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Analysis of the Use of VR in Medical and Science and Technology

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Abstract. Using virtual reality as an asset and a part of our future is discussed in this article. You can experience, feel, and even touch the past, as well as the present, and future, through it. As a means of creating our own reality, it serves as a medium for us to do so. A virtual reality experience could include everything from developing a video game to a virtual walk across the world, or even a virtual walk through our own ideal house. The most terrifying and gruelling experiences can be experienced in a safe and educational manner with virtual reality. As a result of our research, we've compiled this report on everything we've learned about virtual reality so far. It covers everything from levels of immersion to the components that go into creating a virtual environment, as well as the history, present, and future of the technology. As a result, both the technologies themselves and the prices and logistics required to implement them have a variety of restrictions. Nevertheless, these new technologies have their own set of problems, which is why we conclude this study with a number of fresh ways and possibilities for future researchers who want to apply these new technologies to education.

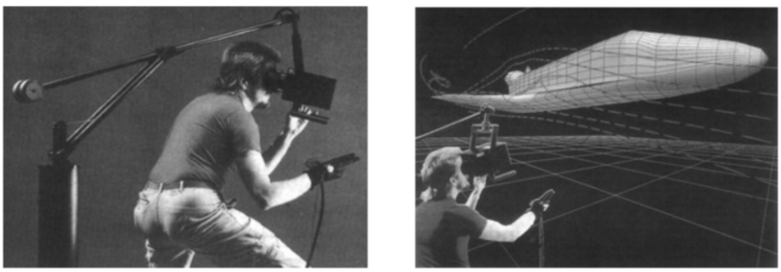
Keywords. Virtual reality, environment, virtual tools, technology

1. Introduction

Computer graphics have been more accessible to the general public in recent years. One's interest with an alternate reality is often sparked by video games, and it can endure a lifetime. In other words, you can see and experience things that aren't available to you in the real world or that haven't even been invented yet. There are no boundaries or limits in the world of three-dimensional graphics; instead, we can construct and alter it to our hearts' content. However, not enough people are always looking for more [1-5]. They want to be a part of this environment, rather than merely viewing it on a computer screen. Virtual Reality is the name given to the technology that has taken the world by storm in the last few decades (VR). A majority of virtual reality environments are largely visual experiences, either exhibited on a computer screen or through stereoscopic displays. Speakers or headphones may also be used to provide audio stimulation in virtual reality [6-9]. Devices like a keyboard, mouse, or wired glove can be used to interact with the virtual environment. Immersive systems, non-immersive systems, and hybrid VR systems are all different types of virtual reality systems based on their level of immersion and interactivity. (i) we no longer see the user's actual head position or orientation because the computer-generated pictures that interact with Immersive systems replace that perspective. (ii) It's possible to see the virtual world through a graphics workstation in a non-immersive system that keeps the user aware of the real world at all times. (iii) Virtual graphics can be placed over a real-world view in a hybrid VR system [10-14].

2. Literature review

Virtual reality (VR) has mostly been used in architecture to help architects, designers, clients, and end-users collaborate in the design process. Architectural tour systems were among the first examples of VR being used as a visualisation tool. After 1986, the University of North Carolina began conducting research in this area, with new system generations being generated on a regular basis. Virtual reality architectural studies use walk-throughs and prototyping technologies to allow people to explore the VE at their own pace. Virtual reality (VR) technology was compared to traditional paper and pencil design sessions in architecture in the late 1990s by Frost and Warren using a sophisticated, immersive CAVE system that had many participants and real-time image production [4]. CAVE is a scientific visualisation and virtual reality system that was first demonstrated in 1992. Stereoscopic visuals are projected on the room's walls rather than through a head-mounted display (HMD) (user must wear LCD shutter glasses). Virtual reality (VR) has long been recognised in the architecture design process as a fun, interactive tool with a high level of realism that can enhance the creative process [5, 6]. Scientific visualisation is another area where virtual reality can be quite beneficial. It's almost as simple as walking through the massive amounts of data that have been rendered in three dimensions. The Virtual Wind Tunnel is an excellent example of this type of application developed at the NASA Ames Research Centre [7, 8]. Using a data glove, scientists can input and alter virtual smoke streams in the airflow surrounding a digital model of an aircraft or a space shuttle using this programme. They can see and analyse the dynamic behaviour of airflow while moving about (using boom display technology) and quickly locate unstable spots. As a result of NASA Ames's success, several firms have built comparable setups — during Eurographics'95, Volkswagen displayed a prototype of a virtual wind tunnel for investigating airflow around automobile bodies in collaboration with the German Fraunhofer Institute as shown in Figure 1.



(a) outside view (b) inside view

Figure 1. Exploration of airflow using Virtual Wind Tunnel developed at NASA Ames [7, 8]

2.1. Telepresence and teleoperating

The remote-control methods for physical things in terms of distance or scale. It's also possible to define manipulators as workers who have the ability to accomplish activities, particularly with their hands, and who receive sufficient sensory feedback at their workstations to have a genuine sense of presence on the job site [8]. No other technology can provide the high level of dexterity of operation that is required in the remote environment. Using the Nan manipulator project, telepresence is shown in a new light operating in a world that is both large and little at the same time. Scientists may see a microscope view, feel and manipulate the sample's surface using this device, which uses an HMD and force-feedback manipulation [9].

3. VR Technology

In the early, the field of Virtual Reality got considerably more turbulent, and the phrase itself became quite prominent. Virtual Reality is a word that is frequently used and misunderstood. An immersive, interactive, computer-mediated experience in which the user observes a synthetic (simulated) environment through sophisticated human-computer interface gear. A simulation of an object in that environment is interacted with. It is a way for humans to share ideas and experiences. It refers to a technique that can move a subject into a different environment without physically moving it.

3.1. Virtual Reality can be shown by these devices

- **HMD-**After 20 years, the "Eye phone" technology became commercially available, providing its wearer with an unseen world of virtual reality. The HMD has two mini-displays and an optical system. The HMD tracks the user's head movement and orientation to provide virtual pictures. The viewer can now look about and wander around in the virtual environment. But HMDs include cords that limit our movement. The viewer can now look about and wander around in the virtual environment.
- **BOOM-**High-resolution stereoscopic viewing is provided via the Binocular Omni-Orientation Monitor (BOOM). The screens and optical equipment are contained in a multi-link arm-mounted box. This device's operating volume may be guided to any position by looking inside the box through two holes. The user can see a virtual environment through these two holes. Sensors embedded in the links of the arm that holds the box allow for head tracking. The biggest advantage of BOOM over HMD is the superior image quality it provides. Second-person viewing can be achieved when the BOOM is released, which is a significant advantage over HMDs.
- **CAVE-**The CAVE is a multi-person, high-resolution 3D video and audio environment. A head tracker records the user's position. Each eye's offset image is computed. The user wears active stereo glasses that alternately block the left and right eyes. The CAVE has four projection surfaces with unique immersive design. The inclusion of ceiling projection enhances the impression of being immersed in the virtual environment. It also allows users to spin around and look in all directions. This enhances the user's immersion in the virtual environment.

- **Virtual Globe -**A virtual globe is a 3D computer model of Earth or another world. Virtual globes are now an easy and accessible tool to search, distribute, and visualise data in a geographic context. Virtual globes allow users to freely roam around in virtual environments by adjusting viewing angle and position. Virtual tools are first class objects, like UGA widgets, that control and display information about application objects. During manipulation, a tool's visual appearance must educate the user about its behaviour. An object can be made interactive by attaching a model to a tool.

3.2. VR to study visual performances of honeybees

The world would be a very different place if there were no honey bees in it. This would be a disaster for the environment and a blow to honey lovers, but it would also pose a huge threat to the world's food supply, which many people are unaware as shown in Figure 2. Finding out what's driving honey bee population decline is the ultimate goal. Micro-sensor kits that feature an Intel Edison board, a customisable computation platform that is just slightly larger than a postage stamp, are given to members. There are RFID tags attached to the backs of the bees that allow the bee micro-sensor kits to track the bees' activities in their hives. They tell us a lot about what occurred to the bees before the hive fell apart. They're a gold mine. Environmental data, like as the relative humidity and temperature of the hive, are included. Because of this, experts from around the world can add environmental sensors depending on what they want to test, such as wind velocity or even the weight of the hive," noted de Souza. Honey and the number of bees in the hive can be counted at any given time by the scientists [11].

Figure 2. VR device [11]

4. Improving Pedestrian Safety

As a part of the training, children will practise estimating the speed, distance, and travel time of a car that they can see in the distance. Because we're working in a computer simulation, there's no harm done. Schoolyards and crosswalks are depicted in the virtual reality, a regular and familiar circumstance where children need to be protected. It is permitted to cross the street if the child considers it is safe and there are no approaching vehicles as shown in Figures 3 (a-c). Additionally, it can be used in a variety of applications, including:

- Virtual Drills for Earthquake Safety Education

- People with severe visual impairments can practise important mobility and orientation skills in a virtual environment, which they can then apply in the real world.
- The use of virtual drills to teach earthquake safety
- A Virtual Reality Driving Simulator's Usability

We all have moments of tension and anxiety in our life. It might be minor or severe and debilitating — or anything in between. Some examples are work-related stress, marital troubles, phobias, depression, and other anxiety illnesses, such as PTSD (PTSD). This reduces the peak anxiety the person feels when exposed to whatever generates the anxiety. An estimated 19 million Americans suffer from a specific fear. A meta-analysis of 14 clinical trials, released recently, indicated that VRET was equally effective as real-life exposure therapy in treating particular phobias. Virtual reality (VR) is being used to treat anxiety disorders in a variety of ways.

(a) (b) (c)

Figure 3. (a) and (b) VR driving simulator (c) VR simulator [13]

5. Applications

- Medicine-In the beginning, the use of virtual reality in medicine was sparked by the need of medical professionals to be able to see complex medical data, especially during surgery and in medical education. In order to aid clinicians in diagnosis, preoperative planning, and intraoperative therapy, researchers are creating 3D organ models utilising virtual reality technology.
- Military-Military training and operations were among the first domains where reality was put to use. There are three perspectives on military applications of virtual reality (VR):
- Entertainment-Applications that treat virtual environments like a fantasy world, rather than a duplicate of a real-world one. Creating engaging virtual worlds relies heavily on the user being able to interact with the objects they see rather than just looking at them. Augmented reality as an aid to learning.
- Education-The use of virtual reality (VR) in education has become a recent trend. As an educational tool, virtual reality is used in virtual classrooms, libraries and labs. Students will learn how to conduct experiments, solve problems, collect data, and analyse results in a scientific context.

6. Conclusion and Future Scope

Virtual reality has facilitated several advancements. This includes production, exploration, defence, recreation, and medicine. Virtual reality could change many facets of our lives. Virtual reality has various applications now and in the future. A wide range of VR applications have been created for use in manufacturing, education and research. Virtual reality (VR) is increasingly being recognised as a significant scientific advancement. If VR is to have a successful future, it needs systems that can manage 'large scale' virtual environments. As more research is done, it is projected that VR will become increasingly widespread in our homes and workplaces. As computers get more powerful, they will be able to produce more realistic graphics. It will be interesting to see how augmented reality evolves. We may soon use virtual phones to communicate. NTT's virtual reality system will allow two people to see a 3D image of each other (VR).

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