An Introduction into Virtual Reality and its Active Use in Real World Applications

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Abstract—In this paper we cover a basic overview to what is Virtual Reality, a computer generated world that can be interacted and manipulated using specialized equipment, in this report we will be covering the use of Virtual reality in different aspects of everyday life, from medical to military use, to its advancement in Video Games Development.

Index Terms—Virtual Reality, Video Games Development, medical, military.

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1 INTRODUCTION

Virtual Reality, is a artificial computer-generated world that experienced and interacted with, the term has come to refer to a user or player that is using specialized equipment to immerse themselves completely and block out the real world.[1] The term virtual reality was initially coined by Jaron Lanier, Originally the term was referred to as "Immersive Virtual Reality". In immersive VR, the user would be fully immersive in a artifical, computer-generated 3D space [2].

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2 INTRODUCTION INTO VIRTUAL REALITY

When we simulate a Virtual World, we want it to match reality as close as possible, we can achieve this using various equipment, such as HMDs, (Head Mounted Displays), specialized controllers, and a computer that processes the artificial world. There are also peripherals that provide the user with artificial smells and force-feedback (to give the sensation of touch) such as the humorously named "Nosulus Rift", and rumble features that have been integrated into various gaming controllers.

2.1 Hardware

There are three current leaders in the development of Virtual Reality HMDs, Oculus Rift developed by a Oculus VR, a division of FaceBook, HTC Vive, a collaboration between HTC and Valve, and the console based PlayStation VR, developed by Sony exclusive to the Playstation 4 system. While all three vary in price, all three of them use the same methods of implementing Stereoscopic Projection to give the illusion of 3-Dimensional Depth to the user .

2.2 Stereoscopic Projection

Perception of depth is key for a immersive Virtual Reality experience, this can be achieved with the HMD, by providing the user with a binocular view of two separate images, the quality of the technique we use to generate these stereoscopic images is important to how weak or strong the depth perception is going to be. All techniques require projection for a object onto a plane from 2 different centers of projection, one for both the left and right eye[2]

3 VIRTUAL REALITY AND ITS USE IN GAMING

Virtual Reality most obvious use is in the development of video games. In 2012, a new Kickstarter campaign hosted by the creator of Doom and ID Software founder, John Carmack, called the "Oculus Rift" was successfully funded, it was promised to be a fully immersive VR device with it's primary focus on letting users play their favorite video games using a HMD. In 2014 Oculus VR and the Rift was acquired by Facebook, as they believed that there was a bigger potential for Virtual Reality, not limited to it's use in gaming, none the less, other companies followed suit with focus exclusively on gaming with the HTC Vive and the Playstation VR.

3.1 User Experience

When the Oculus Rift released in 2016, there was no clear way of knowing how the human body would react to Virtual Reality. Analyzing what exactly is a good user experience can come down to many factors, the testing environment, the users health, complexity of game-play scenarios ect. When developing video games for Virtual Reality, there has been a focus in quanitive and qualitative data, that would help develop a better user experience, The former also include physiological methods such as Skin Conductive Response(SCR), Facial Electromyography (EMG) and Heart Rate (HR), Dracen et al. demonstrated that there is a correlation between facial SCR and Facial EMG can produce better game design. [3] The authors of the paper 'Exploring Game-play Experiences on the Oculus Rift' conducted an experiment, in which 10 participants played the video game First Person Shooter (FPS) 'Half Life 2' (http://store.steampowered.com/app/220/HalfLife$_2$/)

under 2 different gaming setups. One setup was using the HMD, while the other was much more traditional desktop gaming. They chose the games as it has varied game play interactions, from shooting enemies, navigating Three-Dimensional Environments, picking up items, driving vehicles and so on. While the story line of the game is linear, the game play is not, and you can transverse the world at your own leisure and feel free to explore. This was with the in tension that each participant would have a different game play experience, furthermore a different experience session

for session each time the participant plays. The test data was base lined with each participants age, gender, gaming habits, gaming interests ect. It was concluded that 8 of the 10 participants experienced a more intense overall experience on the Oculus Rift once they have completed both gaming sessions. Data observed from the gaming session showed that the participant anxiety were intense and heightened during gunfights and shooting enemies that where crawling on the ceiling. Other in game interaction where also shown to heighten the user experience (positively and negatively), giving the example of jumping or falling, the participants experience was said to be more engaging. [3]

3.2 Cyber Sickness

8 of the 10 users experienced "Cyber Sickness". after 30 minutes of game play, it was noted that the participants experienced nausea and mild headaches without knowing what could have cause this. Virtual Reality sickness was unprecedented how wide spread it would be with the release of the Oculus Rift. It has been describe as a form of "sea sickness" with the player feeling lightheaded when your eyes perceive your character as moving, but "in real life" you're seated/standing. Since the launch of the Virtual Reality HMDs in 2016, developers pivoted mobility options in Virtual Reality gaming, example of which, in January 2017, Japanese game developer Capcom released "Resident Evil 7 : biohazard" the next entry in their long running survival horror franchise for the Playstation VR, with a default control scheme, that allowed the user to only be able to rotate at 30 degree intervals, in an attempt to combat motion sickness. The Elder Scrolls V : Skyrim released a VR version in November 2017, and player where able to navigate the world using an in game cursor, that teleported the player to the cursors location, both of these examples also allow for "free movement" options as Cyber Sickness may not effect everyone. A study carried out by Aliya Iskendernova, Florian Weidner and Wolfgang Broll of the Illmenau University of Technology, Germany, shows that the cure for Cyber Sickness may in fact be what we are explicitly warned against, alcohol.[4] Their study revealed unexpected results that alcohol intoxication at at level 0.07 Percent would experience significantly reduced symptoms to Cyber Sickness.

4 VIRTUAL REALITY AND ITS USES IN MEDICAL

Along side gaming Virtual Reality has it's use in the medical field. Various studies have shown that rehabilitation using Virtual and Augmented Reality in Alzheimer's patients and patients with Post Traumatic Stress Disorder (PTSD) could potentially restore the patients lost functions through hands on rehabilitation, exercise and education. In a study conducted by BK Wiederhold and MD Wiederhold of the Interactive Media Institute, San Diego [5], They acknowledge of the largest costs in the health care sector of the United States of America, is the care and rehabilitation of war veterans, who lost basic motor functions due to illness, injury or disease. These soldiers would need to undergo both physical and cognitive rehabilitation. "As of August 2015, it was estimated that of 12,500 U.S War fighters had

been wounded in Iraq, Because of the advancements in protective armor and battlefield medical care, more military personnel are surviving their wound, that means more people with amputated limbs, traumatic brain injury and other injuries are returning to the U.S for rehabilitation and treatment, The long term care of thousands of wounded veterans promises to be a large expense (Glasser, 2005)". BK and MD Wiederhold believe that the U.S is in dire need of a more efficient and effective form of rehabilitation. On top of the cost that is being spent to maintain the upkeep of the veterans, the forms of rehabilitation that is currently in place proves to be consistently less effective to being monotonous and rather unpleasant for the patient. They focused their research on cognitive therapy on patients that have suffered from strokes, and they believed, if their form of rehabilitation proved to be effective on these patients, the same methodologies would then be able to apply to others patients with different injuries.

4.1 Medical Simulator

Simulation is an important part of the medical field, it can be used evaluate predicted outcomes when a disease is met with a potential antidote. When learning in medicine, more traditional educational methods are still being used, such as surgery. Although change is difficult to be accepted and implemented by hospitals, Virtual Reality Simulators could be a safer, more efficient approach to learning. In a paper by Sofia Bayona, Jose Manuel Fernandez-Arroyo,Pilar Bayona ,Issac Martin [6], the authors believe that simulations in Virtual Reality could potentially reduces stress for the trainee, since consequences cease to be critical or potentially life threatening. and the training session is deduced down to nothing more than a single-opportunity operation. Tasks that involve high risks, the VR simulations grants the student permission to fail, students can then learn from their own mistakes, start to recognize hazardous situations, learn how to recovery from errors, and how to learn what led up to cases, in which errors could not be avoided. The paper concludes that "Further qualitative and quantitative research still needs to be done on the design and implementation of assessment measures to make possible that VR simulators can be considered as a reliable, valid tool for training and assessment of surgical skills. With regards to the evaluation methodology, we have designed and are conducting further experimental designs to assess the construct, concurrent and predictive validity of the mentioned VR arthroscopy surgical simulator."

5 VIRTUAL REALITY AND ITS USES IN MILITARY

As with medical, Virtual Reality has it's place in the development of military operations. The technology has the potential to train soldiers the VR simulations grants the trainee to identify hazardous situations and allows them to make mistakes so they can learn from them.A major application of VR is in operations where surveillance of a area is to be conducted, but is inaccessible by soldiers In such cases, a drone or Unmanned Aerial Vehicle (UAV) with survey the surrounding are with the help of a VR device and perform the required operations. Other uses

consist of battlefield simulations and virtual boot camps where the soldiers experienced the consequences and the aftermath of a war. In a recent article [7] it states that VR Flight Simulators are taking place of teaching real time flying skills. They have the same structure as that of the real plane which has been mounted on hydraulic lift or electronic unit. The VR simulator tilts, move, twist to change the movements and the system even responds to the user. Thus such procedure also directly affects the cost of the training process and nullifies the damages

5.1 Human Emotions and its Relevance in Military Training

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6 CONCLUSION

The future of Virtual Reality can be very exciting, while the cost of having a fully immersed setup is still expensive, The introductory cost of VR is getting cheaper. Companies have started releasing alternatives such as the Google Cardboard and Samsung Gear, that replaces the internal processor and display of the HMD, with your smart phone. VR is expected to be adopted by education, The Franklin Institute currently host virtual tour at the "Brain Station", They allow you to first hand experience 360 Degree Video and Photos, of different exhibits that represent the deep reaches of space, or exploring the human body. There is currently a misconception the Virtual Reality and Augmented Reality are in competition with each other, and which platform will be the one that will be widely adopted by the mainstream. I believe that there will be a place for both in our future. AR will be used for everyday purposes such as navigation and advertisements, while VR will be used for entertainment,

such as viewing media and gaming. Virtual Reality will eventually become more physical, with addition peripherals that will require more movement from the user and in turn, provide a more immersive experience.

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