Introduction (references=684) (wordcount=4135)

A computer-generated universe is an arm’s reach away. Improvements everyday have allowed us to transform many aspects of our daily lives into a digital format. From entertainment such as the renowned VR headsets to virtual classrooms and meetings, our entire world could be taken over by a virtual pandemic! Being put into an “advanced human-computer interface that simulates a realistic environment” [2] almost sounds as if it were in the world of fiction. The possibilities are limitless. As the host you can interact with your surroundings and have the options to adjust your experiences. If the feature is implemented than you as the player can take advantage of it.

“People always want more [1].” Instead of watching a screen people wanted to step into the world that was in front of them. Virtual Reality is a visual orientated environment with audio effects. This is because most of the information we perceive is taken in through our eyes [1]. It is displayed through special stereoscopic displays and users can interact with it using a wired glove. Tracking sensors are used to track hand movement along with the wired glove. More advanced tech can track the full body including the legs.

The spectrum of virtual reality is huge. Anything done in real life can be done on a virtual field. It involves the same experience without the necessary risks involved. When the phrase virtual reality comes up in conversations more times than not it is referring to the gaming side. One of the main reasons was due to the release of the Oculus Rift [] which started the new age of affordable virtual reality consoles. Its success brought a lot of attention to the concept of virtual reality.

Brief history and evolution of virtual reality

The history of Virtual Reality dates to the 1950s but came to public's attention during the late 1980s and 90s. One of the reasons for this is because of the computer scientist Jaron Lanier who invented the word “Virtual Reality”. Research followed as there was a lot of potential for Jaron Lanier’s Virtual Reality and kickstarted the era of virtual reality devices. The first core idea was presented by Ivan Sutherland in 1965 with the quote “make that (virtual) world in the window look real sound real, feel real, and respond realistically to the viewer’s actions” [1].

1950s-The Sensorama

Then in 1957 The Sensorama Machine was invented and patented in 1962 [1]. Morton Heilig an American cinematographer created a multi-sensory simulator. His idea was to make a multi-sensory theatre in 1955. It was a pre-recorded film in colour and stereo was augmented by sound that was recorded by a dual microphone setup with added vibration experiences [1]. This was the first attempt to create a virtual reality system. It had all the features of a virtual environment, without it being interactive [5].

1960s-The Sword of Damocles

A couple of years later in 1968 Ivan Sutherland constructed a device considered to be the first 3D head mounted display (The Sword of Damocles) [6], which had appropriate head tracking. It supported a stereo view that was updated correctly according to the user’s head movement [1]. It resulted in years of research and development for an augmented reality and soon a virtual reality which was invented by Jaron Lanier. Augmented reality really set the basis for virtual reality. It allowed digital elements to be added to real a real-life view but virtual reality advanced that to where we could create our own simulated environment.

1970s-The Videoplace

In 1975 was the next big advancement in virtual reality when The VIDEOPLACE was invented by Myron Krueger [1]. It was “a conceptual environment, with no physical existence “[7]. The VIDEOPLACE was an augmented reality surrounding the user which was interactive without the use of headgear or gloves. The computer coordinates the movements of the user in real time and translates them into interactions with the system [1]. The major importance of The Videoplace was that it changed the way virtual reality was perceived. It gave the ability to manipulate the environment when before we could only see it [7].

The Data Glove

The Videoplace helped spread ideas which led to the further development of the wired glove. In 1977 the Sayre Glove was developed. It was created by Daniel J.Sandin and Thomas Defanti [8] and was based off an idea from a colleague, Richard Sayre. It was a lightweight glove used to monitor hand movements. It offered an effective method to manipulate the surroundings of a virtual world. In 1982 Thomas Zimmerman and Jaron Lanier invented the data glove [8]. The Data Glove was said to be the first commercially available wired glove.

1980s-VCASS

Thomas Furness who was another prominent figure in the development in virtual reality created the VCASS. It was a virtual flight simulator which helped pilots in the army with their decisions making skills [9]. They needed a way to help train pilots during a time where planes were becoming more difficult to fly and operate [9]. Then in 1982 the Visually coupled airborne system simulator was born [1]. It completely immersed the pilot in another world and gave them a false perception of flying an aircraft. The user wore an HMD which allowed the VCASS to provide an immersive experience.

1980s-The Super Cockpit

Later Furness developed the Super Cockpit. It was developed to help improve the awareness the pilots. Furness managed to create a system which projected computer generated maps and 3D space where the pilot could interact with in real time. The helmets tracking system allowed the pilot to control the virtual aircraft with gestures and eye movements [10]. Furness used it to provide a natural and intuitive way to control the aircraft and, in the future, would be used to aid modern day virtual reality devices [10].

VPL, the first company to commercially sell VR devices

Further advancements lead to the development of the Eyephone. It was fully implemented in 1989 constructed by VPL Research founded in 1984 by Jaron Lanier [11]. The system included a goggle and a DataGlove. 1987 was also a big year for virtual reality as it was the year Jaron Lanier created the term “Virtual Reality”.

1990s-SEGA

After seeing the success and popularity of virtual reality Sega wanted to capitalize on it. Development for the SEGA VR began in 1991 [29] but was eventually cancelled. A few years later in 1995 Nintendo released the Virtual Boy. However, it failed as it never delivered on its promises [29].

Early 2000s

The popularity of virtual reality only increased in 1999 after the release of the popular movie “The Matrix”. It explored the concept of an alternate reality and only added hype to the already popular genre of virtual reality.

2010s-The Oculus Rift

The 21st century was major year for virtual reality. One of the main reasons for this was the release of the Oculus Rift. After raising $2,437,429 in 2012 [4] from its campaign, they announced two developer kits [3] which allowed developers to construct commercially available content which would be released with its prototype. The company was bought out by Facebook in 2014 [4] even before the product was released. It has much wider FOV than previous devices [3] but needs to be used with a computer as it does not have the technological power to run games on its own. It was developed with the intention of being a gaming console however, it has been useful in helping people in a variety of ways.

2020s-Oculus Quest and Quest 2

Furthermore, the Oculus would continue to improve. The Oculus Quest was released in May 2019 and the Oculus Quest 2 was then introduced in October 13 in 2020 [12]. It is the most innovative software introduced by Facebook technologies and is also known as the Meta Quest 2. Unlike the Oculus Rift, the Quest 2 is a console so it can run games without the help of a computer [12]. It is perfect for beginners who want to try out virtual reality for the first time. It provides the best gaming experience for its price range at $300 [12]. Although it is a lot cheaper, the console is powerful allowing it to compete with more expensive models. It is also very portable and can be brought to most places with a carry case. The Quest 2 is the perfect virtual reality console for beginners. However, many users complained that the comfortability of the console was not up to standard [12], the problem can be easily fixed by spending a small bit more on a comfier strap. The Quest 2 still has a long way to go as although it is particularly good for its time.

Virtual reality has a come a long way since the 1950s. From Sutherland’s quote “make that (virtual) world in the window look real sound real, feel real, and respond realistically to the viewer’s actions” to the innovative Oculus Quest 2. The world of Virtual reality will only continue to exceed everyone's expectations.

IMPACT OF VR IN MODERN SOCIETY

Virtual reality has become extremely popular and common in today’s society. Its most popular use is for entertainment. In virtual reality anything is possible. There are many games that can be played that let people live out their wildest dreams and there are movies that can be watched in virtual reality. VR technology has advanced tremendously over the years and each year VR is becoming increasingly real. VR unlocks a whole new world of potential, there are many future prospects for VR such as training (since anything learnt in VR can be applied to real life), healthcare improvement and retail. There are many possibilities and things being considered for VR

Entertainment:

This is currently the biggest and fastest growing industry in VR. VR gaming headsets are now widely available to the public at a reasonable price. The industry has gotten so big that huge companies such as valve now create VR games and they have even created their own VR headset. VRChat is a VR social platform where users can interact with other people all over the world. It creates a realistic environment where users can do whatever they want. There are VR ride simulations that let you experience rollercoasters and other rides as if you are there. It is possible to watch movies and videos in VR although it is not as immersive as watching 360° videos/movies specifically created for virtual reality. These 360° videos allow the user to look around as they are watching the video.

Healthcare:

It is believable to think that VR will have an enormous impact on healthcare in the future. Right now, VR is being used to detect and treat glaucoma, schizophrenia, and Alzheimer’s disease. [15] Due to Virtual Reality being in the complete control of the user it can also be used to put people in a comfortable place which can help to treat PTSD, anxiety, and other mental disorders. This is known as virtual reality exposure therapy. Virtual reality is being considered to train healthcare professionals. This is due to virtual reality being a safe environment to learn and reflect since there are no real-life implications. [14] It allows the user to take a “trial and error” approach to learning how to respond to situations simulated in virtual reality. Virtual AI can be used to help simulate situations of child-abuse as in paediatrics, it is essential to practice child protection scenarios however it is ethically inappropriate to use children as victims for the purpose of teaching. However, there are downsides to using Virtual Reality in medical training. To allow for mostly realistic avatars, expensive virtual reality equipment is needed. Even at the top virtual reality level these avatars are not extremely realistic so it may make clinicians less immersed which may prevent them from taking the training seriously. It also may cause the trainee to treat the AI different to human due to not seeing them as human. Due to AI limitations this type of training only allows for behavioural observation and not demonstration of behavioural change.

Education

It is widely recognised that VR technology has a lot of potential in educational use. [16] An estimated 20 or more schools/colleges have attempted to use VR technology to improve their teaching. There are several ways in which VR technology can facilitate learning. Its most unique capability is the ability to allow students to visualise abstract concepts. This allows for observations at atomic or planetary scales, instead of diagrams being used to observe and explain, VR technology can represent that information in a more realistic way. The argument supporting this is that, by presenting information this way, students are better able to master, retain and generalize new knowledge.

Training in VR

A lot of military forces have started using Virtual reality to train their troops. [17] The Institute of Defence in Virginia has been training soldiers using virtual reality to simulate situations in Vietnam. They are training them to use virtual reality tanks that simulate real tanks. Due to the high budget equipment the soldiers are fully immersed, so they feel like they are truly in Vietnam. [17] NASA are also investing in virtual reality technology so they can simulate space exploration and train their subordinates efficiently for space travel. It is clear virtual reality is being used to simulate real experiences which can be used as safe training.

Business in Virtual Reality

Virtual reality can be a good way to present business ideas in a realistic way. Building plans can easily be shown through virtual reality in great detail and in a realistic fashion, this would make it more convincing for investors and managers for idea pitchers as they’d be able to portray their idea without leaving out any detail. [17] Product design can be shown in a realistic manner through virtual reality. It is clear virtual reality can be used to project a clear visualisation of ideas which is convenient for businesses. When trying to convince a consumer to travel to a certain place, VR can allow the user to briefly experience a travel destination which would encourage them to travel there.

Business has come to realise the potential of virtual reality as it enhances training (as previously mentioned) and product design. [17] Simulations can help provide businesses with data that help identify flaws in the product. This means that less raw material needs to be used on prototypes as all prototypes can be shown in virtual reality and all testing can also be done in virtual reality.

Computer science in virtual reality

Virtual reality has branched off into various sectors, slowly starting to be more involved with learning and teaching. People have started to see the potential of virtual reality in the field of education. The introduction of affordable virtual reality consoles has allowed more people to take advantage of it.Virtual reality brought a high level of engagement and interactions which can help to provide an enhanced learning experience [19].

“Learning activities and practical experiments which are often too expensive, risk injury or simply too time consuming that could be conducted in a classroom, can be replaced by virtual experiences” [18]. One of the main reasons for the use of virtual reality in teaching is because it provides a virtual environment for the student to be physically and socially aware of what is happening, as if it were happening right in front of them. It makes working with other individuals simpler due to the fact all parties are perceiving the same world and events at the same time [18]. Experiencing something contributes a lot to learning it which can help with understanding difficult concepts and methods in computer science. It can also help with teaching basic skills for students, such as [18]

* Learning tasks leading to improved spatial knowledge,
* Proceeding with tasks that would be impractical or impossible in the real world,
* Learning tasks that lead to increased motivation and engagement,
* Tasks that lead to develop effective collaboration learning than is possible with 2D alternatives.
* Helping visualize the programmes execution to understand it.
* Teamwork
* Project management
* Organisation

The key factor that differentiates 2D from 3D is immersion. Students are more entranced by a virtual world around them then to its 2D counterpart. The ability to manipulate one's environment in a natural way [19] and explore an almost fiction like concept helps with creativity. VR learning engages students and offers a fun learning experience when learning about a difficult topic like computer science. Programming skills can be developed by exploring and testing programmes in virtual reality [18]. Another thing is that it provides the teachers to have more control over their students. Which has both its positives and negatives as it restricts the student's environment but also gives the potential to offer a “tailored experience to individuals” [18].

However, teaching with the aid of virtual reality is still a new concept and has yet to be perfected. Even after the release of cheaper consoles having the access to a wide range of HMDs will still cost a lot. Usability can also be a problem because many people are still do not understand this new way of teaching and learning. It is also stated in that virtual reality evokes various fears and concerns in the educational field, such as the fear of “virtual VR misuse, loss of control and fear of confusion” [18]. It takes time to setup and to learn how to operate it, making time an issue. VR in computer science has potential but is dragged down by the lack of research in the field [18].

Gaming in VR

Gaming in virtual reality is one of the leading genres of VR use, the ability to experience the extraordinary realities of these games as if you were in them is one of the reasons VR is continuing to advance its Technology and become more realistic with each iteration of VR headsets and software updates for them.

There have been studies taken that researched the impact game features have on gameplay (20). Physical features of a video game such as display size, resolution etc have been proven to psychologically affect the player [21]. Thanks to the entry of virtual reality into the videogame market. Just in 2017, over 7249 games developed for virtual reality were released on the Steam platform [22], while by June 2017, Sony Corp had already sold globally more than one million units of its PlayStation VR headset [23]. Virtual Reality games are quite different from the traditional analog gaming experience most of us are used to.

While virtual reality has already proven its potential in many application domains such as the military, medicine and neuropsychology, its potential in the context of gaming experience and added value in comparison with other technologies is still relatively unexplored despite the fact that virtual reality has only recently risen to success among the public, the technology on which it is based cannot be considered new at all; indeed, it was born in research labs during the Nineteen Sixties [24]. A primary trial of commercialization of virtual truth video games took place during the Nineties, with the release, in 1991, of the Sega VR headset for the Sega Mega drive console (Sega), rapidly followed by the release of the virtual Boy (Nintendo). However, the release of these pioneering virtual reality gaming products for consoles became a commercial disaster, and virtual reality popularity was out shined by the advent of the global web and other more accessible computational devices, networks, and software (e.g., personal computers, smartphones).

Virtual reality gaming presently represents a new and increasing portion of the entertainment industry, and its popularity is continuously growing among users [25]. It is unique from other technological merchandise: while a consumer may be forced to use a specific software to carry out a specific task for lack of options, a game is selected and bought by the customer due to its unique entertainment value. To be entertaining and fun, video games need to be able to motivate customers to play for hours, and to persist over tough challenges; this is only possible when the game gives a great user experience.

Benefits of gaming

Gaming helps with a lot of other things as well as entertainment. One reason many people play videogames is to help forget about problems. It is an effective way to separate yourself from reality. The introduction of virtual reality brought the immersion to a whole other level. The emotions brought by the virtual experience helps the user distract themselves from anything they are going through and any outside sources of stress [26]. Getting sucked into a role-playing game like Skyrim in virtual reality can give the player a false perception of being in an alternate world.

Virtual gaming can also offer a social platform for people to communicate as it allows for a diverse pool of users to experience the same virtual environment. Having the ability to be able to connect to anyone in the world makes it quite easy to speak to friends, family, or complete strangers. It allows people to gain more confidence as it does not require face to face confrontation. Players can chat to anyone while behind an online avatar that they create. No one knows who they are, what they do or what they look like. It is the perfect environment to meet new people. A prime example is VRChat. An online multiplayer game with a sole purpose to socialise. Unlike other games which have a clear objective, VRChat has none. The user is in full control and can express themselves without constraints [27]. The idea was proposed in 2012 by Apostolopoulos to “create an immersive environment to cultivate the desire to socialise” [27]. Since then, it has proved itself to be a perfect social medium to be able to converse. One of the reasons to why is because unlike traditional videogames, the only way to communicate was with your voice and in game character actions. While in a game like VRChat the user can use non-verbal actions such as facial expressions and hand gestures [27]. In a game like this it is all up to the user to define his gaming experience.

Videogames has always been paired with having low motivation and minimal physical activity. It has been recorded that less than 20 percent of adolescents achieve the recommended 60 minutes a day for a healthy lifestyle [28]. The genre of exergaming is nothing new as demonstrated by Nintendo's Wii fit and Pokémon go. Both encouraged users to expend a certain amount of energy to be able to progress through the game. It was found through randomized trials that exergames supported weight loss and increased motivation and fitness [28]. They had a lot of potential. Support for exergames only increased after the release of cheap virtual reality devices. The immersion played a big a part in the enjoyability of exergames. Many experiments were done, and participants exclaimed having a better time while being less tired exercising in the virtual world than in the real world [28]. Virtual reality made something a lot of people hated doing into something they have always loved doing.

Conclusion

Virtual reality is a growing genre and will only continue to grow with further advancements. Many creations helped with build-up of what we know today as virtual reality. We had Sutherland’s quote, “make that (virtual) world in the window look real sound real, feel real, and respond realistically to the viewer’s actions,” Morton Heling’s Sensorama, The Sword of Damocles by Sutherland all the way to The Oculus Quest 2. The most innovative, powerful, and affordable virtual reality console. Virtual reality has changed since the first time it was implemented. It can be used to do all sorts of things now. It can be used in education to help with both teaching and learning. Students can perform experiments in class that would otherwise be too dangerous. The immersion drastically helps students enjoy the process of learning.

Virtual reality has helped a lot in healthcare. It can be used to detect glaucoma, schizophrenia, and Alzheimer’s disease. Aswell as that it can be used to put people in a comfortable place which can help to treat PTSD, anxiety, and other mental disorders.

Another aspect of life virtual reality helps with is entertainment with videogames and movies. It also helps with relieving stress and socialising with others across the world. The rise of virtual reality gave rise to exergames. Adolescents and anyone who want to stay fit can have fun while doing so. The advancements of virtual reality have given us more opportunities to express ourselves and allowed us to help more people than before. We are far better off with the existence of virtual reality than without it.

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