# Introduction

Virtual Reality (VR) as a tool for treatment and education has only continued to flourish over the last few decades with research into the area being published as late as the 1990s (Strickland et al. 1996) in favour of its use as a “learning tool” for autistic children. Its application within ‘Travel Training’ research is no exception to this as can be seen in the findings of the predecessor (Sharkey et al. 2002) to this report. Travel training in this context involves the use of a VR application as a training tool to supplement the education of those with learning disabilities with the aim of helping them achieve independence with regards to solo travel.

Several studies on individuals with learning disabilities have found that they struggle with independent travel due to factors such as travel and social anxiety (**SOMETHING**). In one such study (Simões et al. 2018), they found the use of a VR travel training application to significantly reduce electrodermal activity (a metric of anxiety) with the subsequent bonus of a high success rate for the application at an impressive 93.8%.

This project aims to further build upon existing research into the use of virtual reality in relation to independent travel training. To achieve this, the project will focus on a particular question with regards to locomotion in the virtual world and of what method might cause the least amount of motion sickness in the application’s users.

Motion sickness brought about as a result of an individual’s immersion into a VR application isn’t an uncommon occurrence. One study (Munafo et al. 2017) found in an experiment involving games presented through the Oculus Rift that the “overall incidence of motion sickness” was at 56% amongst its 36 participants. Similarly, a study by () also found there to be a **SOMETHING%** amount of individuals affected by motion sickness/nausea while engaging with virtual environments.

The article by Chang et al. found that there are a few different causes for motion sickness in a VR application. These can be broken down into three main categories: “hardware”, “content” and “human factors” (Chang et al. 2020). Thus, in order to prevent scope creep this project will focus its research on elements within the hardware and content categories.

With regards to hardware, it is believed that motion sickness can be brought about due to delays generated by the latency effect present within the VR headset’s display as seen in the study by DiZio and Lackner from 1997 (as cited in Chang et al. 2020). The delay between what the user does and what is displayed to them does make for a rather disorientating experience. Fortunately, through numerous research papers over the years, several different solutions have been identified, the primary one being that improved latency rates will result in a reduction of motion sickness (study here).

However, this may not be applicable with regard to this project’s travel training target audience. This study () like most others, employs a sample of neurotypicals and thus without express investigation into its application with those who have learning disabilities it cannot be so easily concluded that lower latency would result in an improved experience. Thus, this project aims to investigate this by trialling different methods of locomotion against each with the inclusion of varying latency rates to determine whether the same applies to those with learning disabilities.

Recommendations for Methodology of VR Clinical Trials in Health Care – Albert Rizzo

Introduction

Methods – mixed methods combining qualitative + quantitative

* What will they do
  + Be provided with an OCULUS or PICO headset wherein they will enter the virtual world and be greeted by a welcome screen. From this point onwards there will be a brief tutorial on how to use the tools followed by the opportunity to pick a particular scene and method of locomotion.
  + Do we force them to use a particular one for the sake of results or do we give them the opportunity to decide?
* Where will they go
  + ISTEC Virtual Reality Room on Clifton Campus – will be under the supervision of the project supervisor, myself and their carers
* Why are they doing this
  + To answer the project’s question of what form of locomotion might be better suited for this particular training module
* Who is involved?
  + 4 NICER Group Participants???
* How will this be done?

Results

Analyses

Discussion

Your introduction should expand on the description submitted when you registered your project on the FYP site. You have the opportunity in this chapter to:

* Explain the topic and give a general overview of the project.
* Demonstrate familiarity with the background literature.
* Identify a problem(s) which is relevant to the topic
* Place the topic in a wider context.
* Identify any general implications for the project.

**Stuff:**

As this project aims to determine the most suitable method of locomotion for a walking focused travel training simulator based on feedback received from previous iterations of the application this report will look into the hardware and content areaThis is believed to be

# Aims

The primary aim of this report is to explore the viability of Virtual Reality (VR) to assist people with learning disabilities with independent travelling. This will include detailed primary research from subject experts within the field.

A subsequent aim of this report is to further build upon the existing understanding of navigation methods within the virtual world with the intention of implementing a navigation method that results in a reduction in motion sickness and an overall improved experience of the travel training virtual environment.

# Objectives

* Learn and gain an in-depth understanding of the experiences of those with learning disabilities, especially regarding independent travel through interviews conducted with subject experts within the field.
* Examine and analyse the current Independent Travel Training process by highlighting the positive impact it has had and its current limitations. Summarise these findings within the report with the inclusion of data collected from interviews with Independent Travel Trainers.
* Investigate the use of VR as an exposure therapy tool for people with learning disabilities using the library and online resources.
* Investigate the current effectiveness of VR as a Travel Training tool through comprehensive research into Travel Training studies and the predecessors to this application.
* Research the various alternative methods of navigation within the virtual world using the library and online resources.
* Design and implement a VR Travel Training application that aligns with existing research and includes new ideas to create a useful tool that can be used by people with learning disabilities to build up their independent travel confidence.
* Upon completion of the design and implementation phase of the project, conduct a series of ethical tests of the newly developed VR Application with the help of the target users, people with learning disabilities. The feedback received during testing is to be used to implement additional improvements to the overall application.
* Review and compare this project's results against its predecessors' research and draw conclusions based on the findings. Subsequently, address any remaining questions that could be explored in future work.

# Tasks and Deliverables

Identify the tasks that need to be carried out in order to complete this project. Outline the expected outcomes that this project hopes to deliver. Provide details of the expected scope of the project and which of the tasks and deliverables may or may not be within scope. List the main project milestones.

# Gantt Chart

The Gantt is a graphical representation of the tasks and deliverables listed above as well as other timed commitments you have in your final year. It is a useful tool in managing your time in your final year. Some of the milestones are certain. These include the review points and the assessment deadlines. Other timings are less certain. For example, which tasks to complete first and how long it will take to complete them. If you follow the Agile methodology when working on your project, then you will regularly review the tasks and timescales. For the purposes this planning document your Gantt chart needs to include the initial timings for: a. Project milestones (including main deliverables) b. Project tasks and deliverables including start time and duration c. Other milestones including deliverables for other modules, exams etc.

# Resources

As this project will require a wide variety of resources they have been categorised into three different categories. The first being implementation focused resources for the project. These include resources that are needed to support the development cycle of the actual virtual travel training model.

* 3DS Max – Build up the 3D models as we’ve been given access to it via university
* Unreal Engine 4/5 – Good for virtual reality world building (previous projects have used this too)
* Photoshop or Pixlr – Editing textures and creating materials with the aim of achieving realism

Testing resources:

* NICER Participants group – Individuals with learning disabilities that would form the report’s sample group
* Access to the virtual reality lab in ISTEC – Need enough space to conduct the testing

Information Sources:

* Google Scholar – Insert research here about the credibility of the search engine?
* Library One Search – Another good resource to access articles of research that are locked behind a paywall
* Connected papers – Find interconnected papers

# Risk and Mitigation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Risk Description** | **Probability**  **(1 – 5)** | **Severity**  **(1 – 5)** | **Impact**  **(Low – High)** | **Mitigative Action** |
| 1. | Insufficient knowledge and background research of virtual reality or travel training methodologies. | 1 | 4 | High | All the necessary background research will be conducted prior to the implementation of the solution through a wide variety of sources as highlighted in the Resource section of this document. |
| 2. | The project suffers from scope creep due to objectives not being well-defined and thus the project becomes too complex. | 2 | 5 | High | Clear objectives will be established during the early stages of the project and with the use of Agile methodology, any required changes will be thoroughly and frequently reviewed prior to approval. |
| 3. | The chosen resources are not suitable for the project. | 2 | 3 | Medium | A thorough review of the required resources will be conducted and a justification will be provided based on research done prior to the start of the project. |
| 4. | The project suffers from a time crunch due to poor scheduling. | 2 | 5 | High | A Gantt chart will be used to map out key deliverable dates and will include the necessary flexibility in case a certain element requires more time than previously anticipated. |
| 5. | Loss of some or all of the project’s 3D assets. | 2 | 4 | High | All assets will be backed-up via a hard drive in addition to being stored on a private GitHub repository. |
| 6. | Loss of some or all of the project’s documentation. | 2 | 4 | High | All documentation will be backed-up via a hard drive in addition to being stored on a private GitHub repository. |
| 7. | Loss of some or all parts of the Unreal Engine project files. | 2 | 4 | High | All Unreal Engine project files will be backed-up via a hard drive in addition to being stored on a private GitHub repository. |
| 8. | Equipment malfunctions during the testing stage | 3 | 5 | High | All equipment will be tested a day prior to the actual testing session in addition to being tested once again before the session begins to ensure everything is still functional. A backup set of equipment will be prepared when possible. |
| 9. | A major bug is found during the testing stage. | 2 | 3 | Medium | The project will have two testing phases in which the initial one will be used to gather feedback from the clients on any bugs or requirements that they would like the project to address. |
| 10. | Due to the shared use of Virtual Reality headsets and gear, participants might be at risk of COVID-19. | 3 | 3 | Medium | All equipment will be sanitised before and after each testing session in addition to being sanitised between use by testing participants. All participants will also be asked if they’ve had any symptoms prior to joining the testing session. |
| 11. | Participants experience some form of headache or eye strain as a result of extended use of the VR application. | 3 | 2 | Low | Participants’ time spent immersed within the application will also be limited as a means of reducing the probability of the risk’s occurrence. |
| 12. | Participants experience some form of motion sickness, nausea or vertigo as a result of the VR application. | 3 | 2 | Low | A discussion will be had with the participant before, during and after the testing stage to identify and mitigate any risks. Their well-being will be monitored with the aim of spotting any adverse or negative reactions to the application during the session. Participants’ time spent immersed within the application will also be limited as a means of reducing the probability of the risk’s occurrence. In the case they do experience any of the risk’s symptoms, they will be invited to have a break and given the opportunity to continue on later once they have recovered. |

# Legal, Social, Ethical and Professional Issues (LSEPIs)

It is essential that any project considers the Ethical issues that relate to the project. Ethics are the consideration of how your project effects people and society in any way. It is unlikely that your project will not have an impact on the wider society in some way. You need to consider these issues for both the outcomes of the project and for the way in which you carry out your project.

* Legal issues: any area of computing related legislation (Data Protection Act, Computer Misuse Act, Freedom of Information, ….)
* Social issues: areas that impact on society (home, education, workplace), welfare and surveillance.
* Ethical issues: safeguarding (DBS), Health and safety, risk assessment
* Professional issues: observing professional competence and integrity by observing the rules, standards and conventions of the profession.

The importance of this section in your planning document is emphasised by the fact that a failure will fail the whole PPD assessment.

* Explain the LSEPIs that relate to your project outcomes
* Explain the LSEPIs relating to the process of carrying out your project.
* Specifically, will the research that you carry out have any effect on people?
* As well as completing this section in your PPD all students will also need to complete an Ethical Issues Declaration form (submitted with your Review Point 1 form).

This form helps to identify if additional Ethical approval is required to carry out your project. Further information on the BCS code of conduct is available at: <https://www.bcs.org/membership/become-a-member/bcs-code-of-conduct/>

# New ideas

Methods of navigation that are relevant to this report's focus on travel training have been broken down into two primary categories of analysis: easily accessible and financially unviable.

**Accessible options:**

* Steering wheel to walk (original tech available)
* Teleportation (defeats the purpose – we need walking simulation)
* Walking around in an open space (we don’t have that much-unrestricted space to work with)
* Walking via the swinging of one's arms (existing project's solution)
* Low-latency VR games: Latency refers to the amount of time it takes for an in-app motion to register in the brain. The lower the latency, the less delay there is between what’s happening and your brain’s perception of it.
  + Low latency mixed with walking in place to combat the existing sickness – use this combination and compare it against the current solution and the original use of walking in place to see which one is far more effective at reducing motion sickness.

**Inaccessible options (due to financial constraints):**

* Omnidirectional Treadmills: Perhaps the most financially unviable option as they are quite expensive but would allow for a full range of motion within a set area – a player would be able to walk about ‘freely’ within the virtual world like they would in real life.
* VR Mats: A mat that relies on your sense of touch to keep you within a contained area while immersed in the virtual world.
* Cyber-shoes: These work similarly to VR treadmills, except you wear them while sitting.

# Research Methodology

* Participatory Design versus User Centric Design

Approach to Testing

* Compare Hardware – Oculus vs PICO – Does hardware determine the level of motion sickness? Let’s find the better option between the two
* Using published measurement tools – SSQ (Simulation Sickness Questionnaire) and the FMS (Fast Motion Scale)

References

Chang, E., Kim, H.T., Yoo, B., 2020. Virtual Reality Sickness: A Review of Causes and Measurements. *International Journal of Human-Computer Interaction*, pp.1658–1682. 10.1080/10447318.2020.1778351.

Munafo, J., Diedrick, M., Stoffregen, T.A., 2017. The virtual reality head-mounted display Oculus Rift induces motion sickness and is sexist in its effects [online]. *Experimental Brain Research*, 235(3), pp.889–901. Available at: https://link.springer.com/article/10.1007/s00221-016-4846-7 [Accessed 2 October 2022].

Sharkey, Paul. et al., 2002. *The 4th International Conference on Disability, Virtual Reality and Associated Technologies : proceedings : 18 to 20 of September, 2002, Veszprém, Hungary.* ICDVRAT & The University of Reading.

Simões, M. et al., 2018. Virtual Travel Training for Autism Spectrum Disorder: Proof-of-Concept Interventional Study [online]. *JMIR Serious Games 2018;6(1):e5 https://games.jmir.org/2018/1/e5*, 6(1), p.e8428. Available at: https://games.jmir.org/2018/1/e5 [Accessed 2 October 2022].

Strickland, D. et al., 1996. *Brief Report: Two Case Studies Using Virtual Reality as a Learning Tool for Autistic Children 1*.