UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON DRIVER BEHAVIOUR IN PRE-CRASH SCENARIO INVOLVING PEDESTRIAN AND MOTORCYCLE BY USING UC WIN ROAD SOFTWARE

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DECLARATION

I declare that this Choose an item. entitled "Study On Driver Behaviour In Pre-Crash Scenario Involving Pedestrian And Motorcycle By Using Uc Win Road Software" is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : *Ahmad Abdullah Bin Muhamad*

Date : *10 JANUARY 2023*

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

Signature : Hazwani

Supervisor Name : *Dr. Nur Hazwani Binti Mokhtar*

Date : *10 JANUARY 2023*

DEDICATION

I dedicate my dissertation work to my family and all my friends. Enormous gratitude to my father,Muhamad Bin Doraman, who believe in me and always encourage me to be self-assured. I also dedicate this report to my entire BMMA KOHORT 9 classmate, who provided me with numerous ideas and tips throughout the semester to help me improve my report. Not forgetting to all my lecturers who had taught and gave a knowledge directly or indirectly. Last but not least, thousands of thanks to my PSM supervisor, Dr.Nur Hazwani Binti Mokhtar, always guided me to finish these thesis.

ABSTRACT

Driving simulators are widely used around the world for many purposes. The main purpose of the driving simulator is commonly for research, such as a study on road safety in Malaysia. In Malaysia, road accidents have increased over the last ten years. Meanwhile, the number of fatalities has been steadily decreasing since peaking at 7,152 in 2016 and dropped to its lowest point of 6,167 in 2019. Basicaly, this research is to analyze the market survey, design, develop and study driver's behaviour reaction time, braking time, and participant mental workload using NASA Task Load Index (TLX) based on driving simulator pre-crash scenario on UC Win Road Software. Based on previous research, certain things have been studied, such as validating a driving simulator for research into human factors issues on automated vehicles. The main findings of this research are to get information from society about the driving simulator product preferences and specifications and driving behaviour based on virtual reality to obtain data on recognition time and braking time. Besides that, to obtain workload from participants in experiment. The method used in this research is by conducting a survey questionnaire based on driving simulator product preferences, creating pre-crash scenarios consisting of pedestrian and motorcycle scenarios and providing a NASA TLX questionnaire to determine the participant workload involved in the experiment that has been conducted. The result from this research states that the speed of an object oncoming toward the driver influences the driver's behaviour based on recognition and braking time. As for the workload before and after the experiment conducted based on NASA TLX shows that the null hypothesis is accepted based on the t-test as there is no connection between workload before and after the experiment. In conclusion, the driving simulator can measure driver behaviour based on reaction and braking time.

ABSTRAK

Simulator memandu digunakan secara meluas di seluruh dunia untuk pelbagai tujuan. Tujuan utama simulator pemanduan biasanya untuk penyelidikan, seperti kajian tentang keselamatan jalan raya di Malaysia. Di Malaysia, kemalangan jalan raya telah meningkat sejak sepuluh tahun yang lalu. Sementara itu, jumlah kematian semakin berkurangan sejak memuncak pada 7,152 pada 2016 dan menurun ke tahap terendah iaitu 6,167 pada 2019. Pada asasnya, penyelidikan kami adalah untuk menganalisis tinjauan pasaran, mereka bentuk, membangun dan mengkaji masa tindak balas tingkah laku pemandu, masa brek , dan beban kerja mental peserta menggunakan Indeks Beban Tugas NASA (TLX) berdasarkan senario pra-crash simulator memandu pada Perisian UC Win Road. Berdasarkan kajian terdahulu, perkara tertentu telah dikaji, seperti mengesahkan simulator pemanduan untuk penyelidikan isu faktor manusia pada kenderaan automatik. Penemuan utama penyelidikan kami adalah untuk mendapatkan maklumat daripada masyarakat tentang pilihan dan spesifikasi produk simulator pemanduan dan tingkah laku pemanduan berdasarkan realiti maya untuk mendapatkan data mengenai masa pengecaman dan masa brek. Selain itu, untuk mendapatkan beban kerja daripada peserta dalam eksperimen kami. Kaedah yang digunakan dalam penyelidikan ini ialah dengan menjalankan soal selidik tinjauan berdasarkan keutamaan produk simulator memandu, mewujudkan senario pra-rempuh yang terdiri daripada senario pejalan kaki dan motosikal serta menyediakan soal selidik NASA TLX untuk menentukan beban kerja peserta yang terlibat dalam eksperimen yang telah dijalankan. Hasil daripada kajian ini menyatakan bahawa kelajuan sesuatu objek yang datang ke arah pemandu mempengaruhi tingkah laku pemandu berdasarkan pengecaman dan masa brek. Bagi beban kerja sebelum dan selepas eksperimen yang dijalankan berdasarkan NASA TLX menunjukkan hipotesis nol diterima berdasarkan ujian-t kerana tiada kaitan antara beban kerja sebelum dan selepas eksperimen. Kesimpulannya, simulator pemanduan boleh mengukur tingkah laku pemandu berdasarkan tindak balas dan masa brek.

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DOF	-	Degree of freedom
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CHAPTER 1

INTRODUCTION

1.1 Background

Driving simulator is a tools that use to make a research for example to study car accident on the road that provide realistic, safe and controlled environment. Driving simulation system is typically represented by a vehicle driving simulator. It conducts manned simulation and research, including vehicle driving behavior, dynamic performance, and traffic systems, using electronic computer images with the help of electronic control and other technical support. Over the last 40 years, advances in technology have enabled higher-quality computer processing and graphics, as well as more sophisticated and precise control devices. The majority of simulators are now dynamic, with the driver's actions causing changes in the driving environment. Current simulators can include elements like controllable traffic, various road users (vehicles, motorcycles, bicycles, pedestrians), and interactive modifiable features like billboards and railway level crossings. These elements can be programmed to modulate in response to the driver's actions or as a pattern that the driver must respond to traffic simulation modelling integration into the driving simulator. (Jeihani et al., 2017).

Although, driving simulator provide safe and realistic results as real world driving it is expensive and high cost. Driving simulators have been used extensively in research on intelligent vehicle control, road traffic facilities, and intelligent transportation systems up until now. They've evolved into a useful tool for studying human efficiency, civil engineering, traffic engineering, psychology, and other related fields.(Wynne et al., 2019)

1.2 Problem Statement

In Malaysia, the number of road accidents has increased over the last ten years. Meanwhile, the number of fatalities has been steadily decreasing since peaking at 7,152 in 2016 and reaching its lowest point of 6,167 in 2019. The identification of various risk factors, including road conditions, is required for the development of effective strategies to reduce such fatal accidents. Road tests may be impossible in some countries due to liability concerns. Road tests are frequently allowed only after a first simulation of potentially dangerous situations. In many countries, for example, it is illegal to conduct a roadside investigation into the effects of alcohol or drugs on driving performance.

Besides safety concerns, driving simulator that available in market is expensive and high cost. Simulator fidelity is only half of the equation when comparing simulators to real-world driving. The operational definition of "real-world" driving is another factor that influences the comparison of simulated and real-world driving. Self-reported driving behaviour (e.g., Ba et al., 2016; Szlyk et al., 1992), allied health assessments (e.g., Lauridsen et al., 2016; van Wolffelaar et al., 1988), and on-road drives in instrumented vehicles are all mentioned in the literature (e.g., Helland et al., 2016).

1.3 Research Objective

Specifically, the objectives are as follows:

a) To design, develope and analyze questionnaire study to determine user requiremant on driving simulator

b) Design and developed scenario including, road condition and surrounding by using UC-Win Software.

c) To analyse the driver behaviour in term of reaction time and braking time in various scenario and pre crash scenario.

d) To compare driver workload before and after in the experiment.

1.4 Scope of Research

The scope of this research are as follows:

a) Study limited to driving simulator and not a real driving

b) Study limited to pre-crash scenario on pedestrian and motorcycle.

c) Limitation on reaction time and braking time.

d) The experiment and questionnaire is conducted at Melaka, Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Simulators are a standard tool for studying driving habits because they provide a realistic, safe, and controlled environment. Driving simulators frequently use in research, and there is only a little evidence confirming their validity. There is also a comparison of how accurately driving simulators are compared to real-world driving. Simulators were first originally developed (Lauer, 1960). Researchers have widely used them to study a variety of driver behaviours, including the effects of technologies, devices, and road infrastructure, ranging from variable message signs (e.g., Comte and Jamson, 2000) and in-vehicle systems (e.g., Abe and Richardson, 2005; Lin et al., 2009) to mobile phone use (Choudhary and Velaga, 2019). The validity and reliability of the apparatus, that is, the extent to which they accurately and consistently represent real-world performance is an issue with any laboratory-based experiment. Based on the driving simulator, reliability refers to the ability of a simulator to evaluate consistent results over time. Validity refers to the ability of a simulator to represent real-world driving accurately. There are two types of validity which are absolute validity and relative validity. Absolute validity is when the values obtained in a simulator (for example, speed or lateral position) match those obtained in an actual vehicle in absolute terms. Absolute validity requires a direct comparison of simulated and real-world driving, with statistical tests showing no significant difference between the values for the two types of driving. Relative validity occurs when the results of simulator driving show the same effects as real-world driving.

2.2 Type of Driving Simulator

2.2.1 Train Simulator

There are several type of driving simulator that are in use such as train simulators (Figure 2.1), bus simulators, car simulators, truck simulators, etc. Besides that, there are also modular design simulator and multi driving simulator. Modular design simulator can be configured for use as dump trucks, tractor, and other construction transports, airports operated vehicles, emergency response and police vehicles chase, buses, subway trains, passenger vehicles and heavy equipment such as cranes. Next, multi-driving simulator station allows one to train more driver instructors in a limited time. The system is equipped with an instructor station that allows centralized control of all the driving stations. The advantage of this type of system is that a coach can guide several students driving at the same time thus saving time and reducing costs.

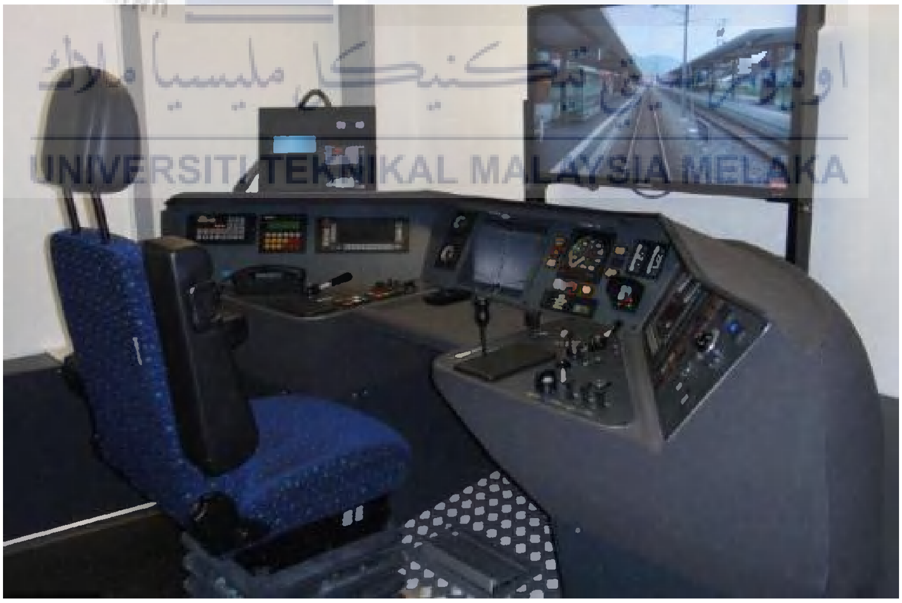

Figure 2.1 Train simulator (Locsim – Führerstand-Simulatoren, n.d.).

2.2.2 Static, 2DOF, 3DOF and 6 Driving Simulator

Next, there are also static driving simulator (Figure 2.2) and motion type of driving simulator such as 2DOF (Figure 2.3), 3DOF and 6DOF (degree of freedom) (Figure 2.4) which is more realistic to real-world driving. Degree of freedom of this simulator describing how something moves in relation to a set of fixed parameters (consider x and y-axis on a graph, except in 3-dimensions). To put it another way, it categorizes how something moves. In total, there are 6 degrees of freedom, and as said above, each of these essentially represents a different type of movement such as elevation, strafing, surging, yawing, pitching and rolling. First, elevation when driving on an uneven surface, your tires will rise and fall as they pass over the undulating surface. The elevation is represented by this vertical displacement. Second, strafing is movement on the horizontal axis (left or right, or 'laterally'). Whenever you turn a corner, inertia means you are pushed into the side of your seat. Third, surging forward and backward motion. Acceleration 'pushes' you back into your seat, while braking/deceleration 'pushes' you out of your seat. Fourth, yawing (oversteer) where the rear axle slides, simulating traction loss at the rear, which consequently changes the direction of motion of the car. Fifth, pitching (tilting forward and backwards) nose of the car dip down and the rear of the car lift up, as the weight of the car is transferred over the front axle. Lastly, rolling which involves the car pivoting on one side. Also consider body roll in a car. In the context of a motion platform, it will tilt from side to side to simulate roll.

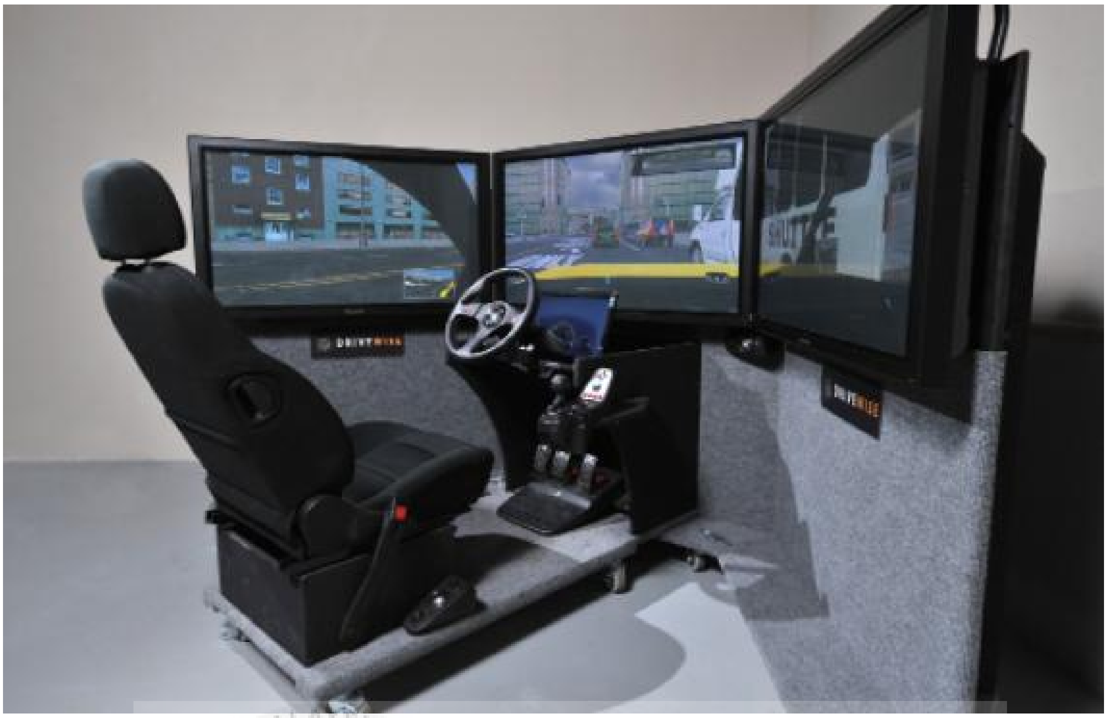

Figure 2.2 Static Driving Simulator (*What Can Driving Simulators Contribute to Driver Training?*.n.d.).

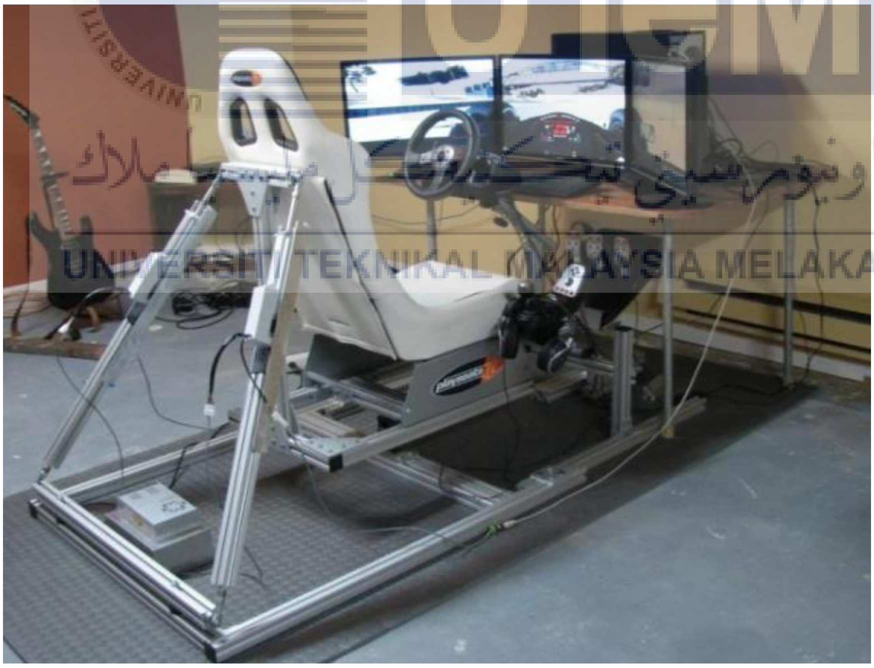

Figure 2.3 Driving Simulator 2DOF (e.g. Parker2005).