Chanel Ramluckan Student

Bachelor of Computer and Information Sciences in Game Design and Development (BCIS)

SATCAP WP3

Virtual Reality Training Methodology

Report 1

18 August 2021

Details:

Name: Chanel Ramluckan

Role: Provide Game design expertise

Date of completion: 18 August 2021

Declaration:

- All the work provided in this document is of my own and none of it has been plagiarised.
- I have correctly cited and referenced any work or works of other people.
- This report is my own work and research.
- I have not allowed and will not allow anyone to copy my work with the intention of passing it off as his or her own work.

1. Introduction

Virtual reality (VR) can be defined as simulated virtual environments created by computer technology which places the user inside that virtual world (Bardi, 2020). Additionally, the technology simulates and enhances as many senses as possible such as touch, hearing, and seeing. The user is also able to interact with objects within that world, resulting in strong spatial immersion and experience (Bardi, 2020). Spatial immersion can be defined as the feeling of being present in a certain space or virtual world (Burridge, 2020). Burridge (2020) states that this type of immersion often results in the user being more engaged in the virtual world and thus, embody that world. Whilst VR and augmented reality (AR) seem similar, AR makes use of overlaying digital visualisations in the physical real world, whilst VR creates an entire simulated world for the user to inhabit and be apart of. Computer algorithms and sensors are used to react to any actions or movements made by the user; for instance, the user turning their head will result in the head-mounted display (HMD) reacting by changing graphics or any other elements (Bardi, 2020).

The spatially immersive world offered by VR creates an environment where trainees can practice high-risk activities and processes without being at as much risk as traditional training methods (Casey, 2021). The mining industry is dangerous as many workers carry out high-risk activities underground which can lead to severe injuries and death. Additionally, it was found that the root for many deaths and injuries that occur are a result of inadequate training methodologies and materials (Casey, 2021). Mining requires hands-on training which limits the period of time that workers can spend practicing dangerous activities and processes (Casey, 2021). Thus, VR training can expose workers to everyday mining environments and activities with a reduced amount of risk that is typically found during onsite training. Hence, a strong demand for VR training in the mining industry.

In the article, *The art of managing risk: Extraordinary results through ordinary people*, Schutte and van Graan (1996) state that various factors such as lack of employee enthusiasm and illiteracy all impact learning and training thus, making traditional classroom training techniques difficult in accomplishing the desired result -an effectively trained worker. A solution proposed by Schutte and van Graan (1996) involve simulation techniques which offers consistent and engaging training material that also requires a certain level of understanding from the workers. For instance, a worker cannot progress without completing the required action and scenario.

Therefore, the following report examines how virtual reality can be used to modernise as well as vastly improve training in the mining industry, and how game design principles can be used to further improve this training.

2. Literature review

Traditional training methods such as instruction manuals used for training are becoming more outdated as VR and AR training are moving into the working environment (Magic Activity, 2019). The mining industry is an example of this, as VR training provides many benefits such as reducing costs, remote assistance, drilling efficiency and accuracy which all increase overall safety and productivity (Malecaj, 2020). Therefore, this literature review discusses virtual reality training in various industries including the mining industry, as well as the implications of this type of training.

2.1. Industries using VR

The first known virtual reality headset was created during 1957 by a cinematographer for cinematic purposes but was then introduced to the public through video games created by ATARI (Cooke, 2017). VR was and is still mainly used by many gaming companies to provide a type of player immersion that no other medium can quite achieve. However, VR is not limited to the gaming industry. Many other industries are using VR to train workers in simulated environments with reduced injury and risk, as well as evolve their companies (Bardi, 2021).

With the use of artificial intelligence (AI) the medical field have used VR to created solutions for surgical planning, education, and efficient training for doctors and surgeons to perform detailed operations with limited to no errors (Gonzalez, 2021). Studies have shown that surgeons who go through VR training perform quicker surgeries with fewer mistakes (Bardi, 2020). Additionally, VR has enabled doctors to advise and monitor their patient’s health without in person meetings due to Covid-19. With recent interest and evolution in space exploration VR training for astronauts have become extremely important (Watson, 2020). Many astronauts rely purely on VR and AR training to properly prepare them for space travel; as other planetary environments and challenges cannot be found or physically replicated on Earth without the use of simulation (Watson, 2020). Many other industries such as aviation and the military use VR training as an alternative to constantly using expensive equipment or being involved in dangerous situations (Bardi, 2020).

These are only a few of many industries that are using VR to modernise their training and companies. Additionally, the VR market is currently valued at $17.25 billion and is expected to reach $184.66 billion by 2026 (Mordor Intelligence, n.d.). Therefore, it can be seen that VR is the future of training and provides many benefits across differing companies.

2.2. VR in mining

Virtual reality and motion capture technology are being used by Platinum mines to create and simulate environments where miners encounter real time wall blasts (Transport and Construction, 2020). The Platinum mines engaged STS3D, a local company specializing in safety training solutions for the mining industry, and STS3D partnered with Vicon, an international motion capture developer to create virtual reality (VR) training experiences.

Training was developed based on VR methodologies portrayed through gaming elements, where miners were required to engage in safe marking, drilling, and blasting (Transport and Construction, 2020). Additionally, the aim of this training required miners to correctly block off a blast wall and drill on the projected red dots under tight timing sequencing. The training makes use of some game elements and attempts to create an immersive, realistic, lived experience through virtual deaths, pieces of rock exploding, and marking red dots. One of the 'game' rules states that a miner must restart and redo the objective if the action was not carried out correctly or a fatal mistake was made (Transport and Construction, 2020). This solidifies the importance of correctly carrying out an action. Furthermore, this training uses tracking technology so guidance and assessment reports can be given in real time.

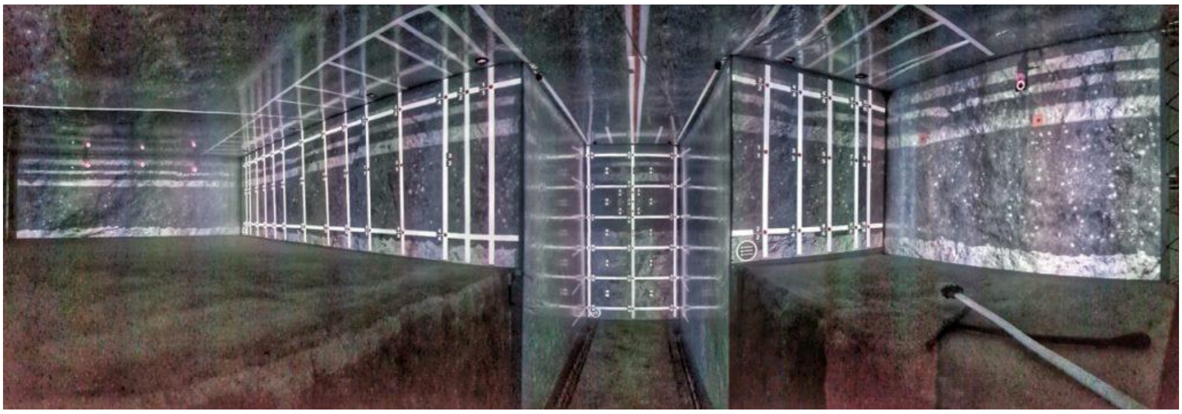


Figure 1. The above image shows the layout and VR training simulation used by STS3D.

Thus, the above demonstrates the need for VR training, how VR allows for creating simulations that attempt to replicate real life as much as possible, and can promote engagement, thus, improved learning.

2.3. VR advantages and disadvantages

As previously mentioned, VR has many benefits such as improving safety, engagement, and productivity but there are also a few more advantages to using this type of training. The spatially immersive experience that VR provides completely engages the user resulting in quicker learning and a more positive learning process. Gamified elements for further modernisation can be applied more easily to VR than AR, as an entire world is being created in VR. Furthermore, VR does not require the user to be present at the location which may reduce overall costs, and feedback and analysis can be given quickly (Casey, 2021).

In contrast, VR does have a few disadvantages which include the user becoming overly dependant on the VR training and technology. Since VR spatially immerses the user, they tend to lose a sense of self awareness which can negatively impact the training. Due to gaming elements users may underestimate any fatal mistakes made virtually which could lead to similar mistakes being made on site. Additionally, the VR equipment could cause eye strain or damage, and would need to constantly be cleaned to avoid any spreading of viruses or other illnesses (Roy, 2021).

2.4. Gaming and VR

As previously mentioned, VR was first introduced through games and still forms a large part of the gaming industry to enhance the user interface of games (Cooke, 2017). The combination of gamified elements and VR training is still a new concept and is evolving but a study conducted by Nguyen and Meixner (n.d.) showed that training videos that incorporated gaming elements resulted in higher user engagement with the software and activity, as well as better performance and memory of the activity. Thus, this re-emphasises the use of gaming elements in VR training.

3. Data gathering and insights

A mini on-line survey is to be administered, in August 2021, by the SATCAP Programme team, to get some views on digital training methodologies, including VR and AR training methodology. High-level insights will be provided, once obtained.

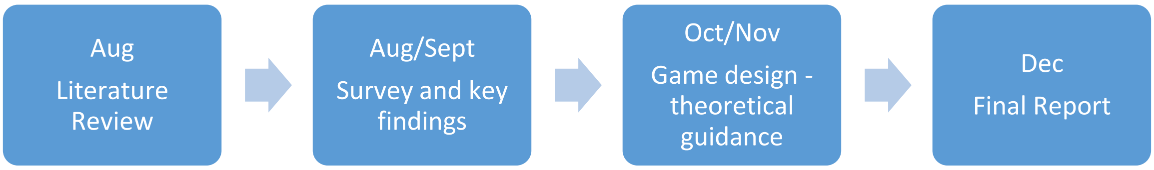
4. Game design - theoretical guidance

The Game Design theoretical guidance to be added as project progresses. This game-design theoretical guidance document may allow for game design principles, which mines may take into consideration in potentially designing for modern training. To note, the game design is provided as theoretical guidance only.

5. Conclusion

To note, utilizing VR in the workforce training requires an understanding of all the aspects of the technology and related human factors. From better learning results to improved motivation to learn, and reduced costs to larger scalability, there are compelling reasons for usage of VR training. VR training methodology should not be used exclusively for training – it may be used to support and complement other training methodologies.

Timeframes planned for completion of this report:



References

Bardi, J. (2020). What is Virtual Reality? *Marxent 3D Commerce*. https://www.marxentlabs.com/what-is-virtual-reality/. (17 August, 2021).

Burridge, M. (2020). Four Categories for Meaningful Discussion of Immersion in Video Games. *ResearchGate*. https://pure.buas.nl/ws/portalfiles/portal /1228916/Haggis_Immersion_4CategoriesInVideoGames.pdf. (16 August, 2021).

Casey, J. (2021). The Future of Mining Training is VR. *Global mining review*. https://www.globalminingreview.com/special-reports/18032021/the-future-of-mine-training-is-vr/. (18 August, 2021).

Cooke, D. (2017). When was Virtual Reality Created? *Pebblestudio.* *https://www.pebblestudios.co.uk/2017/08/17/when-was-virtual-reality-invented/*. (17 August, 2021).

Gonzalzez, W. (2021). How Augmented and Virtual Reality are Shaping a Variety of Industries. *Forbes*. https://www.forbes.com/sites/forbesbusinesscouncil/2021/07/02/how-augmented-and-virtual-reality-are-shaping-a-variety-of-industries/?sh=c6a4fed20616. (17 August, 2021).

Magic Activity. (2019). Why AR Learning is Better than Traditional Methods. *Magic Activity*. https://www.magicactivity.pk/blogs/news/why-ar-learning-is-better -than-traditional-methods. (17 August, 2021).

Malecaj. (2020). Augmented Reality Revolutionizing the Mining Industry. *VSight*. https://www.vsight.io/augmented-reality-revolutionizing-the-mining-industry/. (17 August, 2021).

Nguyen, D., Meixner, G. (2019). Gamified Augmented Reality Training for An Assembly

Task: A Study About User Engagement. *ResearchGate*. https://www.researchgate.net/publication/336071505_Gamified_Augmented_Reality_Training_for_An_Assembly_Task_A_Study_About_User_Engagement#fullTextFileContent. (17 August, 2021).

Roy, C. (2021). What are the Harmful Effects of Virtual Reality? *Law Technology Today*. https://www.lawtechnologytoday.org/2021/01/what-are-the-harmful-effects-of-virtual-reality/. (17 August, 2021).

Schutte, P. and Van Graan, J. (1996). The art of managing risk: Extraordinary results through ordinary people. *Mine Safety Digest*, vol. 8, no. 4, 1996. Mine Safety Division of Chamber of Mines Services (Pty) Ltd, Johannesburg. pp. 32–3

Transport & Construction. (2020). Virtual Reality Gaming Moves into Mine Safety Training. *Transport & Construction*. https://www.transportandconstruction.co.za/virtual-reality-gaming-moves-into-mine-safety-training/. (18 August, 2021).

Watson, T. (2020). Virtual Reality for Space Exploration and Astronaut Training. *Skywell Software*. https://skywell.software/blog/virtual-reality-for-space-exploration-astronaut-training/. (17 August, 2021).