Literature Review

Road Accidents/Fatalities:

On average, in Great Britain, 5 people die per day on the road and many more are injured [1]. There are many different determining factors in these accidents that need to be explored, what are the main causes of road accidents and what percentage of those is the driver at fault? See [2], where speeding and distractions (both areas that can be easily explored in this project) make up nearly 50% of the causes of fatalities on the road. This is the area that needs to be focused on, because the aim of the project is to provide more data into what could potentially cause a driver to have an accident and data into what technology could potentially prevent a driver from causing an accident.

A list of the various reported causes of road traffic accidents [3] lists “driver failed to look properly” as the number 1 reported cause, which is not something that can be easily fixed with software/hardware (apart from self-driving vehicles). However, number 2 is “driver failed to judge the other persons path or speed” which is something that can be very easily tested within this project, and there is high potential for hardware feasibly being able to fix this problem. For example: in the project I could simulate two different scenes – one where there is no indicator of the car in front slowing down, and another where there is an audio (beep) and visual (red light) stimulus for when the car in front is slowing down significantly – then check how quickly the test subject reacted to the car in front slowing down for both scenarios. If there is a significant improvement with reaction times and braking times with the audio and visual stimulus then there is good evidence to suggest that if a company created that technology it would reduce road traffic accidents, as that is the number 2 reported cause.

In regards to other variables to look out for, see [4] where fatigue is focused as a large potential source of accidents in general (including driving accidents). It notes that variables that could be the key cause of fatigue: age, sex, race, socio-economic status, and marital status – are mainly used as descriptive terms (independent of the study) rather than confounding ones. They recommend to record this demographic data of subjects and include these variables within the datasets to help with future research. Further data [5] suggests that you are three more times likely to be in a car crash if you are fatigued and that driver reaction times, awareness of hazards, and general attentiveness is worsened by driver fatigue.

A previous driving virtual reality simulation study was done [6] on subjective risks of driving behaviour – it found that the risk perception of the driver in a specific driving scenario is a key factor in whether they will crash or not. Independent of driver skill, those who crashed were more confident in their success of correctly performing a difficult manoeuvre, hence chose to try and drive through tighter gaps, than those who did not crash.

Virtual Reality:

Some users report to have motion sickness (nausea), loss of spatial awareness, and/or dizziness while using Virtual Reality devices. To quote [8] “The makers of the most popular VR headsets, the Oculus Rift and HTC Vive, recommend taking at least a 10 to 15-minute break every 30 minutes, even if you don’t think you need it”. Hence, I should be tracking the time that each participant takes and make sure that I design the experimental simulations to last less than 30 minutes per person (For example: Three 5-minute simulations, with a minute in between) in order to lower the risk of a subject getting sick due to my experiment. A project [7] on a motion sickness measurement index in a virtual reality environment developed a Virtual Reality Sickness Questionnaire (VRSQ), a variant on a Simulation Sickness Questionnaire (SSQ), which could be used in testing to check whether my application consistently makes users feel ill or not (as that could definitely become an unwanted factor on the results). Also see [9] where the study suggests women in particular are affected by motion sickness in the oculus rift more than men are – another factor to take into account. [11] lists the potential causes of motion sickness within virtual reality experiences, and suggests potential solutions including: ambisonic sound to match the sense of movement, letting users rest between scenes, adding rest frames (fixation points) for users to be able to

focus on, reducing virtual rotations, and reducing angular velocity. The majority of these concepts can be applied to my project and should be considered when designing the application.

Another factor that could affect the results of the project is whether a dangerous situation (potential car crash) is treated as a serious situation within a virtual reality environment. A study on psychological responses to an emergency in virtual reality [10] suggests “a virtual emergency can be staged in a virtual environment since users would acknowledge it as such” from their results, which adds credibility to any potential results I get from my experiment. The study also goes into racial discrimination in a virtual reality situation but that is not relevant to my project.

References:

[1] https://www.brake.org.uk/facts-resources/1653-uk-road-casualties - Brake UK 2017 report on road casualties.

[2] https://www.aceable.com/safe-driving/car-accident-statistics/ - Aceable US driving fatality data (2007 – 2012).

[3] https://www.regtransfers.co.uk/content/common-causes-for-road-accidents-in-britain/ - latest statistic from the department of transport (in Britain) for the most common causes of road traffic accidents (published 2nd July 2018).

[4] https://www.sciencedirect.com/science/article/pii/S0001457509003327 - Accident Analysis & Prevention (Volume 43, Issue 2, March 2011, Pages 516-532)

[5] https://www.nsc.org/road-safety/safety-topics/fatigued-driving#:~:targetText=A%20study%20by%20the%20AAA,times%20the%20police%2Dreported%20number.&targetText=NHTSA%20estimates%20fatigue%2Drelated%20crashes,annually%2C%20not%20including%20property%20damage. – National Safety Council article on “drowsy driving” (2019)

[6] https://www.sciencedirect.com/science/article/pii/S0001457513003497?via%3Dihub - Accident Analysis & Prevention (Volume 62, January 2014, Pages 63-78)

[7] https://www.sciencedirect.com/science/article/pii/S000368701730282X - Applied Ergonomics (Volume 69, May 2018, Pages 66-73)

[8] https://www.businessinsider.com/virtual-reality-vr-side-effects-2018-3?r=US&IR=T#loss-of-spatial-awareness-1 – Business Insider “Here's what happens to your body when you've been in virtual reality for too long” by Kaylee Fagan (Mar 4, 2018, 4:00 PM)

[9] https://search.proquest.com/docview/1877838144?accountid=17256&rfr_id=info%3Axri%2Fsid%3Aprimo - Experimental Brain Research (Volume 235, Issue 3, Pages 889-901)

[10] https://www.sciencedirect.com/science/article/pii/S0747563215000540?via%3Dihub - Computers in Human Behavior (Volume 48, July 2015, Pages 104-113)

[11] https://uxplanet.org/motion-sickness-in-vr-3fa8a78216e2 - Motion Sickness in VR by Anastasiia Ku (Nov 29, 2018)