

Review of using virtual reality technology in the medical industry

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Abstract—This document is a Literature review on research regarding the benefits of using Virtual reality technology in 3D Environments for training medical professionals and in helping people with medical conditions. The use of virtual reality technology has become more widespread over the last few years. Now the range of virtual reality technology has increased from the use of mobile devices mounted in a plastic or cardboard mounted headset, to specifically designed units that are used to play video games, train personnel in different fields and assist with different medical conditions, both physical and mental. The aim is to examine the benefits and side effects presented by continued use of these devices for training and treatment.

Index Terms—Keyword here, index terms

1 INTRODUCTION

THE premise of a literature review is to pose a specific question, the question that should be addressed here is, Is virtual reality technology viable as a teaching or treatment tool in the medical community. This document is a review of the benefits of using virtual reality head mounted display units for training medical personnel and treating patients with mental medical conditions. With the introduction of HMD units to the mass market, through companies such as Facebook with the Oculus line of units, HTC with the Vive, Samsung with the Odyssey and many other groups and start-ups that have designed their own devices and equipment, the amount of users is only set to increase at the moment. With an increase of users it is only natural to wonder and question if using these devices is beneficial or hazardous to the people who use them and whether or not they help to train people more effectively and if they assist with the treatment of physical and mental conditions.

Head mounted display units and room scale environments allow many users to experience many different things and locations that otherwise would be impossible. This provides a unique opportunity to introduce an environment that would be difficult or expensive to simulate in the real world. Some countries use virtual reality to train medical personnel in war like situations, with the intention of retaining knowledge and training that can only be attained by repeatedly performing a task. This same idea can be applied in many fields, medical students could be trained on the inner workings of the human body without the need for human demonstrations. These simulations can be run repeatedly, they can be paused and altered and changed to fit the target audience. If an picture speaks a thousand words, then what can a 3D environment

that can be paused, rerun, reshaped and seen from many points of view be worth as a teaching tool.

2 TRAINING MEDICAL PROFESSIONALS

Surgery within military and civilian situations differ greatly, a civilian surgeon may be highly skilled in a hospital where surgery is expected and prepared for, the surgeons are also assisted by other medical professionals. In a war zone a surgeon with the same training would also require other skills to meet the tasks at hand. In a civilian environment the surgeon would be in an operating theatre where the conditions are sterile and free from interruptions, where as a military surgeon would be in any number of locations and uncontrollable situations. These are unpredictable and cannot be practised without great expense.

Training in virtual simulations is now widespread in the U.S. military (Siu Best, Kim, Oleynikov, Ritter, 2016, p. 215) but is limited to simpler surgical procedures such as laparoscopic surgeons (surgery that requires the use of a telescopic camera) and sutures, this could however be expanded to tasks that require a higher skill set and situations that occur less frequently but where success is critical when they do occur. Along with the training of the overall subject or task virtual simulations allow for better training of cognitive skills for the more basic tasks involved that often are overlooked.

An advantage to using virtual simulations is that it allows for intervention before bad habits have developed.

2.1 The skill retention theory

(Siu Best, Kim, Oleynikov, Ritter, 2016, p. 216) mentions the skills retention theory, where there are 3 stages of learning any task.

Stage 1: Declarative learning, this stage involves the basic learning of a skill and can degrade with lack of use to

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a point where the learner may be unable to perform the task. In this learning phase steps can be missed.

Stage 2: Associative learning, the learner has learned the fundamentals of the topic or task but this mixed knowledge. In stages 1 and 2 training should be introduced to keep the knowledge active.

Stage 3: Procedural learning, is where we have the statement "Practice makes perfect". When the learner has performed a task they truly understand and has practised to a point that they no longer rely on declarative memory but procedural memory.

When it comes to training tasks that either would be expensive to replicate or just impossible for many possible reasons, Virtual reality training simulations could become invaluable. Allowing a learner to repeat a task at their own discretion, to build the procedural memory needed to master a task, to build the muscle memory that would otherwise take time to develop in a real environment and to be free of the consequences of failure during training, on the other hand this can also be a negative as the consequences when a real world situation presents itself can be far greater and must also be understood. Similar to a child playing a racing car video game in an arcade simulation is in no way prepared to drive a car, it does however make them familiar with the controls and demonstrate a basic understanding of the task.

(Siu Best, Kim, Oleynikov, Ritter, 2016, p. 216), This publication was published in the Military medicine journal in May of 2016 volume 181. It also contained insights on an experiment they performed using 5 novices and 4 medical trainees. Each were given basic tasks to perform over a number of weeks. The data from the skill retention seems to be valid. The idea behind the decay of knowledge involved in performing basic tasks is very interesting and shows that using VR technology to assist with teach those tasks shows an improvement compared to traditional methods. The limitation of the experiment is made with a very small sample size of 9 people, so the results may not be completely relevant in a larger sample size. One area of research that would be appropriate to follow this document would be to test the method using a larger sample size but also run an experiment with tasks that

need to support the mental health as well as the physical health of the astronauts. When it has come to space flight in the past, Space exploration organisations have relied on personnel from military backgrounds that have scientific training to train as astronauts as these individuals fundamentally are disciplined and follow a code of conduct that demands they follow the chain of command, they are also often able to withstand situations that place them under great amounts of stress. Virtual reality simulations and interactions could prove to be an invaluable tool for manned space flights as it would allow for a detraction from the reality of being trapped within a confined space often without human contact of any kind.

This article was published May 1, 2018, in *Acta Astronautica*. The document at this moment has no citations but was an interesting read. It does have an interesting approach to the issues that face astronauts in longer manned space missions, However presents many gaps in the idea behind how the system would work or the options that the astronauts would require over a longer period of time and offers no implementation methods.

(Maples-Keller et al., 2017) suggests using Virtual reality for phobia based treatments that would for example allow a person who is afraid of flying to face that fear in a controlled environment. The patient may not be ready to face turbulence or may even be unable to step onto a plane without placing other passengers at risk. A phobia of heights could also be addressed using VR technology with no possibility of a fall. Of course these technologies would still require conventional treatments and for the phobias to be addressed would require an actual experience of the phobia condition but this technology would be a stepping stone that could help with many difficulties that initially would prevent treatment. (Salamon et al., 2018) also suggests that VR could be used to treat such mental disorders as Social anxiety disorder where the patient experiences anxieties when in conversations, meeting new people or public speaking, with VR these experiences could be gradually and could be stopped at a push of a button, this would prevent further trauma to the patient. It also references an article (Reger GM, Koenen-Woods P, Zetocha K, et al. 2016), A controlled experiment that was performed with active soldiers who suffered from PTSD and 9/11 survivors who suffered from PTSD, the results showed an improvement from VR environments over other treatments including placebo treatments. Panic disorder and agoraphobia are also covered and show an interesting point regarding agoraphobia, When someone has difficulties with open spaces and crowds. Virtual reality is an obvious path that can be taken in order to treat agoraphobia as it can allow sufferers to deal with their phobia in smaller steps while also being in a safe environment and the equipment can be removed.

This article comes from the Department of Psychiatry and Behavioural Sciences, Emory University School of Medicine. It offers a breakdown and explanation of each of the disorders described, it also shows a table of an experiment that shows the conditions to qualify to be part

3 VIRTUAL REALITY STUDIES TO IMPROVE MENTAL HEALTH

On 16 November 1973 Skylab 4 was launched and concluded on 8 February 1974, it was the longest space flight at that time lasting 81 days. However unlike many man space missions before it, Skylab 4 was the first "Space mutiny". Gerald Carr, William Pogue and Edward Gibson the astronauts tasked with the mission refused to perform their duties for 24 hours due to the high stress environment and heavy work load they endured. (Salamon et al., 2018) uses this example as a reference when suggesting applications that would assist in preparing astronauts for manned space flight. This incident brought attention to the

of the test groups. It also contains a table depicting the studies and conditions of the individual disorders tested and the conditions of the treatment used and age groups tested.

Most research carried out before 2012 focused on anxiety dis-orders (Opris et al., 2012), eating disorders (Ferrer-Garcia et al., 2013), phobias (Botella et al., 2014) and post traumatic stress disorder (DiMauro, 2014). Findings showed the effectiveness of VR compared to treatment as usual, but only small effect sizes when VR was compared to conventional cognitive behaviour therapy (Eichenberg and Wolters, 2012).

(Maples-Keller et al., 2017)

4 CONCLUSION

While researching this topic it was difficult to find some academic sources as the topic itself is very new. The hardware and software capable of this level of immersion in virtual environments was only developed from 2012 and brought to the consumer market in 2016. It would have been preferable to explore the Skylab 4 mutiny in more detail but most academic papers on the subject were not free. As the sources for these topics are only limited to the last few years, the sources do not have large numbers of citations. This may not be an issue as the idea behind researching these topics is to evaluate and discuss the current level of knowledge in the field at this time, even if that level of knowledge is still in its infancy.

5 ACKNOWLEDGEMENTS

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