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FINAL REPORT – TERM PAPER <i>VIRTUAL REALITY</i>
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1.0 AN OVERVIEW

1.1 AN INTRODUCTION TO VIRTUAL REALITY

1.1.1 DEFINITION

Virtual Reality (VR) is an ambiguous phrase but currently one of the hottest buzzwords in the computer universe that symbolize a major accomplishment. Broad definition of VR would be anything that isn't real, but does a good job of faking it. However, some people would limit or narrowly define VR in terms of goggles, gloves, full body suits, helmets and other paraphernalia associated with full body total immersion into electronic reality.

Let put aside the broad or narrow definition of VR and consider these two terms:

- a) Artificial Reality (AR) which means anything that looks, feels or operate realistically but isn't real. Anything at all that stimulates the mind or senses to create a simulacrum of reality in the imagination.
- b) Virtual Madness (VM) means stuffs that break the rules of reality.

The above two terms are equally legitimate virtual pursuits. Both are part of VR. VR gives us the ability to at least temporarily redefine what is reality.

Most interestingly, the meaning of VR also is changing almost daily as companies try to associate their products with the words. That is why the term VR or AR have stretches further to mean just about anything 3 dimensional and the following are additional meaning of the words:

- a) VR is a high-end user interface that involves real time 3D simulations and interactions through position and motion tracking, stereo audio and video, touch and force feedback techniques. The user's personal viewpoint is completely immersed in the virtual world.
- b) VR is an encumbering technology because of the heavy devices, such as the HMD or the data suit that user have to wear in order to immerse in the virtual world.
- c) VR is a multidisciplinary science founded on the creation, storage and manipulation of models (DNA) derived from a variety of fields such as physics, mathematics, engineering, architecture, geometry, psychology and others.
- d) VR is a cognitive technology based on the employment of the "cognitive capabilities of our body". The body acquires knowledge through action and interaction. The subject-observer becomes an active participant. VR substitutes lived experience and emotional knowledge for texts and representation. According to William Bricken, psychology is the physics of VR.
- e) VR is more than a traditional medium since it introduces a new way of interacting with multimedia info. According to Ted Nelson, VR is a hyper

medium where a hyper medium can be defined as an interactive (multi) medium in which information is stored and presented in a variety of ways.

VR also can be defined by its three major qualities such as immersion, presence and interactivity as follows:

- a) Immersion is when user enter the message the medium disappears. The user is enclosed in the virtual environment (VE) by filling his field of view, as well as by providing multi sensorial information. VE is a computer generated, interactive 3D environment in which a person is immersed and actually present. VE are mediated environments since they are mediated by technology.
- b) Presence is when the user has the sense of being in the environment specified by the displays and perceives the objects of the virtual world as equally present. Virtual presence is a function of vividness. The intensity of vividness depending on the number of sensory modalities involves and on the quantity and quality of information and of interactivity.
- c) Interactivity is the process of control and feedback between user and the VE. The user can navigate and manipulate the VE. Interactivity is determined by the time lag between the actions and the response of the VE, by the amount of changes that can be done on the VE and by the "mapping metaphor". Mapping metaphor refers as the way in which human actions are coupled with the response of the virtual world.

The term VR has been used in variety of ways and often sometimes in a confusing and misleading manner. Research showed that originally, the term referred to 'Immersive Virtual Reality'. In immersive VR, the user becomes fully immersed in the artificial, three-dimensional world that is completely generated by a computer. However, today the term VR has been used widely to denote anything 3 dimensional.

1.1.2 A HISTORICAL PERSPECTIVE

In term of function, VR is a simulation of some aspect of the real world, whether it is a walk through an environment, or a military combat simulation. A key word of definition of VR would have to be interactivity. The heart of VR is based on interactive principles between the real and the virtual world. Some of the major areas pertaining to VR include simulation and modeling, and of-course, entertaining, as well as education. Before the present and future of VR can be scrutinized, a background on the historical perspective is necessary.

The major historical events that contributed to the development of VR were as follows:

- **Introduction of Sensorama simulator machine**

In 1962, Morton Heilig, cinematographer and documentary producer who was not a computer scientist, nor was he an engineer, developed a VR simulator machine called sensorama, a simulator machine that can be considered as an

ancestor of VR arcades. He wanted to create an ultimate full-view experience for the spectator. The sensorama used 3-D video, obtained 35 mm cameras mounted on the cameraman. The setup included stereo sound, integrated with the full 3-D camera views. The viewer could ride a motorcycle and feel the wind blowing, simulated by a fan, even a bumpy ride due to the potholes in the road, vibrating handlebars and seat to create the illusion of motorbiking downtown Brooklyn and through Californian sand dunes. Unfortunately, sensorama was not a commercial success however; the machine had been a model for the other inventors in the VR arcades especially to further develop evolutionary machines like what we can see today.



Sensorama Simulator Machine

- **Introduction of the first Head Mounted Device (HMD)**

In 1965, Ivan Sutherland, a graduate student from University of Utah, in a paper, had envisioned VR as a generalized simulation, with an interface that could produce the experience of being in an artificial space within which the computer could control the existence of matter. In 1968 also Sutherland created the first HMD. Since then, HMD has been referred to as a window into a virtual world. He started the idea of graphics accelerator, which was an integral part in

modern virtual simulation. The military quickly recognized the potential of this idea in flight simulation and as a result in 1970 (s) he spent most of his time designing helmets that could stimulate a view of flight. He managed to produce first flight simulator for the US Army.

- **Introduction of VIDEOPLACE**

In 1973, Myron Krueger coined the term AR and developed VIDEOPLACE. He is the first artist who focused on computer interactivity as a medium for artistic creation. VIDEOPLACE is a form of Projected Reality. In VIDEOPLACE, Myron Krueger used a big screen in front of the user. On this screen, a shadow of the user will be displayed. The user could now finger-paint in the sky. It was possible to display multiple people on the same screen. This development then would lead to the first form of computer Supported Collaborative Work (CSCW). It was also possible to introduce the outline of a little animal, CRITTER, in this environment. The CRITTER was used to allow the user to interact with the computer and his environment. He pioneered the development of unencumbered VR where the user could participate in an experience created by the computer with their entire body without wearing any special devices.

- **Introduction of very high resolution HMD**

In 1980s, the military quickly saw the advantages of VR and developed it further. In 1982, Thomas Furness III developed a HMD with a very high resolution, 2000 scanlines (this is almost four times normal TV and two times most X-window terminals), by using small 1 CRTs. Using the helmet, the pilot saw a symbolic representation of the world. The military kept their VR technology secret for a long time.

- **Introduction of Liquid Crystal Display (LCD) HMD**

Mc Greevy at NASA Ames had put together ideas of Furness and Sutherland to build HMD that used Liquid Crystal Display (LCD). A tracker from polhemus was used to track the movement of the head. This was the first HMD using cheap technology (the HMD cost less than \$2000). Up until now, VR was costly. McGreevy showed that it was possible to use cheap equipment and still build VR setup. This was the breakthrough for VR as now more scientists could afford VR to further develop the research materials.

- **Introduction of VR products commercially**

In 1985, Jaron Lanier together with Thomas Zimmerman, founder of VPL research, had set-up the first commercial company selling VR products. He also popularized the term VR. VPL Research introduced a commercially available HMD, the famous "EyePhone" system in 1989 and the first dataglove.

- **Introduction of CAVE system**

In 1992, The Cave Automatic Virtual Environment or famously known as CAVE System was developed at the University of Illinois's Electronic Visualization Laboratory (EVL) at Urbana Champaign, USA. The system is composed of three

projection walls and one door. It also uses two 3-D magnetic trackers, Flocks of Birds by Ascension Technology, to locate the head and the hand. This interface device has since the introduction develops in more advance way for user to be fully immersed in VR world. Also, has become one of the most popular immersive VR solutions.

▪ **Introduction of Tele Immersion**

In 2000, Tele Immersion (National Tele-immersion Initiative – NTII) will enable users at geographically distributed sites to collaborate in real time in a shared, simulated environment as if they were in the same physical room. This new paradigm for human-computer interaction is the ultimate synthesis of networking and media technologies and, as such, it is the greatest technical challenge for Internet2.

1.1.3 RESEARCH CENTRE

In VR, the research center would provide a place for researchers to share and contribute ideas towards the development and advancement of this area. The realistic environments the research center provides make it easier for researchers to visualize solutions, from medical breakthroughs to crisis simulations to urban planning as well as can also help preserve our heritage by reconstructing ancient sites in 3D for future generations.

There are numerous number of research center around the world especially in universities and government agency like military performing research on VR especially in USA, where VR was born and develop rapidly. In Malaysia, Universities and Government Agency have started to develop VR research center as there are increasing awareness that such center would have stimulate scientific research center in almost all kind of fields. Examples of such research centers are as follows:

a) **Faculty of Information Technology, University Utara Malaysia (UUM), Sintok, Kedah.**

Several research papers on VR especially VR in commercial application have been written and among others the topic of the paper are as follows:

- Virtual Learning: Towards a web-base Intelligent Tutoring by Azizi Zakaria.
- Implementing Virtual Reality in home design: A prototype system by Abdul Nasir Zulkifli.
- Enhancing real estate marketing utilizing virtual reality technique by Ahmad Yusri Baharudin.

b) **Virtual Reality Competency Center (VRCC) at University Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak.**

The VR center consists of a PowerWall Projection node Linux PC Cluster and 4-sided CAVE system driven by SGI Onyx3200. The VR center is running on VEGA VR software application. Users are able to view the CAVE by wearing the 3D glasses and manipulate the models using the virtual wand in order to help viewer perceive the depth of image.

The VR center employs OSS Solutions. The solution can help scientists and researchers achieve insight into the complexities of data by using immersive virtual reality solution. The CAVE technology will immerse into dimensional models of biological systems, including cells, tissues and entire system as to enable scientists to have a much intricate understanding of human diseases and thereby accelerating the pace of life-saving research and reducing the development cost and time.



This figure shows the 4-sided CAVE in UNIMAS VR Lab, Kota Samarahan, Sarawak.

UNIMAS currently offers research on VR for Industry and example of such research are as follows:

- **Simulation and VR Application in Education**
The recent development of desktop VR provides cost-effective but nevertheless educational tools. Current projects on this project include: Exploring the educational value of desktop VR technical dimensions that could affect a user's understanding of a virtual environment and its usability as a learning tools. Few existing academic courses have been adapted to a virtual environment for this purpose. The learning ability or VR base course was then compared to other medium of instruction.
- **Simulation and VR Application for Product Design**
The development of a VR system to help with the design of products and the interior design of an artifacts such as kitchens, libraries, shopping malls. Past project includes a prototype non-immersive virtual reality system of a kitchen, designed and development based on important considerations in kitchen interior design addressed by couple of well-known kitchen designers. The prototype is "intelligent" to some extent, as it allow a 3 dimensional, interactive manipulation.

- **Simulation and VR Application for Marketing**

The uses of virtual system on the web to help with marketing purposes, to enable user explore and interact with the product. Current project involves the design and development of a virtual toy room where interact with “intelligent” toys to get more information on the product.

UNIMAS offers Bachelor of Science (Hons) Cognitive Science for students who want to study human intelligence and artificial intelligence technology in improving work performance. It is multidisciplinary field that consists of computer science, psychology and neuroscience.

c) **Faculty of Creative Multimedia, Multimedia University (MMU), Cyberjaya, Selangor.**

MMU is among the first universities in Malaysia to concentrate a substantial amount of research and development of real-time, interactive and collaboration simulation database including live data from satellite and Geographic Information System (GIS). MMU with Malaysian Center for Remote Sensing (MACRES) had collaborated and generated a Virtual GIS Simulation data from the earth model to downtown Kuala Lumpur as well as a walkthrough of the interior of MACRES building using Digital Elevation Model data from satellite image and GIS.

The research can be categorized as Visual Simulation (Vsim), which is an extension of VR where things we create digitally can be, experienced virtually using the same senses that we experience in the real world. VSIM give us possibility of visualizing huge volume of data and information, which is not possible in low-end VR system. These types of data can be in the form of GIS, Satellite Imagery, Stereo lithography, Urban Planning Data, Survey Data or others. The data type mostly numerical and most often than not, they are translated into 2D drawings and diagrams which can be understood ell enough by lay man but will be much better in the form of interactive 3D. Vsim provides this capability of transforming this myriad of data into something everybody can visualize and understand. “A picture is worth a thousand words” can now be “Vsim is worth thousand pictures”.

d) **Multimedia Development Corporation of Malaysia (MDC), Cyberjaya, Selangor.**

The center is known as The Creative Application Development Center (CADC), will use the latest Silicon Graphic (SGI) technology known as SGI Onyx 3800 system makes it the most advanced Reality Center facility in South Asia. SGI Reality Center visualization system allows teams of technical and creative professionals to engage in interactive, real-time engineering and design review, data analysis, critical training, presentation or command and control operations. They immerse users in virtual environment to explore, understand and communicate about data in ways not possible in the physical world, thus increasing speed of decision-making, realizing savings and enhancing productivity. In addition, SGI’s Visual Area Network concept will in the near

future, also enable MSC large contingent of high-technology organizations to universal access to advanced visualization using any computing device over standard networks.

MDC intends to position the facility as the preferred site for scientists undertaking complex research and computational work, for students of such disciplines as VR, animation and computational sciences, for institutions of higher learning, and as training sites for software developers.

2.0 FORMS OR TYPE OF VIRTUAL REALITY

The most common types of VR are fully immersive and non-immersive. Nevertheless, with more research and current application the boundary has become blurred. More advanced VR forms are taking over the conventional type. The 3 models highlighted are example of current VR form. However, theoretically the two type are highlighted as follows:

2.1 FULLY IMMERSIVE VIRTUAL REALITY

The unique characteristics of immersive virtual reality can be summarized as follows:

- Head-referenced viewing provides a natural interface for the navigation in three-dimensional space and allows for look-around, walk-around, and fly-through capabilities in virtual environments.
- Stereoscopic viewing enhances the perception of depth and the sense of space.
- The virtual world is presented in full scale and relates properly to the human size.
- Realistic interactions with virtual objects via data glove and similar devices allow for manipulation, operation, and control of virtual worlds.
- The convincing illusion of being fully immersed in an artificial world can be enhanced by auditory, haptic, and other non-visual technologies.
- Networked applications allow for shared virtual environments (see below).

2.2 NON-IMMERSIVE VIRTUAL REALITY

Today, the term ' Virtual Reality' is also used for applications that are not fully immersive. The boundaries are becoming blurred, but all variations of VR will be important in the future. This includes mouse-controlled navigation through a three-dimensional environment on a graphics monitor, stereo viewing from the monitor via stereo glasses, stereo projection systems, and others.

Apple' s QuickTimeVR, for example, uses photographs for the modeling of three dimensional worlds and provides pseudo look-around and walk-trough capabilities on a graphics monitor.

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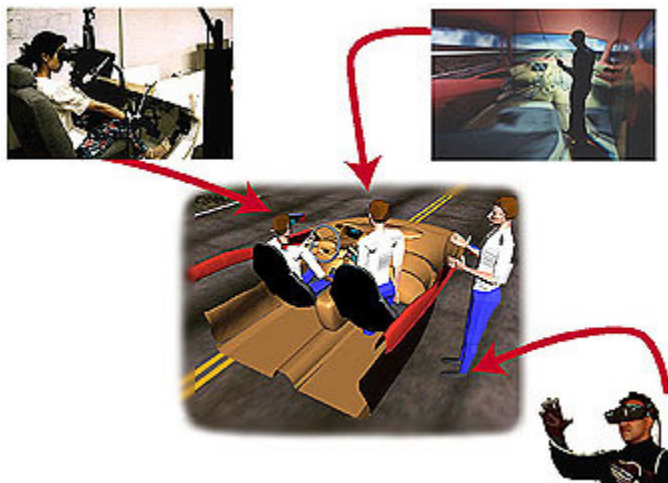
Another example is Stereovision via e-D (electronic dimension) software. The secret of Stereovision concept is actually the normal way almost everyone sees in the real world. We all have two eyes and perceive depth by a mental interpretation of the world we view through those two eyes. Each eye gives a slightly different perspective on the objects viewed and this slight difference provides depth cues to our brain. Objects, which are relatively close, will shift a larger distance horizontally when viewed from one eye and then switching eyes. Objects, which are relatively far away, shift a smaller amount.

The e-D software and drivers automatically convert the images on your monitor into a left and right perspective. Each image flickers back and forth so fast on your monitor that it is not noticeable to the human eye. Working synergistically with our advanced active glasses, the flickering of each image is precisely timed with flickering of the left and right lens of the glasses, again faster than can be perceived. Thus, stereovision as it pertains to viewing a virtual world means that you have the capability to produce two separate images and that each eye sees only one of the two images. If this is done correctly, your mind will combine the two images in such a way that you actually have the perception of being "in" the virtual world rather than just viewing a picture of the virtual world.

This adds a level of realism and immersion to games, web sites, and other images that is otherwise unattainable. In addition to perceiving depth "into" the monitor it is also possible to make objects appear to come "out of" the monitor. Almost all fairly recent computers and games come pre-equipped with the necessary tools for proper viewing.

MODEL 1: Shared Virtual Environments

In the example illustrated below, three networked users at different locations (anywhere in the world) meet in the same virtual world by using a BOOM device, a CAVE system, and a Head Mounted Display, respectively. All users see the same virtual environment from their respective points of view. Each user is presented as a virtual human (avatar) to the other participants. The users can see each other, communicated with each other and interact with the virtual world as a team.



MODEL 2: VRML

Most exciting is the ongoing development of VRML (Virtual Reality Modeling Language) on the World Wide Web. In addition to HTML (HyperText Markup Language), that has become a standard authoring tool for the creation of home pages, VRML provides three-dimensional worlds with integrated hyperlinks on the Web. Home pages become home spaces. The viewing of VRML models via a VRML plug-in for Web browsers is usually done on a graphics monitor under mouse-control and, therefore, not fully immersive. However, the syntax and data structure of VRML provide an excellent tool for the modeling of three-dimensional worlds that are functional and interactive and that can, ultimately, be transferred into fully immersive viewing systems. The current version VRML 2.0 has become an international ISO/IEC standard under the name VRML27.

MODEL3: VR-related Technologies

Other VR-related Technologies combined virtual and real environments. Motion Trackers are employed to monitor the movement of dancers or athletes for subsequent studies in immersive VR. The technologies of Augmented Reality allows for the viewing of real environments with superimposed virtual objects. Telepresence systems (e.g. telemedicine, telerobotics) immerse a viewer in a real world that is captured by video cameras at a distant location and allow for the remote manipulation of real object via robot arms and manipulators.

3.0 VIRTUAL REALITY: Tools for creations and interface devices.

VR starts in the imagination. Mankind was born with the ability to visualized in 3 dimension - that is where VR begins. The computer can only build on or enhance our own built-in VR abilities. There are a full range of 3D and virtual software and hardware. The more interesting one will be interactive as compared to the static vision. The product range from the more expensive to the lower range depending on complexities of its technology.

3.1 SOFTWARE

Among the basic 3D software are:

1) Vistapro. - Vistapro is a program for creation of landscapes. The natural features of landscape such as tree, clouds, lakes, mountain and rivers can be rendered according the setting provided by the softwares. It use the focal view of a camera to describe image rendered. The point of view of the rendering process and finishes are supported with fractal magic (function that enable to modify and generate random landscape such as stretching, create an island, smoothen the edges and height) and lighting effect to create a more impressive image. It also have features such as animation and morphing which enable a flat terrain raising up to a mountain and the movement of clouds. Other softwares with similar landscape capability are Mars Explorer and Distant Suns.

2) Virtus – Virtus Walkthrough and Virtus VR – Both the software take full advantage of the window interface, therefore make them easy to use. Virtus Walkthrough offer more

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significant power for creating virtual world while Virtus VR is more for the beginner to start on creating virtual reality. Another feature of Walkthrough it comes with its own libraries of object that a user need not to create it from scratch.

3) VR Studio – The program require a more powerful machine such as more memory space and higher resolution to make the movement more fluid and realistic. It is one of the software packages that have its own personality. Instead of selecting object and dragging object, you need to select and move it using control button. The most important feature is changing the point of view using control button since it has no grid line to portray the 3D images.

4) TrueSpace – all the above mentioned 3D software face great difficulty to create 3D object while working with a 2D interface i.e. the flat computer screen. TrueSpace runs in Windows, but the interface plays around a bit with the realities of life in windows. The interface allows change of view point and its view from a focal view of a lens camera with grid line.

5) 3D Studio – Allow the images from a camera or video being imported and map into 3 dimension. 3D Studio has 4 view ports on one screen i.e. top, front, left and user or the 3D views (the screen is divided into 4 view screen simultaneously).

The more advance and expensive software use nowadays to create 3D graphic and produce images. The softwares available are widely used for creating 3D computer action games. Among the early 3D games are DOOM, Raptor Duke Nukem Myst and Return to Zork. The most recent 3D games are

The 3D action games are more appealing since it is almost real with 3D images together with digital 3D sound effects.

The more expensive softwares such as Superscape and VREAM are only supported by more complex and expensive input devices such as Spaceball. Due to the demanding task that an input devices required to performed keyboard and mouse is not able to cater. The task like changing point of view, selecting and picking up objects, moving and rotating objects, throwing and dropping object and interacting menus, toolbars, icons, buttons and so on.

These tasks are best handled by Cyberman, Spceball 5000, Gloves input, Flocks of Birds, GAMS and head-tracking devices (HeadMouse).

3.2 INTERFACE DEVICES

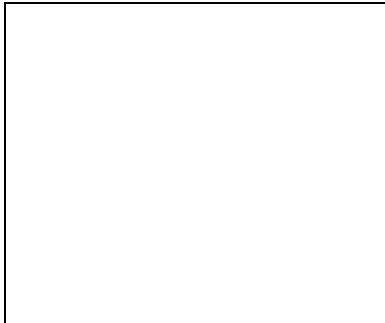
Today, ' Virtual Reality' is used in a variety of ways and often in a confusing and misleading manner. Originally, the term referred to ' Immersive Virtual Reality' whereby the user becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer.

In virtual reality the most attention is focused on the output devices i.e. the glamour futuristic looks and expensive headsets; and other 3D environments.

3.2.1 Head-Mounted Display (HMD) and Goggles

The head-mounted display (HMD) was the first device providing its wearer with an immersive experience. Evans and Sutherland demonstrated a head-mounted stereo display already in 1965. It took more than 20 years before VPL Research introduced a commercially available HMD, the famous "EyePhone" system (1989).

A head-mounted display (HMD) unit:



A typical HMD, houses two miniature display screens and an optical system that channels the images from the screens direct to the eyes, thereby, presenting a stereo view of a virtual world. A motion tracker continuously measures the position and orientation of the user's head and allows the image-generating computer to adjust the scene representation to the current view. As a result, the viewer can look around and walk through the surrounding virtual environment.

The more expensive high end HMD could include full head-tracking sensor, digitized stereo sound system and crystal clear resolution screen. A combination of VR4 headsets and Spaceball 2003 are required to control vrTrader, a virtual reality stock-trading program AVATAR which is used for training floor traders. The more recent HMD is more compact with wireless technology and some use combination of other VR interface devices for more impressive effect and flexible usage.

Models of HMD





V-Real Viewer



i-Scape II



5DT HMD



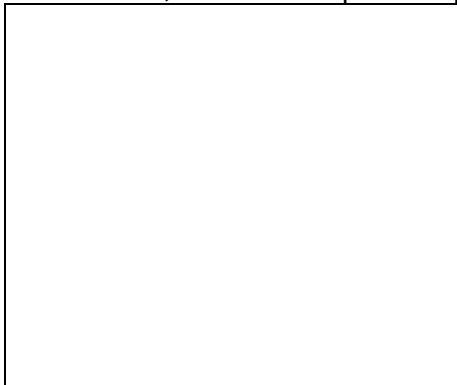
Hi-Res 900

To overcome the often-uncomfortable intrusiveness of a head-mounted display, alternative concepts (e.g., BOOM and CAVE) for immersive viewing of virtual environments were developed.

3.2.2 BINOCULAR OMNI-ORIENTATION MONITOR (BOOM)

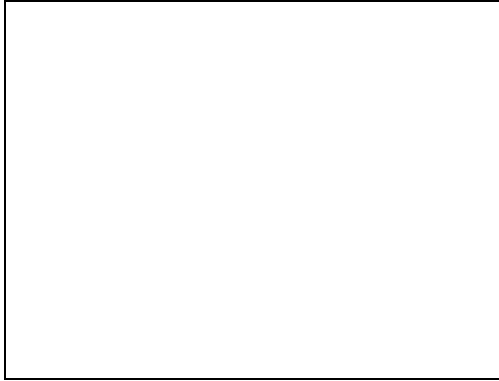
The BOOM (Binocular Omni-Orientations Monitor) from Fakespace is a head-coupled stereoscopic display device. Screens and optical system are housed in a box that is attached to a multi-link arm. The user looks into the box through two holes, sees the virtual world, and can guide the box to any position within the operational volume of the device. Head tracking is accomplished via sensors in the links of the arm that holds the box. It uses similar concept to the earlier "SENSORAMA" machine.

The BOOM, a head-coupled display device:



3.2.3 CAVE

The CAVE (Cave Automatic Virtual Environment) was developed at the University of Illinois at Chicago and provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube. Several persons wearing lightweight stereo glasses can enter and walk freely inside the CAVE. A head tracking system continuously adjusts the stereo projection to the current position of the leading viewer.



CAVE System (schematic principle):

3.2.4 OTHER VR DEVICES: Input Devices and other Sensual Technologies and models

A variety of input devices like data gloves, joysticks, and hand-held wands allow the user to navigate through a virtual environment and to interact with virtual objects. Directional sound, tactile and force feedback devices, voice recognition and other technologies are being employed to enrich the immersive experience and to create more "sensualized" interfaces. Among them are categorized as follows:

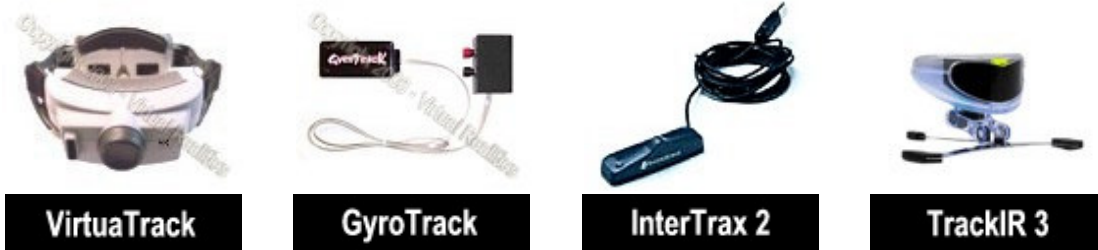
- **HEAD TRACKERS**
- **MOTION TRACKERS**
- **DATA GLOVES**
- **3D CONTROLLERS**
- **FORCE FEEDBACK DEVICES**
- **VR PACKAGES IN THE MARKET**
- **SIMULATORS**

Head Trackers

It use sensor technique to measures vector in ambient magnetic field. The comfort of a tried-and-true fit with 3 and 6 Degrees of Freedom (Roll/Pitch/Yaw), allows users accurately immerse in any PC Game or Application. Head Trackers can navigate accurately in any Windows program or Virtual Reality application (ANY GAME) by looking up, down and side to side with your head like you are really there. The move can be program similar to mouse control.

It will also work with programs that require precise movement such as CAD programs and drawing programs. It can make life easy e.g. to send and receive email, browse the web, play solitaire, or almost any other computer function hands free

Type of Head Trackers



Motion Trackers

Similar to Head Trakers, Motion trackers are devices that are use to navigate and maneuver through the virtual environment via using the 3D software. Among the motion trackers are “The Flock of Birds”. The Flock of Birds is a regulatory-compliant of DC magnetic tracker. It use to track the position and orientation in real time of instruments including ultrasound probes. Tracking accuracy is unaffected by the nearby presence of conductive metals including aluminum and stainless steel.

Features and benefits

- Pulsed DC magnetic technology: Five times less susceptible to distortion caused by conductive metal than AC technology. Occlusion-free tracking
- Class B certified: Compliant with electrical, EMI and safety standards
- Quantitative measurement: Improves diagnostic capability
- 6 degrees-of-freedom: Unrestricted range of motion.

Application

- 3D image reconstruction in ultrasound,Telemedicine, Medical instrument tracking and Quantitative measurement
- Biomechanical Analysis:
Collect real-time relative movement data for gait and limb analysis. Perfect for leg, knee, joint, spine, or shoulder rotational movement.
- Graphics:
Easily changes and controls the lighting of computer generated images in real time, with the ability to move objects on screen without the loss of environmental changes (i.e., lighting and shadowing).
- Stereotaxic Localization:
Mounted on any non-metallic object (such as a robotic prosthesis), the sensor determines its position and orientation.
- CAD Database:
Perfect low cost tool for developing databases of complex, non-metallic objects for CAD, CAE, computer graphic models, or simulation with optional stylus.
- Dimensional Archiving:
Collect the actual dimensions of artifacts, archaeological items, museum sculptures, and other items

Motion Trackers



GyroTrack



InertiaCube2



Logitech Tracker



PATRIOT



FASTRAK



LIBERTY



IS-300 Pro



3D-BIRD



Flock of Birds



Flock of Birds B



Nest of Birds



MotionStar



LaserBIRD 2



pcBIRD



pciBIRD



miniBIRD



3D Navigator



SpacePad



ReActor2

VIRTUAL REALITY

Data Gloves



P5 Glove



5DT Glove 5



5DT Glove 16



5DT Glove MRI



Pinch Glove



CyberGlove

3D Controllers



3D Mouse



X-Gun



Cyberstik



FreeD



SpaceBall 5000



SpaceMouse



CadMan



SpaceTraveler



6D Mouse



Wanda

VIRTUAL REALITY

Force Feed back Devices



Rumble Chair



R&R Chair



Intensor



Interactor Vest



VR Cushion



Bass Shaker



Audio FX

Other VR Packages



PC VR



VR-3D Glasses



VR Racer



VR Pilot



Formula T2



3D Theater



NuView 3D



VR Golf



Star Trek X3D



Zen Master



SimCycle



Virtual FX

Simulators



4.0 APPLICATION OF VIRTUAL REALITY

4.1 VIRTUAL REALITY IN MEDICINE

Virtual Reality (VR) with a medical application, involves at a minimum visualization of data (which is anatomical) in three dimension (3D) and interaction with that visualized data.

VR is being applied in a vast range of medical areas, including remote and local surgery, surgery planning, medical education and training, treatment of phobias and other causes of psychological distress, skill training, and pain reduction. It is also used for the visualization of large-scale medical records, and in the architectural planning of medical facilities.

In this regard, our focus will be on three main application areas i.e. in surgery, training and education and how VR works on cancer patient. Yet in surgery itself, there are enormous applications in VR.

VR for Surgery

Surgeons currently use several VR to plan and practice an operation on a virtual patient rather than a real person.

Surgery is mostly visual and manual. It involves applications of interactive immersive computer technologies to help perform, plan and simulate surgical procedures. In performance, the VR guides the surgeon, sometimes with a robot to execute the procedure under the surgeon's control (for instance, to remove hand tremor and scale down manipulations for key-hole surgery). In other words, VR is used to give the surgeon 3D interactive views of areas within the patient.

Planning is carried out preoperatively, to find the best approach to surgery, involving minimum damage. Simulation is mostly used in training, using patient data often

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registered with anatomical information from an atlas. It may be used for routine training, or to focus on particularly difficult cases and new surgical techniques.

The surgeon opens the body and uses hands and instruments to operate. This is the most invasive form of surgery, with long recovery times. There is a strong movement away from open surgery and towards improved techniques of minimally invasive surgery.

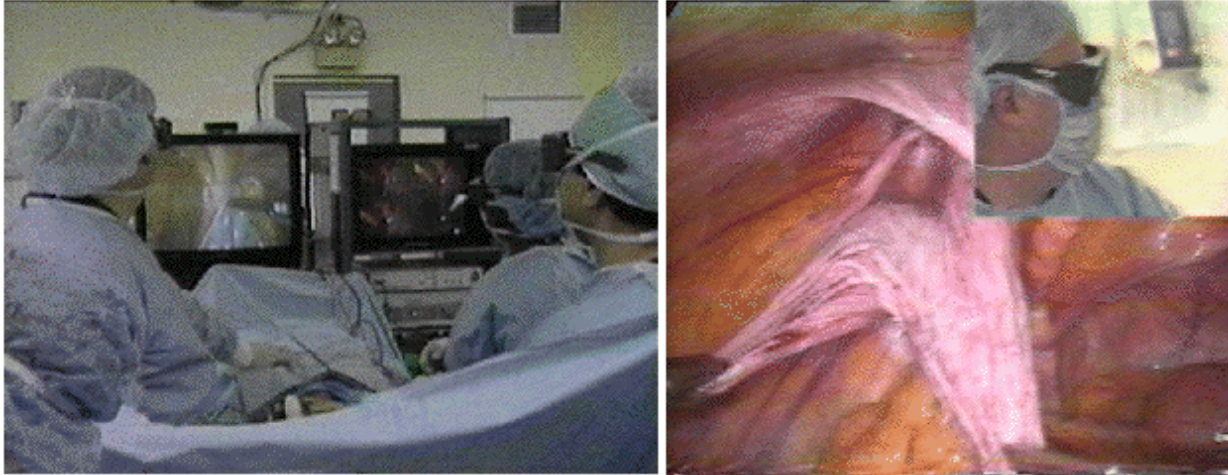
Minimally invasive surgery utilizes miniature cameras placed within the body, to produce a display on a monitor in the operating theatre. Desktop VR also produces representations of 3D environment on a computer monitor. Therefore could be used as direct substitute without too much loss in operational realism.

The surgery may be remote (through the use of robotics) or local such as:

- Endoscopic surgery - minimal invasive surgery through natural body openings or small artificial incisions ('keyhole surgery'). laparoscopy; thoracoscopy; arthroscopy; A small endoscopy camera is used in combination with several long, thin, rigid instruments. Endoscopic surgery is becoming increasingly popular, because of its significant advantages.
- Radiosurgery – X-ray beams from a Liner Accelerator are finely collimated and accurately aimed at an abrasion (cut). Popular products include Radionics X-knife and Elekta's Gammaknife. Planning surgery is suitable for VR, since it involves detailed understanding of 3D structure.
- Image-guided surgery - Guiding surgeons to targets during actual operations; practicing difficult procedures;
- Training simulators; telesurgery; Preoperative planning – studying patient data before surgery;



VIRTUAL REALITY



Endoscopic surgery: the current situation without VR

Advantages of VR includes:

To carry out as much surgery as is feasible by this means, to minimize the risk to patients;

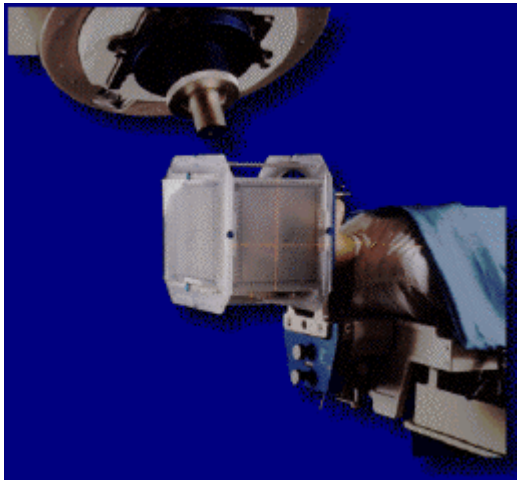
- Less pain to the patient; less strain on the organism and faster recovery. There are also relatively small injuries, and an economic gain arising through shorter illness time.
- It is also the most popular surgical application of VR, partly because it expands on what is already an "unnatural" view of the locus of operation.
- Relatively easy to simulate because of the limited access, restricted feedback (especially tactile) and limited freedom of movement of instruments. Endoscopic simulators are being produced by all the main medical VR companies, usually with a focus on training.
- It is a non-invasive and thus without known complications. The actual cost is less of traditionally endoscopy as it is performed in the same place and manner as all imaging modalities, utilizes the same staff and has no consumable materials.

Challenges of VR

In our research, however, we identified **challenges** instead of disadvantages, as it would translate as an unfavorable condition, involved with:

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- The surgeon, such as restricted vision and mobility, difficult handling of the instruments, difficult hand-eye coordination and no tactile perception except force feedback;
- Heavily dependent on patient data. In surgery planning, surgeons interact with models of patient anatomy. In surgery training, they operate on a model that is built from patient data. This obviously requires the models to be as accurate as possible for the available data. Patient data used in VR may come from various sources familiar to medical practitioners, such as computer (aided) tomography, magnetic resonance imaging (MRI) ultrasound, physiological imaging (PET), others, range, finders, etc. Imaging involves the collection of anatomical or physiological data from the patient. Computer graphics techniques – rendering and modeling are then used to display that data as part of a virtual body so that it can be examined and manipulated.
- Nevertheless, another recent trend is towards so-called Virtual Endoscopy. This is a technique whereby data from non-intrusive sources - such as scans - are combined into a virtual data model that can be explored by the surgeon as if an endoscope were inserted in the patient. VR is increasingly being used to provide surgeons with a meaningful and interactive 3D view of areas and structures they would otherwise be unable or unwilling to deal with directly.



Elekta' s Gammaknife

- VR in surgery differs from most other VR in its focus on contact with objects, which must often be deformable objects and interdependent. The focus is on looking into objects rather than looking into space - there is less room available. The data is essentially volumetric and finger and hand interaction must be extremely precise.

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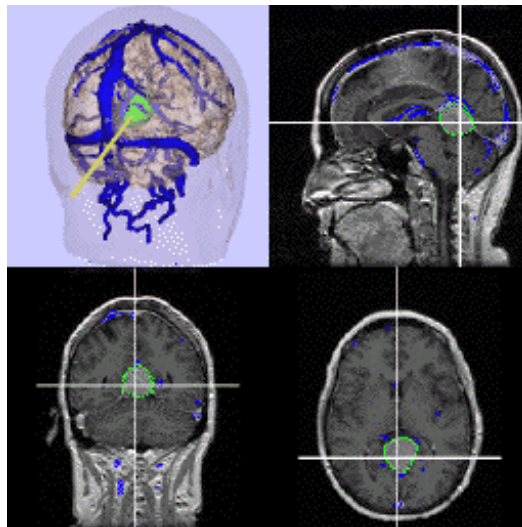
The above characteristics bring with them certain technical requirements, such as real-time response to user's action- which implies fast graphics, low latency input devices. The images must be of high resolution and faithful to the actual patient data, since life-critical decisions are based on the presentation of patient data. For simulators, the physical procedures must match those used in the actual operation.

Image-guided surgery

Principally, VR can be applied to enhance reality for image-guided surgery. When applied to image-guided surgery in this way, the images obviously need to be available intra-operatively, and accurate registration of the real patient with the data becomes a crucial issue.

Currently, VR is used much more for preoperative planning than to guide actual surgery (due to the understandable conservatism of medical practitioners). When VR is used intra-operatively, it tends to be implemented as some form of Augmented Reality. Image-guided surgery is also a prerequisite of remote telemedicine and collaboration. Image-guided surgery, implemented as [Augmented Reality](#) at the University of North Carolina.

The picture shows a brain tumor surgery guidance images



The video-imaging detector is based on a special camera equipped with an optical viewing and lighting system and electronic 3D sensors. When combined with

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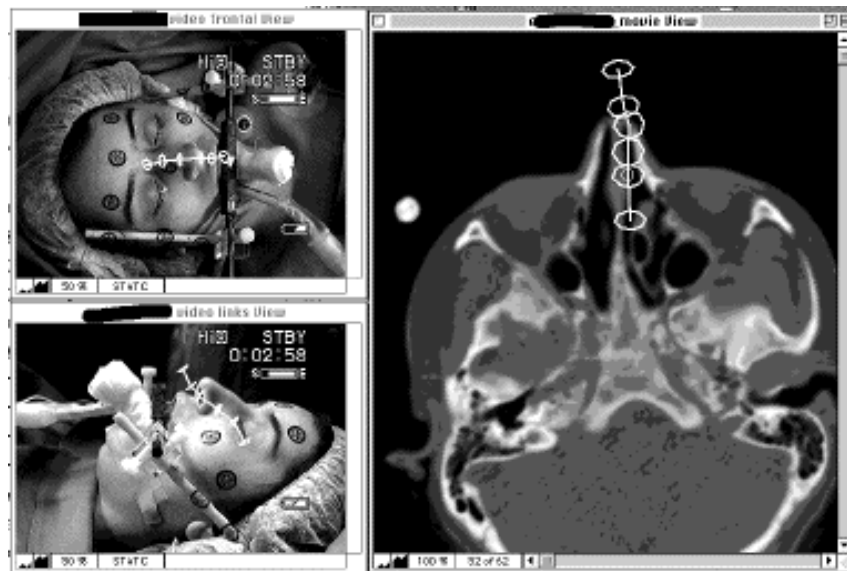
endoscopes it is used for examining the inside of cavities or hollow organs of the body from many different angles.

The IVT image sequence represents a 4D data set in stereo tactic space and contains image, surface topography and motion data, which obsolete the use of 3D.

A main tool for traditional image-guided surgery is the microscope. Microscopes are now being integrated with robotic transport systems. Microscopes can also, in principle, serve as the vehicles for VR, as they will increasingly allow 3D views and are already "in place" in the operating theatre. Surgeons readily accept microscope-based views from which they can easily look away, whereas they are less comfortable with overlays placed on their primary direct view of the patient - the traditional augmented reality approach.

In ENT surgery an IVT image sequence of the planned and so far accessible surgical path is acquired prior to surgery. During surgery the video sequence component of the IVT simulation is substituted by the live video source.

During surgery a head-up display is used to overlay real-time reformatted cross sectional imaging data with the live video image.



ARTMA (University of Vienna) implemented the system for Image-guided Ear, Nose & Throat Surgery (picture above). The ARTMA team is the pioneer in this field.



The Zeiss MKM Microscope transport. It is a 6-degree of freedom robot with a surgical stereomicroscope attached.

4.2 EDUCATION AND TRAINING

VR provides a unique resource for education about anatomical structure. One of the main problems for medical education in general is to provide a realistic sense of the inter-relation of anatomical structures in 3D space. Through 3D visualization of massive volumes of information and databases, clinicians and students can understand important physiological principles or basic anatomy.

Advantages of VR

- With VR, the learner can repeatedly explore the structures of interest, take them apart, put them together, view them from almost any perspective. This is obviously impossible with a live patient, and is economically infeasible with cadavers (which, in any case, have already lost many of the important characteristics of live tissue).
- Another advantage of VR for medical education is to demonstrate and exercises or to explore which can easily be combined.
- The learner may then explore the structure freely and, perhaps later, be assigned the task of locating particular aspects of this structure. It is also possible to preserve particularly instructive cases, which would be impossible by other means.

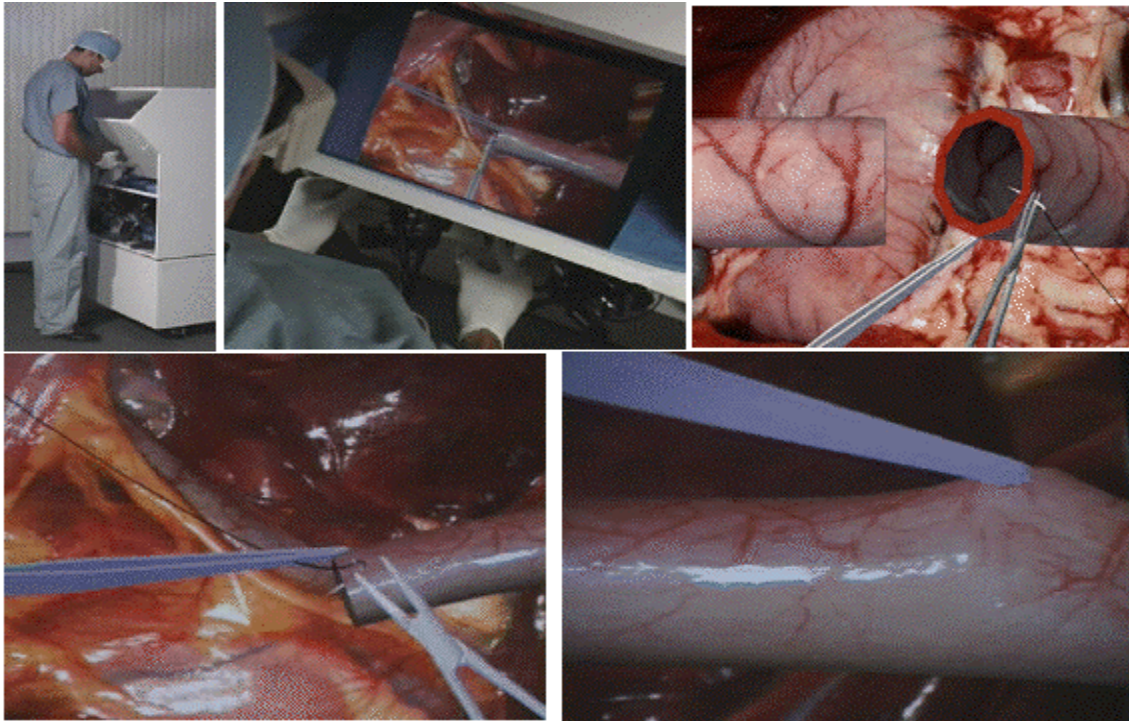
VIRTUAL REALITY

- The advantages of training simulators are obvious. Training can be done anytime and anywhere the equipment is available. They make possible the reduction of operative risks associated with the use of new techniques, reducing surgical morbidity and mortality.

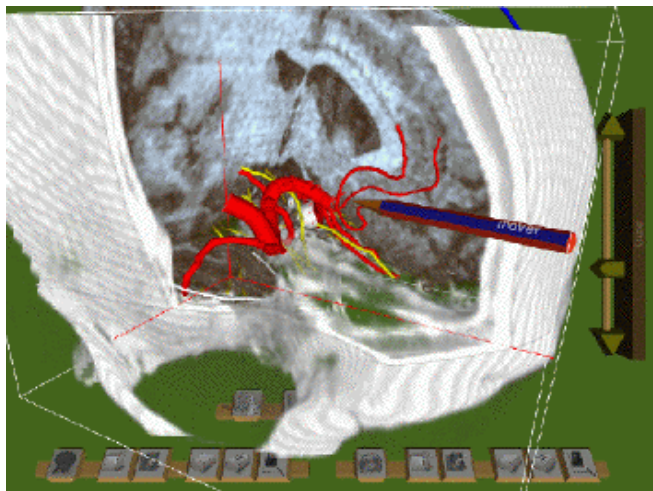
Challenges by VR

- There is something of crisis in current surgical training. As the techniques become more complicated, and more surgeons require longer training, fewer opportunities for such training exist.
- Training in the operating theatre itself brings increased risk to the patient and longer operations. New surgical procedures require training by other doctors, who are usually busy with their own clinical work. It is difficult to train physicians in rural areas in new procedures. Training opportunities for surgeons are on a case-by-case basis. Animal experiments are expensive, and of course the anatomy is different.
- The big challenge is to simulate with sufficient fidelity for skills to be transferred from performing with the simulation to performing surgery on patients. Faithfulness is hard to achieve and much more evaluation of different approaches to training simulation are needed. Many experienced surgeons predict that in time, experience with training simulators will constitute a component of medical certification. But this will require new regulations and legislation.
- For simple operations like suturing and biopsy needle placement, VR is effective, but perhaps an excess to train skills that can easily and cheaply be acquired in other ways.
- The solution to these problems is seen to be the development of VR training simulators. These allow the surgeon to practice difficult procedures under computer control. The usual analogy is where trainee pilots gain many hours of experience before moving on to practice in a real cockpit.

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Boston Dynamic open surgery anastomosis trainer.ⁱⁱⁱ

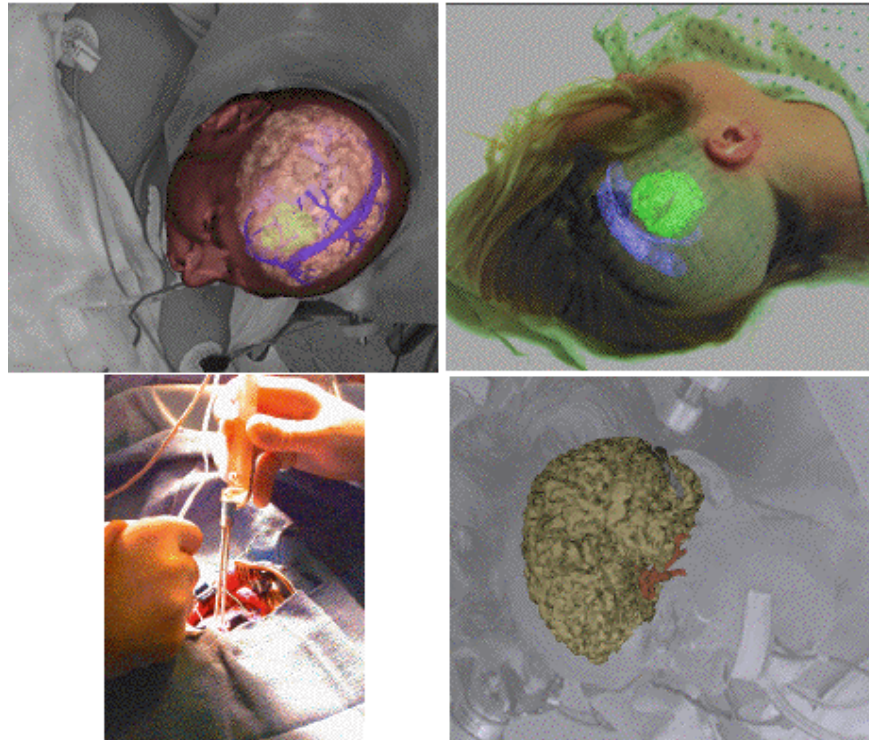


The most technologically challenging area of simulator training is for highly specialized aspects of life-critical operations such as brain surgery. The Johns Hopkins/KRDL

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VIRTUAL REALITY

skull-base surgery simulator for training aneurysm clipping. The interaction is entirely with the VR itself (above). Researchers at University of California San Diego Applied Technology Lab developed this interesting Anatomy Lesson Prototype.^{iv}



Combined neurosurgery planning and augmented reality from Harvard Medical School^v

Virtual Reality Helps Breast Cancer Patients Cope With Chemotherapy

Researches made by the Duke University School of Nursing and Case Western Reserve Comprehensive Cancer Center that women with breast cancer have **fewer** adverse effects from chemotherapy and **less fatigue** when using virtual reality as a distraction intervention during treatments,.

In the study, published in January 2004 issue of Oncology Nursing Forum, the researchers described how chemotherapy patients eased their fatigue and discomfort by solving a mystery, touring an art gallery or going deep-sea diving in a virtual environment as they underwent treatment.

Virtual reality enables people to immerse themselves in a computer-generated visual and aural environment by wearing a head-mounted display device. The researchers believe that virtual reality makes for an excellent distraction intervention because it is interactive, engages several senses simultaneously and immerses participants in a new world, thereby blocking out their current and often stressful environment.

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If patients can focus on something other than their treatments, they have less nausea and vomiting and they tolerate the treatments better. Participants alternatively received chemotherapy treatments with the help of virtual reality and without. While using virtual reality, patients could choose between a variety of commercially available programs, such as walking on a beach, touring an art gallery or deep-sea diving.

The goal of the intervention was to ease anxiety, fatigue and symptom distress. Symptom distress encompasses the discomfort the patients experienced from receiving chemotherapy. Such symptoms include nausea and vomiting, inability to concentrate, and fatigue. According to the researchers, such distress interferes with a person's ability to perform activities of daily living and affects quality of life. Nearly 60 percent of chemotherapy patients report some form of symptom distress.

Based on the survey made, women who used virtual reality during chemotherapy treatments reported significant decreases in symptom distress and fatigue immediately following treatments. Anxiety levels were not directly impacted by the intervention. Data shows a drop in anxiety levels directly after the treatment, but were attributed that patient's relief about the treatment being over. However, one added benefit was that the virtual reality seemed to make patients feel as though time was moving faster. For example, on average, a chemotherapy treatment might last 67 minutes, but patients would perceive that it only lasted 42 minutes."

The headsets and programs are cost-effective and easy to use for both patients and providers. The equipment can be set up in five minutes and several patients can use a single set of equipment throughout the day



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4.3 APPLICATION OF VIRTUAL REALITY IN MILITARY

Virtual Reality in military simulations

One of the earliest uses of simulators in a military environment was the flight trainers built by the Link Company in the late 1920' s and 1930' s. These trainers looked like sawed off coffins mounted on a pedestal, and were used to teach instrument flying. The darkness inside the trainer cockpit, the realistic readings on the instrument panel, and the motion of the trainer on the pedestal combined to produce a sensation similar to actually flying on instruments at night. The Link trainers were very effective tools for their intended purpose, teaching thousands of pilots the night flying skills they needed before and during World War II.

To move beyond the instrument flying domain, simulator designers needed a way to produce a view of the outside world. The first example of a simulator with an outside view appeared in the 1950' s, when television and video cameras became available. With this equipment, a video camera could be ' flown' over a scale model of the terrain around an airport, and the resulting image was sent to a television monitor placed in front of the pilot in the simulator. His movement of the control stick and throttle produced corresponding movement of the camera over the terrain board. Now the pilot could receive visual feedback both inside and outside the cockpit.

The logical extension of the video camera/television monitor approach was to use multiple monitors to simulate the entire field of view from the airplane cockpit. This method is still in use for transport aircraft simulators, where the field of view needs to be only about 180 degrees horizontally and 60 degrees vertically.

For fighter aircraft simulators, the field of view must be at least 180 degrees horizontally and vertically. For these applications, the simulator consists of a cockpit placed at the center of a domed room, and the virtual images are projected onto the inside surface of the dome. These types of simulators have proven to be very effective training aids by themselves, and the newest innovation is a project called SIMNET to electronically connect two or more simulators to produce a distributed simulation environment.

Distributed simulations can be used not only for training, but to develop and test new combat strategy and tactics. A significant development in this area is an IEEE data protocol standard for distributed interactive simulations. This standard allows the distributed simulation to include not only aircraft, but also land-based vehicles and ships. Another recent development is the use of head-mounted displays (HMDs) to decrease the cost of wide field of view simulations.

Telepresence for military missions

Two fairly obvious reasons have driven the military to explore and employ telepresence in their operations; to reduce exposure to hazards and to increase stealth. Many aspects of combat operations are very hazardous, and they become even more dangerous if the combatant seeks

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to improve his performance. Prime examples of this principle are firing weapons and performing reconnaissance. To perform either of these tasks well takes time, and this is usually time when the combatant is exposed to hostile fire. Smart weapons and remotely- piloted vehicles (RPVs) were developed to address this problem.

Some smart weapons are autonomous, while others are remotely controlled after they are launched. This allows the shooter and weapon controller to launch the weapon and immediately seek cover, thus decreasing his exposure to return fire. In the case of RPVs, the person who controls the vehicle not only has the advantage of being in a safer place, but the RPV can be made smaller than a vehicle that would carry a man, thus making it more difficult for the enemy to detect.

Military information enhancement

In a dynamic combat environment, it is imperative to supply the pilot or tank commander with as much of the necessary information as possible while reducing the amount of distracting information. This goal led the Air Force to develop the head-up display (HUD) which optically combines critical information (altitude, airspeed, heading) with an unobstructed view through the forward windscreen of a fighter aircraft.

With the HUD, the pilot never has to look down at his instruments. When the HUD is coupled with the aircraft's radar and other sensors, a synthetic image of an enemy aircraft can be displayed on the HUD to show the pilot where that aircraft is, even though the pilot may not be able to see the actual aircraft with his unaided eyes. This combination of real and virtual views of the outside world can be extended to nighttime operations. Using an infrared camera mounted in the nose of the aircraft, an enhanced view of the terrain ahead of the aircraft can be projected on the HUD. The effect is for the pilot to have a ' daylight' window through which he has both a real and an enhanced view of the nighttime terrain and sky.

In some cases, the pilot may need to focus totally on the virtual information and completely exclude the actual view. Work in this area has been pioneered by Thomas Furness III and others at Wright Laboratories, Wright-Patterson Air Force Base, Ohio. This work, dubbed the Super Cockpit, involved not only a virtual view of the outside world, but also of the cockpit itself, where the pilot would select and manipulate virtual controls using hand gestures.

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Flight Simulator

Tactical Tank Trainer, a new tactical training system for the Swedish army's Leopard 2 main battle tanks. The Turret Trainer consists of a movable gun/turret and loading simulator, including practice rounds, and a computer generated virtual environment.

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The virtual environment is shown on small displays connected to the turret's gun sight and periscope and the views are continuously updated according to the position and heading of the battle tank. The views can be changed from a day sight to an infrared sight with several choices of magnification. After the training session the scene can be replaced from any position during debriefing. Several simulators can also be networked using the distributed interactive simulation (DIS) protocol.



4.4 APPLICATION OF VR IN MANUFACTURING: Vehicle Designing

Virtual Reality in Industry companies are increasing their global competitiveness by using virtual environment to design equipment. There are also a number of advantages in using VR technology in a number of business areas. For instance in the automotive industry, prototypes can be built a virtual worlds rather than building real mockups.

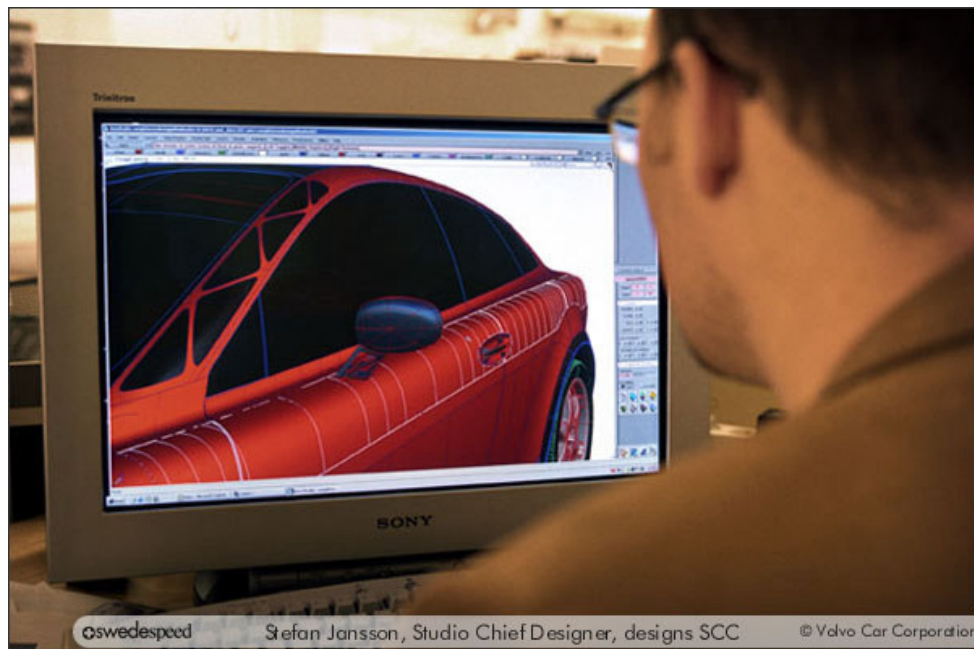
Which means, having to build fewer real physical prototypes, which in turn means cost savings. Virtual prototypes are generally more flexible, leading to shortened lead time and other competitive advantages. The flexibility also enables the designers to try more options before turning to production, leading to increased quality and increased customer satisfaction.

Volvo for instance, is using VR technology at various stages throughout the design, engineering, manufacturing and testing of cars. One promising application, developed with the assistance of Prosovia Clarus, is in the area of usability testing of virtual prototypes. Volvo's Creative Ergonomics Department, has since 1992 developed virtual driving simulators. The simulators comprise a combination of real fittings and controls and virtual instrument and scenery. Various experiments are conducted in the driving simulator, including measurements of drivers' behaviors – their mental and physiological response – during dynamic traffic conditions. New controls and

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instrument are multiplying the cognitive load for today's drivers and in future designs, the amount of information presented to drivers will continue to grow.

Volvo is interested in studying cognitive ergonomics, the driver's response to this information. The concern is that drivers will be overwhelmed with information and distracted from the task of driving safely. Engineers can improve automotive safety by evaluating the driver's reaction to information displayed in different configurations. In the virtual environment, more design alternatives can be explored and situations can be created that would be unsafe in a real car.



Virtual car design might be said to have moved from the stone age to the present day in a space of eight years. In 1994, it took several hours to display a design sketch on a computer – now, only 30 seconds!

The modern car designer has the fantastic advantage of being able to design a car from concept to finished product in a few weeks using the Alias supercomputer program. And yet, he or she is well aware that pencil and paper, as well as the polystyrene model, will always be essential design tools.

Advantages of VR

- Speedy in designing compared to early days.

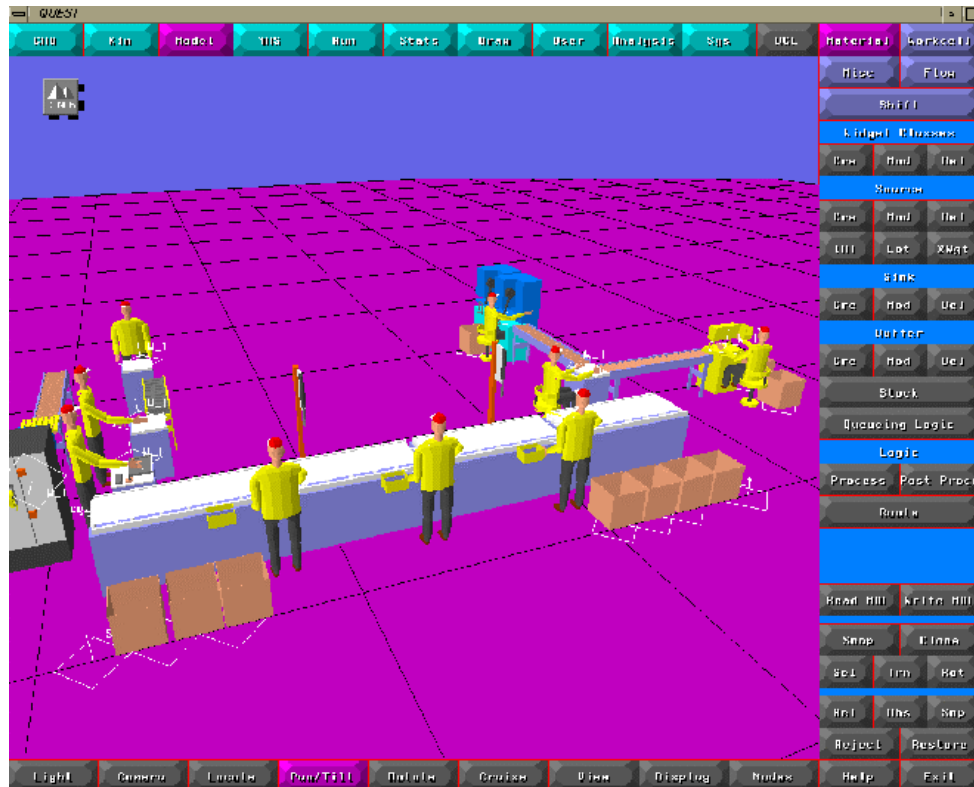
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- Modern programs enable geometrical information to be used during the entire period that the car is being 'built' in the computer. As an example, the designer may opt to include either the complete engine or only its 'corners' to reduce the size of the document. The number of variations is almost limitless.
- Virtual design enables to keep better track of the process. It also leads more quickly to the stage at which models can be built and necessitates fewer modifications later on. You can aim at the target from Day 1 and obtain the right information for decisions earlier on.
- Cost saving since clay models are expensive, although there may be some lines, which are easier to visualize in clay than on the computer. A clay model is still required for verification.
- A design process in which the computer can do everything is feasible. In the early stages, when there are no physical models, the designer can work on perhaps a dozen computer designs before reducing them to just one.
- Borderless world of information. Volvo Cars has design centers in California and Barcelona, as well as in Gothenburg. The designers would have video-conference with each other, so that can display the same models in each location and work on them simultaneously. They can project full-scale models onto the walls of their virtual reality rooms.
- The fact that the program can be run on a laptop. Basically, the designers may travel anywhere in the world to gather ideas and impressions – which is necessary to sell the car in a given market. Or to obtain that vital inspiration which is needed to add the finishing touches to its design.

Challenges by VR

- The process is fast and efficient – but it can be too fast. There can be a temptation to make decisions too early – forfeiting the opportunity of going back to make important changes. A design must be allowed to mature, to give time for reflection.

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Manufacturing line in this millennium era is dramatically different from the manufacturing line of the '70's. Today's manufacturing work-cell probably works because a computer, or series of computers sends a series of pre-programmed instruction to a control unit within the work-cell. Human intervention may be needed only to replenish parts and to diagnose problems. Although the operator from previous generations also had to diagnose problems, they did not have to understand advanced robotics, nor computer technology.

Many of the workers in today's factories do not have the skills needed to operate the state of art equipment. Leading many organizations to face the question of how can we efficiently upgrade the skill of our workers to enable them to operate technologically advanced manufacturing equipment?

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4.5 VIRTUAL REALITY IN ARCHITECTURE AND DESIGN

Architects could take clients on a virtual tour of a new house before it was built. Applications in architecture could include a more complete analysis of the design due to viewing it from any angle; and the communication of designs to clients using "3D walkthroughs". Walkthroughs might include voice commands, sounds, and touch.

With a bit more imagination, we can envisage totally new applications of the technology e.g. clients may walk onto an empty building site and put on a pair of glasses which lets them see their proposed design as well as the site, and move things about to suit their needs.

The department of visualization and virtual reality at the IGD University in Germany has developed a program that uses radiosity and raytracing to simulate light. This virtual reality program has application in this field.

With light simulation architects can examine how outdoor light will fall inside and outside the building before it is built. If the lighting needs to be redesigned the architect can redesign the building on the computer and examine the new outdoor light effects.

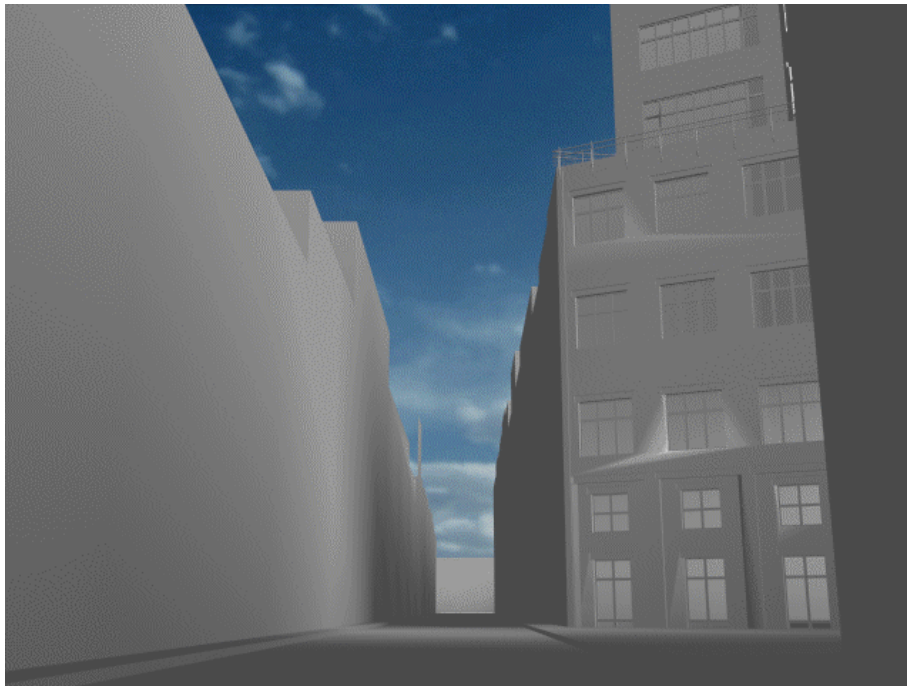
Further to the outdoor light, lighting engineers use virtual reality to examine the effect of point lights, spotlights and other indoor light sources. An interior design could examine how light will affect different room arrangements.



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Advantages of VR

- As a marketing tool - Interactive adaptive displays, for example, to demonstrate the use of different finishes on a building; walkthroughs.
- As a communication tool - Cross distance and language barriers (say, between the architect and client); To educate architects.
- As an evaluation modelling tool – for example to study effects of lighting - natural and artificial.
- Evaluate acoustics, for example, the user could test the resistance of a material by listening to sounds "through" it.
- Modeling/Design tool - Analyze spaces by actually "getting inside them".
- Incorporate rational data during schematic design stages, then look at different design solutions.
- Design of "virtual architecture (picture below).



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4.6 REAL ESTATE AND TOURISM

VR has been used to increased real estate sales in several powerful ways. VR provides excellent exposure for properties and attracts potential buyers by publishing it from the web. Clients may talk a virtual walk through properties and eliminate wrong choices without wasting valuable time. Virtual walk through can be mailed on diskettes or posted on the Web as a convenience for non-load clients. A CD-ROM containing all virtual reality homes can also be sent to clients and other agents. You may surf the website of Real Property VR Virtual Reality Home Tours (<http://www.realpropertyvr.com/realpropertyvr/main.htm>) or the website of Realatrends Real Estate Service offering homes for sale in Orange Country, California (http://www.realatrends.com.virtual_tours.htm); these are the two of many real estate firms offering this service. In another web application, the US government created a virtual tour of the White House while the facility was closed for security concerns/reason. The virtual tour allowed people to see a 360-degree view of rooms on the Internet.



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5.0 APPLICATION OF VR IN MALAYSIA

- Ultrasound in all hospitals and most clinics in Malaysia;
- Ct Scan available only in general/private hospitals in Malaysia;
- MRI or NMR also available in all hospitals in Malaysia;
- Recently, Electa Gammaknife being introduced in Malaysia; refer paper cutting in attached.
- Malaysian portal for Tourism industry.

6.0 CONCLUSION

VR is considered to be a very useful tool for diagnosis, therapy, education and training etc. It can be applied beneficially in not only to the medical community, but also to other related areas such as in military, manufacturing industrial, real estates, educational and not to leave sports and fitness, etc.

One of the main aims of Virtual Reality is to have interactive environments in which humans can interact with one another also known as "Virtual Worlds". This will require people who understand the psychological effects of (computer) spaces on people inside them. Architects as designers of Virtual Worlds/Environments will be required to make these environments rich, interesting and engaging places.

However, several barriers still remain. The PC based-system, while inexpensive and easy to-use, still suffers from lack of flexibility and capabilities necessary to individualize environments for each patient.

Virtual Worlds/Environments should also provide a degree of changeability, as in reality, to stop them from becoming too static. For example, a "virtual workspace" should have furniture that is easily rearranged, and could have a choice of "views" to see through your window. A "virtual art gallery" should be able to have changing and interactive exhibits, and could conceivably be "cut and pasted" by individuals to include only certain art displays. The question of interaction with other users is raised. Using the previous example of an art gallery, as designers of "virtual art galleries", can the users interact freely with one another in the gallery? Will there be places to "sit" and discuss the art?

Finally communication networks have the potential to transform VR into shared worlds in which individuals, objects and processes interact without regard to their location.

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It is hope that by bringing together community experts, further stimulation of interest from granting agencies will be accelerated.

Some of the above applications are already being done using current 3D computer modeling technology. Other applications such as those at the end of the list still have a long way to go.

If more attention were given to the realism of the context, to the extent that the user could look through a window and see the appropriate view, the computer-generated design could be far more persuasive in convincing the client and building authorities. Therefore the development of computer-generated images is vital to the success of VR in architecture. The advantages of VR as a "conceivable" medium over other "alternate realities" in architecture.

As for Malaysian scenario, we may say that we are far behind from others in terms of Virtual Reality, but it is not impossible for us to be at least at par with other countries, if we really work on it, in the next 10 years? We do have the expertise, the issue is that are we willing and able to spare more fund in doing such research and development in this related discipline?

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