Chapter – 2

Virtual Reality
Concepts, Meanings and Applications

2.0 Introduction

2.1 What is virtual reality ?

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2.3 Evolution of virtual reality

2.4 Devices use to create virtual environment

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2.0 Introduction :-

Virtual Reality is a computer-based technology that provides visual, aural and tactile stimuli of a virtual world generated in real time. This is usually achieved by isolating the user from the sensorial signals of the real world, thus creating the immersion effect. The Virtual Reality technology came up from forty years of development in areas such as computer science, electronics and psychology. From the beginning, Virtual Reality has been used for simulation and training, mainly in the military area. Therefore, the use of this technology was not properly justified because of its added value as an educational tool but mainly because in military Virtual Reality simulators allow to test different situations without putting extremely expensive material and personnel in high risk situations. Due to cost reasons, the use of Virtual Reality technology was associated in the beginning to scientific military visualization, and entertainment. Other applications were only made possible with the decrease in equipment costs in the past few years. One of these newer areas of Virtual Reality applications is education, centered mainly on the merging of education with entertainment, supporting the birthday to a new field "edutainment".

2.1 What is virtual reality ? :-

Virtual Reality has been addressed by a large number of authors in the literature for decades, many of them introducing slightly different meanings to the term. Some years ago a common definition had it that Virtual Reality should be looked upon as a situation where a person was immersed into a computer generated environment that bore strong similarities with reality. Other authors tend to define Virtual Reality from the point of view of what technological tools are being used, i.e. Virtual Reality happens when head mounted visual display units and motion-tracking gloves are present. Some other authors also define Virtual Reality from a

psychological perspective, where it becomes nothing of a technology but rather a state produced in the users' minds that can occupy their awareness in a way similar to that of real environments. The best meaning of Virtual Reality is to center the user and look at the style of interaction that takes place between the user and the computer-generated environment. The users manipulate what is perceived to be "real" objects in the same manner as they would manipulate them in the real world. For example, to move an object in a Virtual Reality based environment, you may grab the object with your hands, lift it as you normally lift objects in the real world, and put it down wherever you want it inside the virtual environment.

According to Cronin there are basically three different kinds of Virtual Reality, categorized by the quality of the immersion that is being provided.

2.1.1 Desktop based Virtual Reality :-

This type of Virtual Reality is by far the most common and least expensive form of Virtual Reality there are, which typically consists of a standard desktop computer. This form of Virtual Reality completely lacks any feelings of immersion on the part of the user.

"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."[1]

2.1.2 A semi-immersive Virtual Reality System :-

This type of Virtual Reality System attempts to give the users a feeling of being at least slightly immersed by a virtual environment, which is often achieved by a different types of so called workbenches and reach-in displays.

2.1.3 A fully-immersive Virtual Reality System :-

The third form of VR is usually referred to as being fully immersed. It typically consists of head mounted visual display units that allow users to be completely isolated from the physical world outside. Recently, a growing interest in building so-called Caves has been noted. A Cave is a room in which the walls surrounding the user produce the images, and thus deliver a sense of immersion. Not surprisingly, fully immersive VR is generally considered the best option for several reasons, including the ability to almost completely filter out interference from the outside world and thus allowing oneself to focus entirely on the virtual environment. However, even reasonable VR hardware and software designed to support full immersion is quite expensive and application development in this area is generally more difficult and time-consuming.

2.2 Definitions and terminology :-

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, Artificial Worlds or Artificial Reality. All these names mean the same:

"Real-time interactive graphics with three-dimensional models, combined with a display technology that gives the user the immersion in the model world and direct manipulation." [2]

"The illusion of participation in a synthetic environment rather than external observation of such an environment. VR relies on a three-dimensional, stereoscopic head-tracker displays, hand/body tracking and binaural sound. VR is an immersive, multi-sensory experience." [3]

"Computer simulations that use 3D graphics and devices such as the DataGlove to allow the user to interact with the simulation." [4]

"Virtual reality refers to immersive, interactive, multi-sensory, viewer-centered, three dimensional computer generated environments and the combination of technologies required to build these environments." [5]

"Virtual reality lets you navigate and view a world of three dimensions in real time, with six degrees of freedom. In essence, virtual reality is clone of physical reality." [6]

Although there are some differences between these definitions, they are essentially equivalent. They all mean that Virtual Reality is an interactive and immersive experience in a simulated world and this measure we will use to determine the level of advance of VR systems.

Many people, mainly the researchers use the term Virtual Environments instead of Virtual Reality because of the hype and the associated unrealistic expectations. Moreover, there are two important terms that must be mentioned when talking about Virtual Reality. These terms are *Telepresence* and *Cyberspace*. They are both tightly coupled with Virtual Reality, but have a slightly different context as follows.

• **Telepresence :-**

This term is a specific kind of virtual reality that simulates a real but remote environment.

Another more precise definition says that,

"Telepresence occurs when at the work site, the manipulators have the dexterity to allow the operator to perform normal human functions; at the control station, the operator receives sufficient quantity and quality of sensory feedback to provide a feeling of actual presence at the worksite"[7]

• **Cyberspace :-**

This term was invented and defined by William Gibson as

"Cyberspace is a consensual hallucination experienced daily by billions of legitimate operators a graphics representation of data abstracted from the banks of every computer in human system"[8]

Today the term Cyberspace is rather associated with entertainment systems and World Wide Web (Internet).

2.3 Evolution of virtual reality :-

Nowadays computer graphics is used in many domains of our life. At the end of the 20th century it is difficult to imagine an architect, engineer, or interior designer working without a graphics workstation. In the last years the stormy development of microprocessor technology brings faster and faster computers to the market. These machines are equipped with better and faster graphics boards and their prices fall down rapidly. It becomes possible even for an average user, to move into the world of computer graphics. This fascination with a new reality often starts with computer

games and lasts forever. It allows to see the surrounding world in other dimension and to experience things that are not accessible in real life or even not yet created. Moreover, the world of three-dimensional graphics has neither borders nor constraints and can be created and manipulated by ourselves as we wish.

But not enough: people always want more. They want to step into this world and interact with it instead of just watching a picture on the monitor. This technology which becomes overwhelmingly popular and fashionable in current decade is called Virtual Reality. The very first idea of it was presented by Ivan Sutherland in 1965: “make that (virtual) world in the window look real, sound real, feel real, and respond realistically to the viewer’s actions” . It has been a long time since then, a lot of research has been done and status quo: “the Sutherland’s challenge of the Promised Land has not been reached yet but we are at least in sight of it”. Authentically Virtual Reality word was first coined by Myron Krueger in 1970. But according to one belief Virtual Reality word was first mentioned by French Novelist Antonin Artaud in his book “The theatre and its double”. By proper meaning of this word as today it was first utilized by Damien Broderick in 1982 in his science fiction novel “The Judas Mandal”. In 1987 Virtual Reality word was authentically comprised in “Oxford English Dictionary”. The first book about Virtual Reality was written by writer Howard Rheingold in 1991. The name of book was also “Virtual Reality”.

Virtual Reality pioneers such as Ivan Sutherland, Michael Noll, and Myron Krueger all had their parts to play in the creation of 'modern-day' VR. Popular culture and the science fiction genre both have also had profound effects on research as to the social implications of VR. Below is a list of key dates and people who have made their mark on the virtual reality historical timeline.

Table – 2.0 : ***Historical timeline of evolution of Virtual Reality***

Year	Person/Firm(s) Responsible	Accomplishment	Why it was important
1962	Morton Heilig	Sensorama	Multi – sensory simulator
1965	Ivan Sutherland	Ultimate Display	The beginnings of Virtual Reality
1965	Ivan Sutherland	The Sword of Damocles	A device considered as the first Head Mounted Display (HMD)
1971	University of North Carolina (UNC)	Grope	First prototype of a force-feedback system
1977	Dan Sandin, Richard Sayre and Thomas Defanti	The first dataglove	Interaction through body movement
1980s	University of North Carolina	Walkthrough project	An architectural walkthrough application
1982	Bonnie MacBird (Writer)	Tron	The first computer generated movie
1982	Thomas Furness	Vcass	The Visually Coupled Airborne Systems Simulator – an advanced flight simulator
1983	Myron Krueger	Videospace	First virtual environment
1984	William Gibson	Neuromancer	The term ‘Cyperspace’
1984	NASA (Organization)	VIVED (Virtual Visual Environment Display)	Off-the-shelf technology a stereoscopic monochrome HMD
1985	VPL (Company)	DataGlove	First commercially available VR device

1987	Michael Piller (Writer)	Star Trek – The next generation	The holodeck, idea of immersive Virtual Reality
1988	VPL (Company)	Eyephone (HMD)	First commercially available VR device
1989	Unknown	Boom	Fake Space Labs
1990s	NASA (Organization)	Virtual Wind Tunnel	Application that allowed the observation and investigation of flow-fields with the help of BOOM and DataGlove
1992	Unknown	Cave	Automatic virtual environment
1992	Brys	Augmented Reality	Presents a virtual world that enriches, rather than replaces the real world
1992	Stephen King	Lawnmovyer Man	A look at the possible negative side of Virtual Reality
1995	Silicon Graphics (Company)	VRML 1.0	Virtual Reality Modeling Language
1999	Larry and Andy Wachowski	The Matrix	First Virtual reality based movie

2.4 Devices use to create virtual environment :-

2.4.1 Screen (Desktop/Laptop/Projection) :-

Figure 2.0 High Definition LED Screen

Figure 2.0. This figure shows high resolution

A screen may be a desktop, laptop or a projection screen must be used to project virtual materials. Nowadays LCD or LED screen are used to project such materials. Pixels are the most important factor to create a high definition virtual environment. As high as the resolution of the screen the quality of the picture is also high.

2.4.2 3D glasses

Figure 2.1 3D Picture

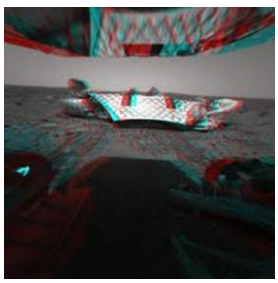

Figure 2.1. A 3d picture shot by two different camera located at a different angle.

Figure 2.2 3D Glasses

Figure 2.2. 3D glasses have different colored two glasses red and cyan.

Figure 2.3 3D Projection

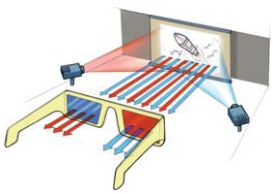

Figure 2.3. These two glasses filter the rays of different frequencies which shot with two different cameras.

3D glasses are used to watch 3d stereoscopic pictures. The effect of stereoscopic 3D pictures is called anaglyph 3d. The stereoscopic 3D effect could be achieved by means of encoding each eye's image using filters of different colors, typically red and cyan. Anaglyph 3D images contain two differently filtered colored images, one for each eye. When viewed through the color-coded anaglyph glasses, each of the two images reaches one eye, revealing an integrated stereoscopic image. The visual cortex of the brain fuses this into perception of a three dimensional scene or composition.

2.4.3 Controlling pad

Figure 2.4 Controlling Pad

Figure 2.4. A mouse has a different buttons that controlled the software by transmitting different commands.

Controlling pad is a basic input device having different control buttons. It is basically used in 3d games to control 3d virtual environment of game. The pad has a start button, direction buttons and action buttons.

2.4.4 Joystick

Figure 2.5 Joystick

Figure 2.5. A joystick is other form of mouse. It also consists different buttons which works same as a mouse

Joystick is also an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the control column, is the principal control device in the cockpit of many civilian and military aircraft, either as a center stick or side-stick. It often has supplementary switches to control various aspects of the aircraft's flight.

Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. A popular variation of the joystick used on modern video game consoles is the analog stick. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs, surveillance cameras, and zero turning radius lawn mowers. Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phones.

2.4.5 3D Mouse

Figure 2.6 3D Mouse

Figure 2.6. A mouse has a different buttons that controlled the software by transmitting different commands.

3D mouse is a human interface device for manipulating computer generated 3D imagery. This device is often referred to as 3d motion controllers, 3d navigation device or 6DOF* (six degree of freedom) device. 3D mouse helps to pan, zoom or rotate the 3d model or camera as if it is holding in our hand. It's a level of control that's simply not possible with a traditional mouse and keyboard. Whether we're working on complex assemblies, dazzling 3D models or fantastic fly throughs, with a 3D mouse we can set our imagination free!

2.4.6 Dataglove or cyberglove

Figure 2.7 Dataglove (Cyberglove)

Figure 2.7. A dataglove is input device. It has different censors which can measure movement of hand and figure and send data to digital machine.

A dataglove is an input device for human-computer interaction worn like a glove. Various sensor technologies are used to capture physical data such as bending of fingers. Often a motion tracker, such as a magnetic tracking device or inertial tracking device, is attached to capture the global position/rotation data of the glove. These movements are then interpreted by the software that accompanies the glove, so any one movement can mean any number of things. Gestures can then be categorized into useful information, such as to recognize Sign Language or other symbolic functions. Expensive high-end datagloves can also provide haptic feedback, which is a simulation of the sense of touch. This allows a dataglove to also be used as an output device. Traditionally, wired gloves have only been available at a huge cost, with the finger bend sensors and the tracking device having to be bought separately.

2.4.7 Video Goggles

Figure 2.8 Video Goggles

Figure 2.8. Video goggles having two small displays which represents a stereoscopic picture.

A video goggles has two small displays with lenses and semitransparent mirror embedded in it. The display units are miniaturised and may include CRT, LCDs, Liquid crystal on silicon (LCos), or OLED. Some goggles employ multiple micro-displays to increase total resolution and field of view. It may have unique non-spherical optical system, anti-fatigue technology built-in flash memory for mega storage and play of media files.

2.4.8 Head Mounted Device

Figure 2.9 Head Mounted Device

Figure 2.9. Video goggles having two small displays which represents a stereoscopic picture.

A Head Mounted Device has display screens, ear phones, micro phones and other digital sensors in it. It is able to show stereoscopic imagery. A binocular HMD has the potential to display a different image to each eye.

2.4.9 Virtusphere

Figure 2.10 Virtusphere

Figure 2.10. Virtusphere is a big sphere having 360^0 screen in all direction.

VirtuSphere is a virtual reality device. It is, as the name suggests, spherical. It consists of a 10-foot hollow sphere, which is placed on a special platform that allows the sphere to rotate freely in any direction according to the user's steps. It works with computer based simulations and virtual worlds, and rotates as the user walks, allowing for an unlimited plane upon which the user can walk. A wireless head-mounted display with gyroscopes is used to both track the user's head movement as well as display the environment of the virtual world. VirtuSphere can serve many purposes, including exercise, video gaming, military training, and virtual museum tours.

2.4.10 Cave

Figure 2.11 VR Cave

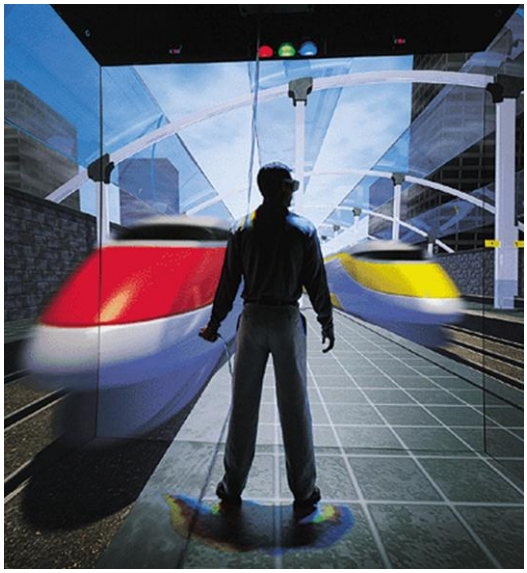

Figure 2.11. VR Cave is a big room being projected on all walls with

The CAVE is a large theatre sited within a larger room. The walls of the CAVE are made up of rear-projection screens, and the floor is made of a down-projection screen. High-resolution projectors display images on the screens via mirrors. The user wears special glasses inside the CAVE to see 3D graphics generated by the CAVE. People using the CAVE can see objects apparently floating in the air, and can walk around them, getting a proper view of

what they would look like in reality. This is made possible by electromagnetic sensors. The frame of the CAVE is made of non-magnetic stainless steel to interfere as little as possible with the electromagnetic sensors. A CAVE user's movements are tracked by the sensors and the video adjusts accordingly. Computers control both this aspect of the CAVE and the audio aspect. There are multiple speakers placed at multiple angles in the CAVE, providing 3D sound to complement the 3D video.

2.5 Applications of virtual reality :-

2.5.1 Motivation to use Virtual Reality

Undoubtedly Virtual Reality has attracted a lot of interest of people in last few years. Being a new paradigm of user interface it offers great benefits in many application areas. It provides an easy, powerful, intuitive way of human-computer interaction. The user can watch and manipulate the simulated environment in the same way we act in the real world, without any need to learn how the complicated (and often clumsy) user interface works. Therefore many applications like flight simulators, architectural walkthrough or data visualization systems were developed relatively fast. Later on, Virtual Reality was applied as a tele-operating and collaborative medium, and of course in the entertainment area.

2.5.2 Architectural visualization

For a long time people have been gathering a great amount of various data. The management of megabytes or even gigabytes of information is no easy task. In order to make the full use of it, special visualization techniques were developed. Their goal is to make the data perceptible and easily accessible for humans. Desktop computers equipped with visualization packages and simple interface devices are far

from being an optimal solution for data presentation and manipulation. Virtual reality promises a more intuitive way of interaction.

The first attempts to apply Virtual Reality as a visualization tool were architectural walkthrough systems. What is so fantastic about Virtual Reality to make it superior to a standard computer graphics? The feeling of presence and the sense of space in a virtual building which cannot be reached even by the most realistic still pictures or animations. One can watch it and perceive it under different lighting conditions just like real facilities. One can even walk through non-existent houses – the destroyed ones or ones not even created yet (see figure 2.12).

Figure 2.12 Virtual Architect

Figure 2.12. Virtual building named Progress Bank.

Other disciplines of scientific visualization that have also profited of virtual reality include visualization of chemical molecules (see figure 2.13) and the digital terrain data of Mars surface (see figure 2.14) etc.

Figure 2.13 3D Molecules

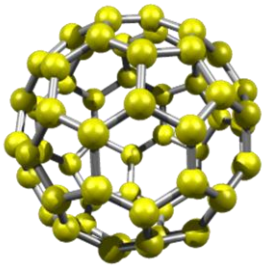

Figure 2.13. It is a 3D molecule named Buckyball or fullerene having 60 carbon atoms bonded with covalent bond. Each carbon atom is bonded with another four carbon atoms.

Figure 2.14 Mars Surface

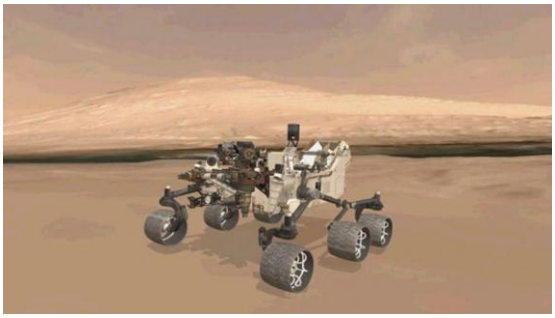

Figure 2.14. Surface of mars on which mars rover is moving to analyze soil structure of mars crust.

2.5.3 Modeling, designing and planning

In modeling virtual reality offers the possibility of watching in real-time and in real-space what the modeled object will look like. We can change colors, textures and positions of objects, observing instantaneously how the whole surrounding would look like.

Virtual Reality could also be successfully applied to the modeling of surfaces. 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 (see figure 2.15).

Figure 2.15 Wind Tunnel

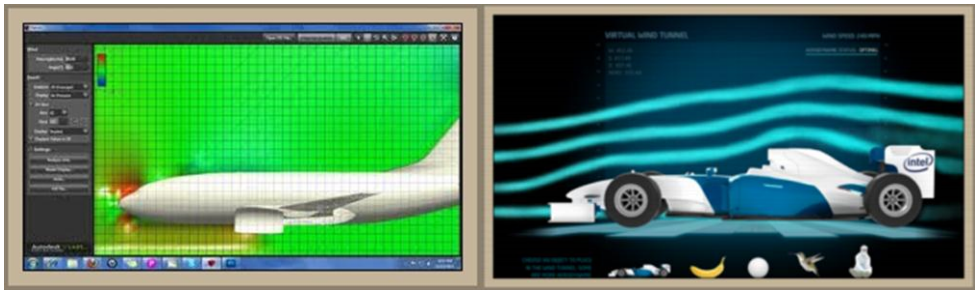

Figure 2.14. Testing effect of wind on the surface of aircraft and car using VR based software.

2.5.4 Training and Education

The use of flight simulators has a long history and we can consider them as the precursors of today's VR. Nowadays they are used by many civil companies as well, because they offer lower operating costs than the real aircraft flight training and they are much safer (see figure 2.16). In other disciplines where training is necessary, simulations have also offered big benefits. Therefore they were prosperously applied for determining the efficiency of virtual reality training of astronauts by performing hazardous tasks in the space. Other applications that allow training of medicine students in performing endosurgery, operations of the eye and of the leg were proposed in recent years (see figure 2.17). And finally a virtual baseball coach has a big potential to be used in training and in entertainment as well.

Figure 2.16 Aircraft Training

Figure 2.16. Virtual Control room of Virtual aircraft. A screen opposite to the trainee showing virtual movie as the aircraft taking off or flying or landing.

Figure 2.17 Virtual Lasik Eye Surgery

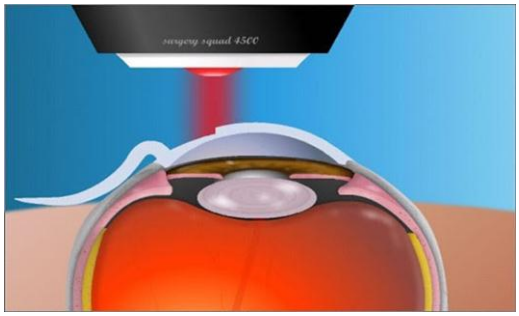

Figure 2.17. Students of medicine can learn through virtual surgery, operations, etc. In above figure a virtual lasik eye surgery is performed.

2.5.5 Telepresence and 3D holographic :-

Although the goal of telerobotics is autonomous operation, a supervising human operator is still required in most of cases. Telepresence is a technology that allows people to operate in remote environments by means of VR user interfaces. In many cases this form of remote control is the only possibility. The distant environment may be hazardous to human health or life, and no other technology supports such a high level of dexterity of operation. This system that uses a HMD and force-feedback manipulation allows a scientist to see a microscope view, feel and manipulate the surface of the sample.

3D holographic is also a part of telepresence. Holography is a technique that enables a light field, which is generally the product of a light source scattered off objects, to be recorded and later reconstructed when the original light field is no longer present, due to the absence of the original objects.

3D holographic is entirely a Latest and vary unique “Hi-Definition Projection Technology” in which a person is captured in 3-dimentional aspect with a special Hi-Definition Camera on a specially built stage and projected “As Is” at various Distant

Locations “At –A – Time”. Viewers at the other end will feel the presence of real Person in front of them and also interact with the projected ‘Virtual” person, without wearing any kind of 3D glasses, as they interact with ‘Actual Person’ (see figure 2.17).

Figure 2.18 Telepresence with 3D holographic technology

Figure 2.18. Chief Minister of Gujarat Narandra Modi in a 3D holographic telepresence. In 2012 he embraced 3D Holographic projection to address his followers in 4 cities of Gujarat.

2.5.6 Cooperative working

Network based, shared virtual environments are likely to ease the collaboration between remote users. The higher bandwidth of information passing may be used for cooperative working. The big potential of applications in this field has been noticed and multi-user VR becomes the focus of many research programs like NPSNET, AVIARY and others. Although these projects are very promising, their realistic value will be determined in practice.

Some practical applications, however, already do exist – just to mention a collaborative CO-CAD desktop system that enables a group of engineers to work

together within a shared virtual workspace. Other significant examples of distributed VR systems are training applications in inspection of hazardous area by multiple soldiers or in performing complex tasks in open space by astronauts.

2.5.7 Entertainment

Constantly decreasing prices and constantly growing power of hardware has finally brought VR to the masses – it has found application in the entertainment. In last years W-Industry has successfully brought to the market networked multi-player game systems (see figure 2.19). Beside these complicated installations, the market for home entertainment is rapidly expanding. Video game vendors like SEGA and Nintendo sell simple VR games, and there is also an increasing variety of low-cost PC-based VR devices.

Figure 2.19 VR based game system

Figure 2.19. Two player enjoying a virtual reality based 3D games.

Virtual reality is a very common theme in science fiction movies, where it is often used a way to turn the fantastical into something that seems totally real. TRON, for instance, was one of the first movies to use virtual reality as a plot element. The main characters were taken from reality and transported into a virtual world inside a computer. Some of the most popular movies of our time use concepts of virtual

reality. Some of these movies, which you've probably heard of, include “Matrix Series”, “2012”, “Avatar”, etc. (see figure 2.20).

Figure 2.20 Use of VR movies

Figure 2.19. Movie scenes from films “2012” and “Avatar” respectively. Both are a milestone of using VR technology.

2.6 Disadvantages of virtual reality :-

2.6.1 The Cost :-

This new technology is expensive. The cost of developing hardware and software for the application of virtual reality technology is too great for many institutions to implement at this time. Computer instrumentation is expensive after introduction but has always decreased over time; so I suspect as this occurs virtual reality will eventually become more common place in education.

2.6.2 The Restraint :-

Presently the equipment used to create virtual environment is restrictive and uncomfortable to its users. This would have to be overcome for more convenient uses in education.

2.6.3 Social Isolation :-

Socially, some of the disadvantages of virtual reality as entertainment have already started to surface, even without an experience that fully removes a person from his or her surrounding stimuli. One issue is social isolation, in which the user of virtual reality relies more on interactions that take place in a virtual world than on

experiences in the real world. This lack of true, physical interaction has the potential to create incorrect associations that are not part of real social settings. The isolation could eventually cause depression, disassociation and other conditions, if it is severe enough.

2.6.4 Psychological Effect :-

Another of the possible psychological and social disadvantages of virtual reality is desensitization. If some users were to use virtual reality for entertainment extensively, then they could run the risk of failing to recognize the true consequences for actions in which they are taking part or are viewing. When translated to the real world, in an extreme case, this could cause a lack of understanding of the effects of some actions when performed outside the virtual environment.

2.6.5 Cyber Addiction :-

There are people who become addicted to virtual reality games and as a consequence, start to blur the boundary between real and virtual life. They spend increasing amounts of time in the virtual environment which has a detrimental effect on their real world life.

2.6.6 Virtual Criminality :-

It is hard to imagine but what happens if someone commits a criminal act but within a virtual environment? A potential situation is one in which several people are immersed within a virtual environment but one of these participants becomes injured or traumatized due to the actions of another person in that situation.

The question is whether it is possible for someone to suffer an injury or mental distress as a result of a violent action carried out in a virtual environment. And if this

does happen is the perpetrator punished in a similar way to someone who commits this action in the real world?

What may be argued is whether a virtual reality participant can experience pain, distress or other emotions associated with a criminal act?

2.6.7 Other Disadvantages :-

- People lack face to face communication skills.
- Lack of physical activity.
- Loss of natural light.
- Being cooped up in front of a computer screen for hours at a time.
- Encourages bad posture and strained eyesight.
- Promotes social isolation.
- Increased Electricity bills.
- Loss of focus in school and in life.
- Loss of jobs as people became addicted and don't go to work.
- Increased health problems as people don't eat properly and become sick.
- Friendship is an illusion.
- Promotes an escape to reality or a distorted view of reality.
- High technical requirements for computer systems.
- Steep learning curve to control avatars in virtual worlds.
- Potential for harassment, humiliation, victimization, or other distractions.
- Lack of environmental control unless situated in a private area.

2.7 Conclusions :-

Each and every coin has two sides. As well as there are advantages and disadvantages for uses of virtual reality. The latest technology must be used in the beneficial of human life. It makes human life easy if it is used positively, otherwise it will not take time to make our life curse to worst hell.

As it is mentioned above the VR based hardware are very expensive to purchase and use. The researcher's goal is not to create a virtual environment but to construct learning software by which using 3D aspect the learning of Chemistry become in easiest way. The researcher tried his best to construct such type of learning material. He faced many difficulties because he is not professionally trained. Whenever he faced such situation, he tried to remove his inability through internet. A lot of hard work has done by the researcher but after all, the researcher had learned so many hard things in this way. The whole process that researcher has performed to construct virtual reality based learning material is mentioned in chapter – 3 in details.

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