



CHETANA
INTERNATIONAL JOURNAL OF EDUCATION (CIJE)

Peer Reviewed/Refereed Journal

(ISSN: 2455-8729 (E) / 2231-3613 (P))

Impact Factor
SJIF 2023 - 7.286



Prof. A.P. Sharma
Founder Editor, CIJE
(25.12.1932 - 09.01.2019)

First draft received: 12.06.2023, Reviewed: 18.06.2023, Accepted: 26.06.2023, Final proof received: 30.06.2023

Introduction of Virtual Reality & its Challenges

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Abstract

Virtual Reality (VR) has become a most important resource and facet of our present and future learning. Virtual reality (VR) is a technology which allows a user to interact with a computer simulated environment, whether that environment is a simulation of the real world or an imaginary world. It is the key to experiencing, feeling and touching the past, present and the future. It is the medium of creating our own world, our own customized reality. It could range from creating a video game to having a virtual stroll around the universe, from walking through our own dream house to experiencing a walk on an alien planet. With virtual reality, we can experience the most intimidating and gruelling situations by playing safe and with a learning perspective. The term VR was first used in 1974 Myron Krueger describing a specific environment, an artificial reality display as a video place. Today, we are experiencing the most daunting and exhausting learning perspective settings with virtual reality. The introduction of virtual reality (VR) technology in online courses has raised several ethical issues. Very few people, however, really know what VR is, what its basic principles and its open problems are. In this paper a historical overview of virtual reality is presented, basic terminology and classes of VR systems are listed. An insightful study of typical VR systems is done and finds the challenges of Virtual Reality. The main aim of this paper is to provide an insight of VR system application & its challenges within the classified design and development area of studies.

Virtual

Reality is now involved everywhere. We can't imagine our life without the use of VR Technology. In this paper researchers define Virtual Reality and its history & define some important developments which give birth to this new technology. Issues findings are reviewed and reported under the categorized system of visualization, navigation and interaction to suggest Future innovation. However, this article presents no empirical evaluation conducted, but it can Aid researchers and even developers upfront through understanding and learning from presented aspects. Another future direction would be on the reconstruction of VE for VR application whereby to reduce the complexity of the design and development phase and to make it a multi-disciplinary research area.

Keywords: *Virtual reality (VR), Innovation, Technology, Computer simulated environment (CSE) etc.*

Introduction

Virtual Reality is a term used to describe a computer generated virtual Environment that may be moved through and manipulated by a user in real time. A virtual environment may be displayed on a head-mounted display, a computer monitor, or a large projection screen. Head and hand tracking systems are employed to enable the user to observe, move around, and manipulate the virtual environment. Virtual reality (VR) is a technology which allows a user to interact with a computer-simulated environment, whether that environment is a simulation of the real world or an imaginary world. It is the key to experiencing, feeling and touching the past, present and the future. It is the medium of creating our own world, our own customized reality. It could range from creating a video game to having a virtual stroll around the universe, from walking through our own dream house to experiencing a walk on an alien planet. With virtual reality, we can experience the most intimidating and grueling situations by playing safe and with a learning perspective. Nowadays 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 –we can enhance it by a fourth dimension: the dimension of our imagination 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.

Basic Definitions and Terminology of Virtual Reality

Virtual Reality (VR) and Virtual Environments (VE) are used in computer community interchangeably. These terms are the most popular and most often used, but there are many other. Just to mention a few most important ones: Synthetic Experience, Virtual Worlds, 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, we call virtual environments.” [Fuch92]
- Merriam-Webster's New Collegiate Dictionary, Ninth Edition, defines virtual as "being in effect but not in actual fact", and environment as "the conditions, circumstances, and influences surrounding and affecting an organism".
- “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.” [Giga93a]
- According to Jerry Prothero, a research associate at the University of Washington, who works in the

Human Interface Technology Laboratory, definition of virtual reality saying: "It can be defined in technological terms as a set of input devices which stimulate a high percentage of our sensory input channels, for instance, by providing a wide visual field-of-view and stereo sound. It can be defined in psychological terms a pattern of sensory stimuli which gives one an impression of being in a computer-generated space."

According to Clark (2006) the Virtual Reality can be used to make the learning more interesting and fun with the purpose of improving the motivation and attention, decreasing costs when using the objective and the real environment no matter how expensive the simulation is. It also makes possible that situations that were impossible to explored in the real world can be done, for example: exploring a planet like Mars, traveling inside the human body, doing submarines explorations or inside caves, visiting very small places to be seen (molecules) or very expensive or very far away, or yet because this place is in the past (historical places).

Early attempts at virtual reality:

Panoramic paintings

If we focus more strictly on the scope of virtual reality as a means of creating the illusion that we are present somewhere we are not, then the earliest attempt at virtual reality is surely the 360 degree murals (or panoramic paintings) from the nineteenth century. These paintings were intended to fill the viewer's entire field of vision, making them feel present at some historical event or scene. Panoramic paintings are massive artworks that reveal a wide, all-encompassing view of a particular subject, often a landscape, military battle, or historical event. They became especially popular in the 19th century in Europe and the United States, inciting opposition from some writers of Romantic poetry.

1838 – Stereoscopic photos & viewers

In 1838 Charles Wheatstone's research demonstrated that the brain processes the different two-dimensional images from each eye into a single object of three dimensions. Viewing two side by side stereoscopic images or photos through a stereoscope gave the user a sense of depth and immersion. The later development of the popular View-Master stereoscope (patented 1939), was used for "virtual tourism". The design principles of the Stereoscope is used today for the popular Google Cardboard and low budget VR head mounted displays for mobile phones.

- 1838 : The stereoscope (Charles Wheatstone)
- 1849 : The lenticular stereoscope (David Brewster)
- 1939 : The View-Master (William Gruber)

1960 – The first VR Head Mounted Display

Morton Heilig's next invention was the Telesphere Mask (patented 1960) and was the first example of a head-mounted display (HMD), albeit for the non-interactive film medium without any motion tracking. The headset provided stereoscopic 3D and wide vision with stereo sound.

1961 Headsight - First motion tracking HMD

In 1961, two Philco Corporation engineers (Comeau & Bryan) developed the first precursor to the HMD as we know it today - the Head sight. It incorporated a video screen for each eye and a magnetic motion tracking system, which was linked to a closed circuit camera. The Headsight was not actually developed for virtual reality applications (the term didn't exist then), but to allow for immersive remote viewing of dangerous situations by the military. Head movements would move a remote camera, allowing the user to naturally look around the environment. Headsight was the first step in the evolution of the VR head mounted display but it lacked the integration of computer and image generation.

1965 - The Ultimate display by Ivan Sutherland

Ivan Sutherland described the "Ultimate Display" concept that could simulate reality to the point where one could not tell the difference from actual reality. His concept included:

- A virtual world viewed through a HM

Evolution of Virtual Reality

Virtual reality is considered to have begun in the 1950's but it came to the public's attention in the late 1980's and 1990's. This can be attributed to pioneering computer scientist Jaron Lanier who introduced the world back in 1987 to the term 'virtual reality'. Research into virtual reality continued into the 1990's and that combined with the appearance of films such as The Lawnmower Man helped to raise its profile.

Sensorama-The Sensorama Machine was invented in 1957 and patented in 1962 under patent # 3,050,870. Morton Heilig created a multi-sensory simulator. A prerecorded film in color and stereo, was augmented by binaural sound, scent, wind and vibration experiences. This was the first approach to create a virtual reality system and it had all the features of such an environment, but it was not interactive.

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" [Suth65]. It has been a long time since then a lot of research has been done. Let us have a short glimpse at the last three decades of research in virtual reality and its highlights:

"The Sword of Damocles" -The first virtual reality system realized in hardware, not in concept. Ivan Sutherland constructs a device considered as the first Head Mounted Display (HMD), with appropriate head tracking. It supported a stereo view that was updated correctly according to the user's head position and orientation.

GROPE -The first prototype of a force-feedback system realized at the University of North Carolina (UNC) in 1971.

VIDEOPLACE -Artificial Reality created in 1975 by Myron Krueger -"a conceptual environment, with no

existence". VIDEOPLACE was created where the computer had control over the relationship between the participant's image and the objects in the graphic scene. It could coordinate the movement of a graphic object with the actions of the participant. In this system the silhouettes of the users grabbed by the cameras were projected on a large screen. The participants were able to interact one with the other thanks to the image processing techniques that determined their positions in 2D screen's space.

VCASS -Thomas Furness at the US Air Force's Armstrong Medical Research Laboratories developed in 1982 the Visually Coupled Airborne Systems Simulator -an advanced flight simulator. The fighter pilot wore a HMD that augmented the out-the window view by the graphics describing targeting or optimal flight path information.

VIVED-Virtual Visual Environment Display - constructed at the NASA Ames in 1984 with off-the-shelf technology a stereoscopic monochrome HMD.

VPL -The VPL company manufactures the popular DataGlove (1985) and the Eyephone HMD (1988) -the first commercially available VR devices.

BOOM -commercialized in 1989 by the Fake Space Labs. BOOM is a small box containing two CRT monitors that can be viewed through the eye holes. The user can grab the box, keep it by the eyes and move through the virtual world, as the mechanical arm measures the position and orientation of the box.

UNC Walkthrough project-in the second half of 1980s at the University of North Carolina an architectural walkthrough application was developed. Several VR devices were constructed to improve the quality of this system like: HMDs, optical trackers and the Pixel-Plane graphics engine.

1987 - Virtual reality the name was born

Even after all of this development in virtual reality, there still wasn't an all-encompassing term to describe the field. This all changed in 1987 when Jaron Lanier, founder of the visual programming lab (VPL), coined (or according to some popularised) the term "virtual reality". The research area now had a name. Through his company VPL research Jaron developed a range of virtual reality gear including the Dataglove (along with Tom Zimmerman) and the EyePhone head mounted display. They were the first company to sell Virtual Reality goggles (EyePhone 1 \$9400; EyePhone HRX \$49,000) and gloves (\$9000). A major development in the area of [virtual reality haptics](#).

1989 - NASA Gets Into VR

NASA, with the help of a Crystal River Engineering, creates Project VIEW. A VR sim used to train astronauts. VIEW looks recognizable as a modern example of VR and features gloves for fine simulation of touch interaction. Interestingly, the technology in these gloves leads directly to the creation of the Nintendo Power Glove.

1991 – Virtuality Group Arcade Machines

We began to see virtual reality devices to which the public had access, although household ownership of cutting edge virtual reality was still far out of reach. The Virtually Group launched a range of arcade games and machines. Players would wear a set of VR goggles and play on gaming machines with real-time (less than 50ms latency) immersive stereoscopic 3D visuals. Some units were also networked together for a multi-player gaming experience.

1991 – Medina’s VR Mars Rover

These days we are pretty used to seeing live footage from Mars rovers. Back in 1991 this was still a future dream and there were many problems left to solve. A NASA engineer named Antonio Medina develops a VR system that lets you pilot a Mars rover, even taking the time delay into account. A system dubbed “Computer Simulated Teleportation”.

1992 – The Lawnmower Man

The Lawnmower Man movie introduced the concept of virtual reality to a wider audience. It was in part based on the founder of Virtual Reality Jaron Lanier and his early laboratory days. Jaron was played by Pierce Brosnan, a scientist who used virtual reality therapy on a mentally disabled patient. Real virtual reality equipment from VPL research labs was used in the film and the director Brett Leonard, admitted to drawing inspiration from companies like VPL.

1993 – SEGA announce new VR glasses

Sega announced the Sega VR headset for the Sega Genesis console in 1993 at the Consumer Electronics Show in 1993. The wrap-around prototype glasses had head tracking, stereo sound and LCD screens in the visor. Sega fully intended to release the product at a price point of about \$200 at the time, or about \$322 in 2015 money. However, technical development difficulties meant that the device would forever remain in the prototype phase despite having developed 4 games for this product. This was a huge flop for Sega.

1994 – The Sega VR-1

On a roll with their VR devices, Sega also releases it’s VR-1, an arcade motion simulator that moves in accordance to what’s happening on-screen. This makes it like the AS-1, but the VR uses a head-mounted display, whereas the AS-1 made use of a regular projection screen.

1995 – Nintendo Virtual Boy

The Nintendo Virtual Boy (originally known as VR-32) was a 3D gaming console that was hyped to be the first ever portable console that could display true 3D graphics. It was first released in Japan and North America at a price of \$180 but it was a commercial failure despite price drops. The reported reasons for this failure were a lack of colour in graphics (games were in red and black), there was a lack of software support and it was difficult to use the console in a comfortable position. The following year they discontinued its production and sale.

1997 – Landmark VR PTSD Treatment

Georgia Tech and Emory University collaborate to use VR for the treatment of PTSD in war veterans. This is still a crucial aspect of PTSD treatment and research today. Controlled exposure to traumatic triggers are crucial to treating the symptoms of PTSD. VR technology gave therapists unrivaled control over what the patients sees and experiences.

1999 – The Matrix

In 1999 the Wachowski siblings’ film *The Matrix* hits theatres. The film features characters that are living in a fully simulated world, with many completely unaware that they do not live in the real world. Although some previous films had dabbled in depicting virtual reality, such as *Tron* in 1982 and *Lawnmower Man* in 1992, *The Matrix* has a major cultural impact and brought the topic of simulated reality into the mainstream.

2007 – Google Brings Us Street View

Google enhanced its Maps service with street-level 360-degree images, captured by special cars fitted with custom camera equipment. Immersive Media did the work using a dodecahedral camera of their own design. Today you can “stand” in just about any part of the world and look around thanks to this technology.

2010 – Street View Goes 3D and the Oculus is Prototyped

Just a few years later, Street View gets a 3D mode, but much bigger news in the history of VR is the work being done by a young man known as Palmer Lucky. He’s created a kit VR headset that anyone can make, but a fateful meeting with computer legend John Carmack puts him on the path to taking his “Oculus Rift” bigger than he could have imagined.

2012 – The Oculus Kickstarter

Palmer Lucky launches a Kickstarter to fund the product and development of his prototype headset, the Rift. The campaign raises almost 2.5 million dollars and is a clear dividing line between the commercial failures of consumer VR in the past and the modern VR revolution.

2014 – Facebook Buys Oculus and Sony Announced their VR Project

Social media giant sees potential in the Oculus technology, buying the company and making Lucky incredibly wealthy. This is a bumper year, also seeing the launch of Google Cardboard, PSVR and the Samsung Gear VR. **Virtual Reality is suddenly a very hot topic.**

This is also the year that Sony announced that they are working on a VR add-on for the popular PS4 console. The PS4 is much less powerful than VR-capable computers of the day, so everyone is pretty curious to see how they’ll pull it off.

2016–2017 – All Hell Breaks Loose

This is the year everyone unleashes VR products that are ready for primetime. The Rift and the HTC Vive

lead the way, but the floodgates have truly opened. You can see the results of this boom by visiting our [HMD database](#).

2018 – The Half-dome HMD is Announced

Oculus shows off a new HMD prototype known as the “half dome”. This advanced headset uses varifocal lenses and an extremely wide field of view, at 140 degrees.

2018 – Standalone VR Rises, Mobile VR Dies

We now have both the Oculus Go and Oculus Quest. Two examples of standalone VR, that need no computer or phone to work. Mobile VR is declining rapidly and standalone systems such as the Go are very affordable.

2019 – VR is Shifting Rapidly IN EDUCATION

Mixed Reality systems and sophisticated technologies are now part of standalone VR headsets.

Simulated Technical/Vocational Skills Training

Schools are using VR to help students learn valuable technical and vocational skills. Compared to traditional instructions that center around reading books or watching instructional videos, the simulated scenarios made possible by virtual reality provide a much better and more immersive learning experience for students. In addition to providing opportunities for students to gain “hands-on” experience with the subject matter, VR training scenarios can also eliminate any potential dangers that may arise while practicing new skills in an uncontrolled environment. Take chemistry experiments, for example. While they have been a time-honored way for students to learn chemistry principles, they can sometimes lead to dangerous or even deadly outcomes if gone awry. Virtual reality allows students to learn and practice chemistry principles safely and repeatedly by eliminating the risks associated with conducting potentially dangerous experiments in the real world.

Distance/Remote Learning

Schools are also leveraging virtual reality technology to help facilitate distance learning. In situations where physical barriers or limitations (such as the COVID-19 pandemic) may prevent teachers and students from being in the same classroom together, VR can provide a viable alternative. Rather than relying on two-dimensional video conferencing, VR can create an immersive learning environment that allows teachers and students to be present within the same “room” virtually. Stanford University’s Graduate School of Business currently offers a “Creativity Workout” course conducted entirely in virtual reality. As part of the Stanford Executive Program, this course aims to help business leaders embrace creativity as a discipline. The University of British Columbia’s Peter A. Allard School of Law is also using virtual reality to offer lectures to its students via a VR social application called VR Chat.

Special Educational Needs and Disabilities (SEND)

Being on the Autism Spectrum, having limited mobility, and/or having other Special Educational Needs and Disabilities (SEND) can affect a student’s

learning ability in various ways. Virtual reality technology makes it possible for teachers to create personalized educational content that can tailor to these students’ unique needs. For SEND students, simply getting around a school, visiting new environments for the first time, going on field trips, and many other activities that most take for granted as routine can be very stressful. Thankfully, immersive VR experiences can also be calming for students prone to overstimulation, making it less likely for them to become heightened in an otherwise over stimulated school environment.

Virtual reality has also been used extensively to treat phobias (such as a fear of heights, flying and spiders) and post-traumatic stress disorder. This type of therapy has been shown to be effective in the academic setting, and several commercial entities now offer it to patients. Although it was found that using standardized patients for such training was more realistic, the computer-based simulations afforded a number of advantages over the live training. Their objective was to increase exposure to life-like emergency situations to improve decision-making and performance and reduce psychological distress in a real health emergency.

Challenges

The big challenges in the field of virtual reality are developing better tracking systems, finding more natural ways to allow users to interact within a virtual environment and decreasing the time it takes to build virtual spaces. While there are a few tracking system companies that have been around since the earliest days of virtual reality. Likewise, there aren’t many companies that are working on input devices specifically for VR applications. Most VR developers have to rely on and adapt technology originally meant for another discipline, and they have to hope that the company producing the technology stays in business. As for creating virtual worlds, it can take a long time to create a convincing virtual environment -the more realistic the environment, the longer it takes to make it. It could take a team of programmers more than a year to duplicate a real room accurately in virtual space.

The future of Virtual Reality depends on the existence of systems that address issues of ‘large scale’ virtual environments. In the coming years, as more research is done we are bound to see VR become as mainstream in our homes and at work. As the computers become faster, they will be able to create more realistic graphic images to simulate reality better. It will be interesting to see how it enhances artificial reality in the years to come.

Conclusion

Virtual Reality is now involved everywhere. We can’t imagine your life without the use of VR Technology. In this paper we define the Virtual Reality and its history. We also define some important development which gives the birth of this new technology. Now we use mail or conference for communication while the person is not sitting with us but due to technology distance is not matter. This technology give enormous scope to explore the world of 3D and our own imagination.

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