Technology of Virtual Reality

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***Abstract*— The term 'Virtual Reality' was initially developed by Jaron Lanier, who is the founder of VPL Research (1989).V R is a way for people to see, manipulate and interact with computers and extremely complex data. The Virtual Reality uses a huge number of technologies to produce a Virtual world so that a user can interact and manipulate with the virtual objects in the so produced Virtual Worlds. With the help of some specially developed gadgets like a Head Mounted Display, Electronic Glove and Mechanical armatures that fit the human organs we can immerse the human into the Virtual world. Here the word see means to the computer-generated outputs such as CGI, simulations, and other such as the Computer Aided Design models. Virtual Reality is an enabling technology that has wide applications in training, product design, etc. Virtual reality technology is being used to resolve problems in real-world situations.**

Keywords*— *Virtual Reality, Uses of virtual reality

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 .Virtual reality (VR) means experiencing things through our computers that don't really exist. From that simple definition, the idea doesn't sound especially new. VR is quite different. It makes you think you are actually living inside a completely believable virtual world (one in which, to use the technical jargon, you are partly or fully immersed). It is two-way interactive: as you respond to what you see, what you see responds to you: if you turn your head around, what you see or hear in VR changes to match your new perspective. At the beginning of1990s the development in the field of virtual reality became much stormier and the term Virtual Reality itself became extremely popular. We can hear about Virtual Reality nearly in all sort of media, people use this term very often and them is use it in many cases too .The reason is that new promising and fascinating technology capture greater interest on people. Moreover, the world of three-dimensional graphics has neither borders nor constraints and can be created and manipulated by ourselves as we wish .

II. BASIC DEFINITION OF VIRTUAL REALITY

Virtual Reality (VR) and Virtual Environments (VE) are used in computer community interchangeably. These terms are the most popular and most often used, but there are many other. Just to mention a few most important ones: Synthetic Experience, Virtual Worlds, and Artificial Worlds artificial Reality.

Virtual reality (VR) means experiencing things through our computers that don't really exist. From that simple definition, the idea doesn't sound especially new. When you look at an amazing Canaletto painting, for example, you're experiencing the sites and sounds of Italy as it was about 250 years ago—so that's a kind of virtual reality. Virtual reality is the term used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions. The person wears a head-mounted display (HMD) or glasses which displays three-dimensional images as part of their experience. Some systems enable the person to experience additional sensory input, e.g. sound or video which contributes to their overall experience.

The experience of a virtual world mimics that of a real world scenario but often without many of its constraints. Virtual reality enables allows someone to do the following:

Walk around a three-dimensional building
Perform a virtual operation
Play a multi-user game
Take part in a theater of war
Interact with an artwork, e.g. installation

Plus the fact that they can do this in a 3D environment means that they replicate an experience similar to that in the real world but without many of the dangers.

This is preferable to trying to simulate these experiences in a two-dimensional setting, e.g. a computer desktop.

Virtual reality is essentially:

- Believable: You really need to feel like you're in your virtual world (on Mars, or wherever) and to keep believing that or the illusion of virtual reality will disappear.
- Interactive: As you move around, the VR world needs to move with you. You can watch a 3D movie and be transported up to the Moon or down to the seabed—but it's not interactive in any sense.
- Computer-generated: Why is that important? Because only powerful machines, with realistic 3D computer graphics, are fast enough to make believable, interactive, alternative worlds that change in real-time as we move around them.

- Explorable: A VR world needs to be big and detailed enough for you to explore. However realistic a painting is, it shows only one scene, from one perspective.
- Immersive: To be both believable and interactive, VR needs to engage both your body and your mind. Paintings by war artists can give us glimpses of conflict, but they can never fully convey the sight, sound, smell, taste, and feel of battle. You can play a flight simulator game on your home PC and be lost in a very realistic, interactive experience for hours (the landscape will constantly change as your plane flies through it), but it's not like using a real flight simulator (where you sit in a hydraulically operated mock up of a real cockpit and feel actual forces as it tips and tilts), and even less like flying a plane.

III. VARIETY OF USES

A wide variety of applications for virtual reality which include:

- Architecture
- Sport
- Medicine
- The Arts
- Entertainment

Virtual reality can lead to new and exciting discoveries in these areas which impact upon our day to day lives. One example of this is the use of virtual reality in medicine, such as surgical simulations, which helps with training the next generation of surgeons.

In video games, from flight simulators to race-car games, VR has long hovered on the edges of the gaming world never quite good enough to revolutionize the experience of gamers, largely due to computers being too slow, displays lacking full 3D, and the lack of decent HMDs and data gloves.

There are two big differences between VR and looking at an ordinary computer screen: in VR, you see a 3D image that changes smoothly, in real-time, as you move your head. That's made possible by wearing a head-mounted display, which looks like a giant motorbike helmet or welding visor, but consists of two small screens (one in front of each eye), a blackout blindfold that blocks out all other light (eliminating distractions from the real world), and stereo headphones. The two screens display slightly different, stereoscopic images, creating a realistic 3D perspective of the virtual world. HMDs usually also have built-in accelerometers or position sensors so they can detect exactly how your head and body are moving (both position and orientation—which way they're tilting or pointing) and adjust the picture accordingly. The trouble with HMDs is that they're quite heavy, so they can be tiring to wear for long periods; some of the really heavy ones are even mounted on stands with counterweights.

See something amazing and your natural instinct is to reach out and touch it—even babies do that. So giving people the ability to handle virtual objects has always been a big part of VR. Usually, this is done using data gloves, which are ordinary gloves with sensors wired to the outside to detect hand and figure motions. One technical method of doing this uses fiber-optic cables stretched the length of each finger. Each cable has tiny cuts in it so, as you flex your fingers back and forth, more or less light escapes. A photocell at the end of the cable measures how much light reaches it and the computer uses this to figure out exactly what your fingers are doing. Other gloves use strain gauges, piezoelectric sensors, or electromechanical devices (such as potentiometers) to measure finger movements.

VR was also successfully applied to the modeling of surfaces [Brys92b, Butt92, Kame93]. The advantage of this technology is that the user can see and even feel the shaped surface under his/her fingertips. Although these works are pure laboratory experiments, it is to believe that great applications are possible in industry e.g., by constructing or improving car or aircraft body shapes directly in the virtual wind tunnel.

The use of flight simulators has a long history and we can consider them as the precursors of today's VR. First such applications were reported in late 1950s [Holl95], and were constantly improved in many research institutes mainly for the military purposes [Vinc93]. Nowadays they are used by man civil companies as well, because they offer lower operating costs than the real aircraft flight training and they are much safer.

Constantly decreasing prices and constantly growing power of hardware has finally brought VR to the masses–it has found application in the entertainment.

Anything that happens at the atomic or molecular scale is effectively invisible unless you're prepared to sit with your eyes glued to an electron microscope. But suppose you want to design new materials or drugs and you want to experiment with the molecular equivalent of LEGO. That's another obvious application for virtual reality. Instead of wrestling with numbers, equations, or two-dimensional drawings of molecular structures, you can snap complex molecules together right before your eyes. This kind of work began in the 1960s at the University of North Carolina at Chapel Hill, where Frederick Brooks launched GROPE, a project to develop a VR system for exploring the interactions between protein molecules and drugs.

IV. TECHNOLOGY IN VR

A. The reality engine

The reality engine employs both computer hardware and software to create the virtual world. Reality engines are based largely on the same components that make up a personal computer (PC), although much more computing power is required for the reality engine than what is available in a standard PC.

The reality engine is also involved in bringing sound to the virtual world. Sound enriches the virtual world. For example,

in a flight simulator, the experience of soaring through the air in a simulated cockpit is more realistic if the user hears the roar of the engines. Sound also enhances participation in the virtual world by providing the user with audio cues. For example, the user may be directed to look for another virtual airplane flying overhead.

B. Headsets

Head-mounted display (HMD) units use a small screen or a pair of screens (one for each eye) that are worn in a helmet or a pair of glasses. The HMD allows viewers to look at an image from various angles or change their field of view by simply moving their heads. In contrast, a movie is a passive experience, where the view of the audience is controlled by the position of the camera that recorded the scene.

HMD units usually employ cathode ray tube (CRT) or liquid crystal display (LCD) technology. The optical systems in CRTs reflect an image onto the viewer's eye, creating an image of very clear and realistic image. CRT images can be semi-reflective. This means that the user can experience the virtual world while still being able to see the outside world. This permits the user to operate another machine or device while viewing the virtual world.

LCD technology has lagged behind CRT in picture quality. LCD monitors display two slightly different images to each eye. The brain processes and merges the images into a single three-dimensional view. However LCD systems have the advantages of being slimmer, lighter, and less expensive than CRT systems. Thus, LCD is better suited to home entertainment.

C. Audio units

Sound effects in virtual reality rely on a prerecorded sound set. This aspect of the virtual reality experience is less prone to alteration.

The audio portion of virtual reality is transmitted through small speakers placed over each ear. Audio cues may include voices, singing, the sound of bubbling water, thud-like noises of colliding objects—in short, any sound that can be recorded.

While the sounds themselves cannot be changed from a recording, the presentation of the sounds to the user can be changed. Three-dimensional (omni directional) sound further enhances the virtual reality experience. Sound that seems to come from above, below, or either side provides audio cues that mimic how sounds are heard in the real world (e.g., footsteps approaching or a plane flying overhead). Three-dimensional sound is achieved through the use of complex filtering devices. This technology must take into account the delay in the detection of sound by the ear that is furthest away from the source of the sound (inter aural time difference) and the tendency of one ear to hear a sound more loudly than the other ear (inter aural amplitude difference).

The most complex human hearing dynamic is called head-related transfer functions (HRTF). HRTF accounts for how the eardrum and inner ear process sound waves. Factors that are influential in HRTF include the various frequencies at which the sound waves travel, and how waves are absorbed and reflected by other objects. HRTF audio processing enables the listener to locate a sound source and to focus in on a specific sound out of a multitude of sounds. (i.e., the sound of their name called out in the midst of a noisy party).

D. Gloves

A popular image of a virtual reality experience shows the user wearing gloves. The gloves allow the user to interact with the virtual world. For example, the user may pick up a virtual block, and, by turning their gloved hands, turn the block over and set it on a virtual table.

Virtual reality gloves are wired with thin fiber-optic cables, or have light-emitting diodes positioned at critical points over the glove's surface. The optics detects the amount of light passing through the cable in relation to the movement of the hand or joint. The computer then analyzes the corresponding information and projects this moving hand into the virtual reality. Magnetic tracking systems are also used to determine where the hand is in space in relation to the virtual scene.

Some gloves use haptic enhancement to provide a sense of touch and feel. In haptic enhancement, the reality engine relays the various sensations of force, heat, and texture that are experienced by the user to the computer software. The software can use the information to determine an outcome of the user's actions, and relay the outcomes back to the user. For example, if the user closes a hand on a virtual squeeze toy, the software will alter the virtual image to show the toy becoming compressed. To achieve this two-way communication, virtual reality gloves may use either air pressure (such as strategically placed, inflated air pockets in the glove) or vibrating transducers placed next to the skin (such as a voice coil from a stereo speaker or alloys, which change shape through the conduction of electrical currents) to simulate tactile experience.

E. Tools Under Development

Many other virtual reality tools are in the phases of research and development. Remote control robotic or manipulation devices are being tested for industry and medicine. Already, surgery has been done by a physician located hundreds of miles away from the patient, by means of robotics and virtual imaging.

Special wands with sensors, joysticks, and finger sensors such as picks and rings will eventually be as common to virtual reality technology as microwaves are to cooking. The technology to control the virtual world through voice commands is also rapidly advancing.

Perhaps the most impressive technology under development is the whole body suit. These suits would function similarly to the gloves, creating a virtual body that could take a stroll through a virtual world and feel a virtual windstorm.

V. CONCLUSION

Virtual reality (VR) means experiencing things through our computers that don't really exist. From that simple definition, the idea doesn't sound especially new. Virtual reality (VR) means experiencing things through our computers that don't really exist. From that simple definition, the idea doesn't sound especially new. It have different applications in various fields like architecture, game, education, aircrafts, medical etc. it have different modern technologies used.

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