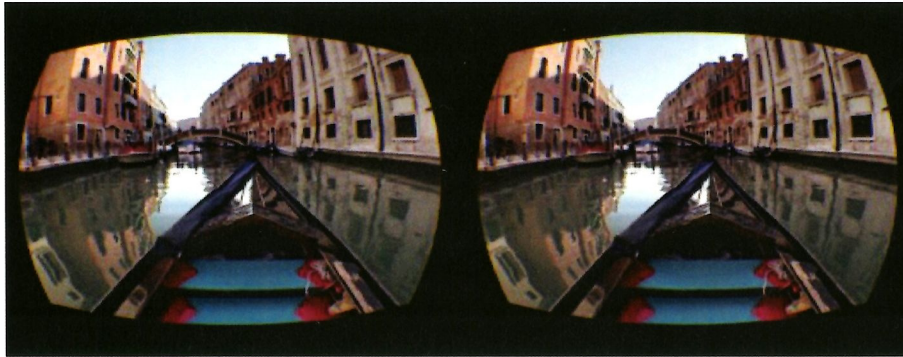


Figure 2.1.1. Basic components of VR immersive application.



to view the results. Body movements such as walking and head rotating etc. were sensed by the sensors, and the data was sent to the

computers by the input devices. The real-time feedback was sent to the user using output devices.

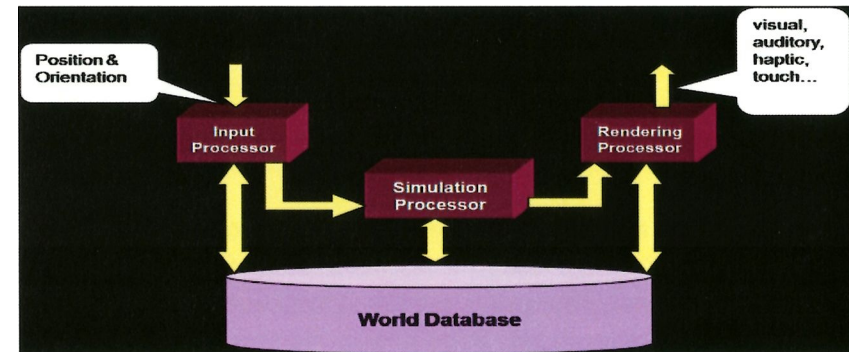
Usually input devices tell the computer how the user communicates. These devices should keep the environment as natural as possible so that they look practically real. Output devices present the visual information to the user in real time. They control visual, audio and haptic displays. Special soft-wares are installed to control hardware devices like I/O device, manage incoming data and generate proper feedback. The whole process is very much time critical and software has to manage all of that.

Results

An experiment was done to determine the effectiveness and benefits provided by Virtual Reality. As a result of this experiment we got some images which were taken with the help of VR stimulation. This technology can be explained with the help of taking into account the qualities of these images which is provided above and also the following images were taken by VR stimulation.

Technologies of VR

The technologies of virtual reality can be distinguished on two basis; hardware and software. The hardware and software technologies of VR



are further categorized into sub- categories. Talking about hardware technologies of VR, there are four major categories: Head- Mounted Display (HMD), Binocular Omni-Oriented Monitor (BOOM), Cave Automatic

Virtual Environment (CAVE) and Data Glove. HMD may consist of a helmet or a mask that will help in providing visual images to the user with the help of LCD or CRT in the past. This helmet may also contain built-in stereo headphones for providing audio synched to the visuals and head-tracker. BOOM is comprised of head that is joined with stereoscopic device to display high resolution images with the help of CRT. The advantage of BOOM is that is more accurate and easy to operate as well. CAVE technology uses immersion and displays the images on the walls and floor of cube shaped room. Head-tracker helps in displaying of images on the walls and floor of room relevant

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to the position of the head. The last hardware technology for VR is data gloves that are incorporated with built-in sensors those synchronizes the movements of hands and fingers with the system for taking inputs from the user. It enables the users to interact with the objected being projected in VR.

Architecture of VR system

The architecture of VR systems are based on mainly four modules: input processor, simulation processor, rendering processor and world database. The input processor actually processes the inputs being given to VR system, but the type of input here might be different from normal technology. The input processor receives all kinds of input types including position coordinate, voice recognition system and 3D position tracking with minimum lag time. The simulation processor is the core of VR system that processes the inputs from the input processor and coordinates with the rendering processor to give real life experience to the user.

Figure 1 VR System Simulation processor

The rendering process or is the one that creates the output for displaying the results. It processes simulations separately for each module like visual, auditory and vibrations. The instruction for real world experience is taken from the simulation processor. Lastly, a real world processor stores the objects associated with the real world so that they can create an actual VR experience.

Applications of VR

VR technology is being used in multiple fields for multiple purposes and has proved to be quite successful in each field. Some of famous applications of VR include in medical for treatment of anxiety problems and phobias. VR is also being used for training purposes in fighting terrorism,

welding, pilot training and a lot more. The extensive use is seen for entertainment purposes as well where people are using it for recreational purposes, for education, playing games, watching movies, etc.

Current problems and future work

Despite of its usage in numerous fields, VR still has some serious issues that need to be taken care of for its survival. The price of VR is a big problem for most of the people around the world, and some require special graphics card. Another problem with using VR is that it may cause some health issues as well because some people experience disorientation, dizziness, nausea, fatigue and more after using it. There is also need for more useful content that should be integrated with VR so that it can be more useful. There are more shortcomings in this technology and it has to go a long way. It needs to focus on its usability in more useful fields like for education and illustration for explanation of complex ideas.

Conclusion

This is the most important technological advancement of today. Tall buildings, huge bridges and mega structures can be thoroughly visualized using VR in 3D mode. Moving machines, fighter aircrafts and their prototypes all can be manufactured with more accuracy minimizing the dangers of failure. Besides this, entertainment has now been redefined with the help of VR and the next generations cinemas will be much more enjoyable. Medical sensing has been made quite easy using VR technology, and complex operations can now be done with much more accuracy. Still there is a bit of need for improvement and simulation of those areas where human access is not possible can be included like the sun, planets and other areas of the solar system. Scientists are working on it day and night, and we expect to see more advancement in the future.