VIRTUAL REALITY – THE PRESENT, THE PAST & THE FUTURE

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Abstract – Virtual Reality refers more specifically to a computer-generated graphical representation of real or fantasy world. "Fred Brooks" defines Virtual Reality as an experience in which the user is effectively immersed in a responsive virtual world. He pointed out that the user has dynamic control of their viewpoint, which is something at the heart of any VR display system.

Not many individuals, however, understand what VR really is, what are its basic principles, and the problems that occur when creating and using the VR. In this paper, we have explained the origin of VR & how it came into existence, the basic terminologies, and its types.

Keywords – Introduction, CAVE, HMD, Levels of Immersion, Psychology of VR, Three Illusions, Application & Challenges of VR.

1. INTRODUCTION

Currently, it is possible for an ordinary computer user to enter the world of graphics. The excitement of experiencing a new world starts with computer games. Through this we see a world that is not real and encounter the things that are not accessible in real life and are yet to be created. Furthermore, this world does not have any boundaries and it can be manipulated by us – we can even expand this three-dimensional world by creating a fourth dimension of our own imagination. Unfortunately, this is not enough for the people. They not only want to see this imaginary world on a computer screen, but they want to step inside this world and feel it. The technology that makes this experience possible is known as Virtual Reality (VR).

Virtual reality has beginnings that proceeded the time that the concept was coined and formalized. In this detailed history of virtual reality, we look at how technology has evolved and how key pioneers have paved the path for virtual reality as we know it today. Its creation begun in the 1950's, but it caught the people's eye in the late 1980's and 1990's. The credit of introducing the term Virtual Reality to the world goes to Jaron Lanier. After many research, the concept of virtual reality was popularized in mass media by movies such as Tron (1982), Brainstorm (1983), and The Lawnmower Man (1993).

There are plenty of definitions of VR today, which all overlap in key areas. When we use the word "VR" now, it specifically refers to computer generated imagery and hardware specifically designed to bring those sights and sounds to us in a way that is totally immersive.

2. THE HISTORY OF VR

"When anything new comes along, everyone, like a child discovering the world thinks that they've invented it, but you scratch a little and you find a caveman scratching on a wall is creating virtual reality in a sense. What is new here is that more sophisticated instruments give you the power to do it more easily."
- Morton Heilig [Hamit 1993]

Precursors to what we think of today as VR go back as far as humans have had imaginations and the ability to communicate through the spoken word and cave drawings (what could be called analog VR). The Egyptians, Chaldeans, Jews, Romans, and Greeks used magical illusions to entertain and control the masses. In the middle Ages, magicians used smoke and concave mirrors to produce faint ghost and demon illusions to gull naive apprentices as well as larger audiences [Hopkins 2013]. Although the words and implementation have changed over the centuries, the core goals of creating the illusion of conveying that which is not actually present and capturing our imaginations remain the same.

The history of VR has been an attempt to give the people more real experience. Most of the experiences have been visual rather than auditory. This is because, of all the human senses, vision helps largely in experiencing, understanding and gathering information as compared to hearing.

In a historical context then, we must broaden what is seen as VR or VR-adjacent. Some of the milestones discussed in this article are therefore also ancestors to other forms of media, such as film. The technologies are also branched into many different directions. In some cases, a milestone is more about the establishment of an idea, rather than the invention of a specific technology.

3. HOW VIRTUAL REALITY EVOLVED?

● **The 1800s**

The static version of today's stereoscopic 3D TVs is called a stereoscope and was invented before photography in 1832 by Sir Charles Wheatstone [Gregory 1997]. The device used mirrors angled at 45° to reflect images into the eye from the left and right side.

Charles Wheatstone's Stereoscope.

David Brewster, who earlier invented the kaleidoscope, used lenses to make a smaller consumer-friendly hand-held stereoscope. His stereoscope was demonstrated at the 1851 Exhibition at the Crystal Palace where Queen Victoria found it quite pleasing.

A Brewster Stereoscope From 1860

• **The 1900s**

The idea of VR was given by Ivan Sutherland in the year 1965: "make that (virtual) world in the window look real, sound real, feel real, and respond realistically to the viewer's actions", he said. Since then, a lot of research has been performed. Let us have a look at some of the research in virtual reality and their features.

1. **Link Trainer – The First Flight Simulator:** Edwin Link developed the first simple mechanical flight simulator, a fuselage-like device with a cockpit and controls that produced the motions and sensations of flying. Surprisingly, his intended client—the military—was not initially interested, so he pivoted to selling to amusement parks. By 1935, the Army Air Corps ordered six systems and by the end of World War II, Link had sold 10,000 systems. Link trainers eventually evolved into astronaut training systems and advanced flight simulators complete with motion platform and real-time computer-generated imagery, and today is Link Simulation & Training, a division of L-3 Communications. Since 1991, the Link Foundation Advanced Simulation and Training Fellowship Program has funded many graduate students in their pursuits of improving upon VR systems, including work in computer graphics, latency, spatialized audio, avatars, and haptics [Link 2015].

Left: Edward Link, Right: The Link Trainer

2. **Morton Heilig's Sensorama:** In the mid-1950s cinematographer Morton Heilig developed the Sensorama (patented 1962) which was an arcade-style theatre cabinet that would stimulate all the senses, not just sight and sound. It featured stereo speakers, a stereoscopic 3D display, fans, smell generators and a vibrating chair. The Sensorama was intended to fully immerse the individual in the film.He also created six short films for his invention all of which he shot, produced and edited himself. The Sensorama films were titled, Motorcycle, Belly Dancer, Dune Buggy, helicopter etc.

3. **The First VR Head Mounted Display (HMD):** 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
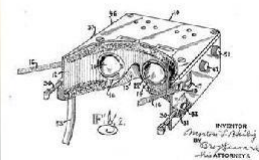

Image Source: veer.tv/blo

4. **The Ultimate Display:** 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 HMD and appeared realistic through augmented 3D sound and tactile feedback.

➢ Computer hardware to create the virtual word and maintain it in real time.

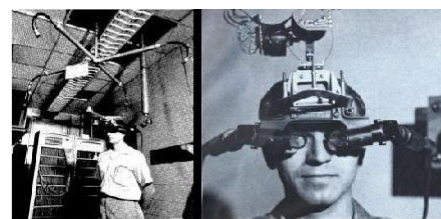➢ The ability users to interact with objects in the virtual world in a realistic way.

Image Source: os.typepad.com

5. **Sword of Damocles:** In 1968 Ivan Sutherland and his student Bob Sproull created the first VR / AR head mounted display (Sword of Damocles) that was connected to a computer and not a camera. It was a large and scary looking contraption that was too heavy for any user to comfortably wear and was suspended from the ceiling (hence its name). The user would also need to be strapped into the device. The computer-generated graphics were very primitive wireframe rooms and objects
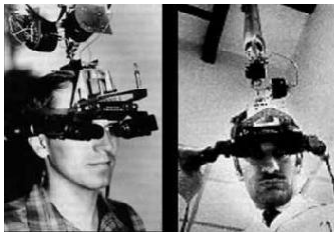
Image Source: researchgate.ne

6. **Krueger's VIDEOPLACE:** The VIDEOPLACE is widely regarded as the first interactive VR system. Using a mix of CG, light projection, cameras and screens it could measure user position. In modern terms it is more like an AR projection and did not feature any sort of headset.

7. **VPL:** VR pioneers Jaron Lanier and Thomas Zimmerman found VPL Research. This is the first ever VR company to sell HMDs and gloves. The term "data glove", comes from their Data Glove product.

8. **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.

9. **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.

10. **Cave:** A Cave Automatic Virtual Environment (CAVE) is an immersive virtual reality environment where projectors are directed to between three and six of the walls of a room-sized cube. The name is also a reference to the allegory of the Cave in Plato's Republic in which a philosopher contemplates perception, reality and illusions
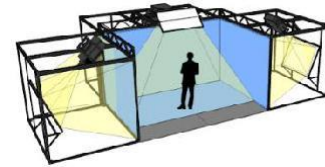

Image Source: medium.com

4. WHAT IS VR?

The term virtual reality (VR) is commonly used by the popular media to describe imaginary worlds that only exist in computers and our minds. However, let us more precisely define the term. Sherman and Craig [2003] point out in their book Understanding Virtual Reality that Webster's New Universal Unabridged Dictionary [1989] defines virtual as "being in essence or effect, but not in fact" and reality as "the state or quality of being real. Something that exists independently of ideas concerning it. Something that constitutes a real or actual thing as distinguished from something that is merely apparent." Thus, virtual reality is a term that contradicts itself—an oxymoron! Fortunately, the website merriam-webster.com [Merriam-Webster 2015] has more recently defined the full-term virtual reality to be "an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment." Jason Jerald the author of The VR

Book Human-Centered Design for Virtual Reality defined virtual reality as a computer-generated digital environment that can be experienced and interacted with as if that environment were real.

5. LEVELS OF IMMERSION

VR is about psychologically being in a place different than where one is physically located, where that place may be a replica of the real world or may be an imaginary world that does not exist and never could exist. Either way there are some commonalities or essential concepts that must be understood to have users feel like they are somewhere else. This chapter discusses immersion, presence, and trade-offs of reality.

Immersion is the objective degree to which a VR system and application projects stimuli onto the sensory receptors of users in a way that is extensive, matching, surrounding, vivid, interactive, and plot informing [Slater and Wilbur 1997].

- Extensiveness is the range of sensory modalities presented to the user (e.g., visuals, audio, and physical force).

- Matching is the congruence between sensory modalities (e.g., appropriate visual presentation corresponding to head motion and a virtual representation of one's own body).
- Surrounding is the extent to which cues are panoramic (e.g., wide field of view, spatialized audio, 360° tracking).
- Vividness is the quality of energy simulated (e.g., resolution, lighting, frame rate, audio bitrate).
- Intractability is the capability for the user to make changes to the world, the response of virtual entities to the user's actions, and the user's ability to influence future events.

Plot is the story—the consistent portrayal of a message or experience, the dynamic unfolding sequence of events, and the behaviour of the world and its entities.

Immersion is the objective technology that has the potential to engage users in the experience. However, immersion is only part of the VR experience as it takes a human to perceive and interpret the presented stimuli. Immersion can lead the mind but cannot control the mind. How the user subjectively experiences the immersion is known as presence. These are the 3 levels of immersion:

1. Non-Immersive VR: One of the examples of the non-immersive VR systems is the Desktop VR. One can easily play a game or watch a movie on a desktop, but the level of immersion is exceptionally low. The users cannot feel the environment on the screen they can only view it on the screen and hear the sound from the speakers.

2. Semi-Immersive VR: It is the improved version of non-immersive VR systems. This type of VR is mainly used for educational and training purposes like in a Flight Simulator. The experience is made possible with graphical computing and large projector systems. Also, these simulations give the users the perception of being in a different reality.

3. Fully Immersive VR: This type of VR is used mainly for gaming and other entertainment purposes where you use head-mounted displays, headphones, gloves and maybe a treadmill. These simulations give the users most realistic experience, with complete surrounding and sound. It provides a larger field of view with high resolution where you can feel like you really are present there.

6. THREE ILLUSIONS OF VR

In virtual reality, since the early 90s, people have been using the concept of presence to describe this feeling of being there. But, unfortunately, over many years, this concept has been mixed up with many things that do not have much to do with it. These are feelings of enjoyment, or engagement, or excitement and so on. They are all important, but they are not the same thing. When you have visual sensory motor contingencies, they are like in real life, this affords the possibility of the brain to make the decision that this is where I am. The virtual place rather than the real place. So, the

place illusion is the first one of these illusions.

Place Illusion: The feeling of being in a virtual place, even though you know you are not there. And place illusion can occur even if nothing is happening in the environment.

There is another aspect of this, which is the dynamic aspect. Suppose the events happening on virtual reality, like a crowd walking along, or cars going by, or leaves rustling in a forest in the wind. The next question is, does this seem to me to be really happening? So, the second illusion is the illusion of plausibility.

Illusion of Plausibility: Event that the user is experiencing or engaged in really happening even though they are not. So, for example, in the real world, the user is driving along and sees a policeman standing on a corner. And so, it slows down because the speed is a bit too fast. Then, as they get closer, they realize it is not really a policeman, it is a life size cardboard cut-out. So before, the user had plausibility.

And the third illusion is something very, very, unique to virtual reality, which has to do with one's own body. When the users look at themselves in the virtual world, they can see that they look different. And this can give rise to a third illusion, which is the illusion of body ownership.

Illusion of Body Ownership: The illusion of that virtual body is one's real body and the things like falling and getting hurt are happening really to the real body.

7. APPLICATIONS OF VR

1. Films / Movies: Aside from gaming, virtual reality technology is being used for other entertainment purposes. For example, moviegoers can up their cinematic experiences with applications like Oculus Cinema. True, we already have 3D in theatres; but VR technology can still make the audience feel more involved in whatever they are watching as if they are part of the narrative itself. Some of the films that use virtual reality technology are: Notes on Blindness, Lincoln in the bardo, Bashir's Dream, Bear71, My Brother's Keeper etc.

2. Sports: VR technology has something awesome for sports enthusiasts. Specifically, the company, LiveLikeVR, has created a virtual stadium for them. This platform can make them experience the thrill and excitement of a sports game, alone or with their friends, without having to leave their house.

Not only sports fans, but athletes themselves benefit from the VR technology as well. American Football teams can practice their game through a simulation, improving their teamwork and individual skills without stepping on an actual field. Besides American Football, here are other organizations and sports categories that use virtual reality technology: NASCAR, Soccer, Basketball, Poker.

3. Live Concerts & Performances: Next VR, a VR filming

company captures the performances and brings them to the people. This reduces the problems like ticket scarcity and reduces the travelling time. Some of the performers that used virtual reality in their concerts are Kasabian, Imagine Dragons, Panic! At the Disco, Liam Payne, Billie Elish.

Other places where VR can be used are:

- Travel

- Museums

- Shopping & eCommerce

- Surgery & Medicine

- Space Exploration

8. CHALLENGES IN VR

1. The Price Is Too High: Price is one of the major roadblocks industry is facing right now. Plain and simple - most of the engaged audience cannot afford buying VR gear. On the other hand - industry players cannot afford lowering price to a reasonable level.

2. The Content Is Lacking: Offer piece of action. That is obvious thing. It is also the best way of introducing new cutting-edge technologies to the mass market is through innovative and engaging content. This approach smooths the acceptance curve and attracts widest possible audience.

3. Lack of Viable Business Models: Virtual Reality Technology is in the weird place right now. On the one hand - it is cutting edge technology, a brave new world of sorts. On the other, its future is highly questionable on the business side of things.

4. VR Perceived as Gimmick: This one is particularly perplexing. Despite being a huge technological achievement with potentially ground-breaking impact on everything - VR lacks acceptance from anyone beyond tech enthusiasts and early adopters. Majority of the public perceives it as an expensive gimmick designed for video games.

9. PROBLEMS FACED BY EXCESSIVE USE OF VR

The experience of virtual reality brings advantages and disadvantages. The problems that arise due to excessive use of virtual reality are nausea, motion sickness, problem ion differentiating what is real and what is not real etc.

- Cyber Sickness: Cybersickness is a form of motion sickness that occurs as a result of exposure to VR. It can range from slight headache to an emetic response. Several factors have been identified that may contribute to cybersickness such as lag, field of view but it is still an undergoing research to identify the specific causes of cybersickness and to develop methods to alleviate this ailment.

- Social Impact: There is high level of concern over the negative influences of interactive VR environments towards social implications. The users who are engage in violence VR video games and television in the virtual world may become desensitized to their violent virtual actions and mimic that behaviour in real world.

- Human Sensory Limitations: For a virtual environment system to be compatible with their users, it is vital for designers to understand design constraints imposed by human sensory and motor physiology. The physiological and perceptual issues that directly impact the design of virtual environment systems are visual perception, auditory perception, and haptic and kinaesthetic perception.

10. THE FUTURE OF VIRTUAL REALITY

The eventual fate of Virtual Reality relies upon the presence of systems that address issues of 'enormous scope' virtual conditions. In the coming years, as more examination is done, we will undoubtedly see VR become as pillar in our homes and at work. As the PCs become quicker, they will have the option to make more genuine realistic pictures to re-enact reality better. It will be to perceive how it improves fake reality in the years to come. It is truly conceivable that later we will speak with virtual telephones. Nippon Telephone and Telegraph (NTT) in Japan is building up a framework which will permit one individual to see a 3D picture of the other utilizing VR methods.

11. CONCLUSION

Virtual Reality is currently included all over the place. You cannot imagine your existence without the utilization of VR Technology. In this paper we characterize the Virtual Reality and its set of experiences. We likewise characterize some significant advancement which gives the introduction of this innovation. Presently we use mail or meeting for correspondence while the individual is not sitting with you, however because of innovation distance is not matter. This innovation gives tremendous extension to investigate the universe of 3D and your own creative mind. It has numerous applications from item improvement to entertainment. It is still particularly in the improvement stage with numerous clients making their own tweaked applications and arrangements to suit their necessities.

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