UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF RIG AND DRIVING SIMULATOR

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Univerisiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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Supervisor : DR NURHAZWANI BINTI MOKHTAR

ABSTRAK

Pemanduan simulasi adalah unit operasi, yang membolehkan pengguna berinteraksi dengan skrin komputer dengan cara yang hampir dengan dunia sebenar. Pemanduan simulasi digunakan adalah kerana, jauh lebih selamat daripada ujian dalam situasi memandu dunia sebenar, ia boleh menjadi lebih mudah untuk mengumpul data memandu dari setiap ujian, ia adalah cara yang lebih murah untuk menguji kenderaan baru sistem dan ia memberi pilihan untuk membina semula keadaan pemanduan tertentu. Tujuan penyelidikan adalah untuk merekabentuk dan membangunkan pemanduan simulasi dengan antropometri tempatan untuk mengkaji tingkah laku dan keselesaan pemandu. Pembangunan projek ini adalah kerana, kesusahan dalam penyelidikan tingkah laku dalam pemanduan sebenar yang berbahaya dan kerana pemanduan simulasi yang beradi di pasaran tidak sesuai dan memerlukan kos yang tinggi. Pengeluar kereta menggunakan garis panduan dan reka bentuk standard di seluruh dunia. Walau bagaimanapun, penggunaan garis panduan sedemikian yang dibangunkan mengikut orang Amerika yang didapati tidak sesuai dengan anthropometri dan kedudukan penduduk Malaysia. Kajian ini bertujuan untuk mengatasi masalah ini dengan melihat piawaian sedia ada dan mencadangkan parameter reka bentuk baru yang lebih sesuai dengan antropometri tempatan. Dari kajian mendapati penduduk Malaysia lebih rendah berbanding data standard SAE J833. Pengumpulan data tempatan digunakan untuk membangunkan pemanduan simulasi untuk digunakan sebagai medium pengajian dan penyelidikan di masa akan datang.

ABSTRACT

A driving simulator is an operation unit, which allow the user to interact with a computer screen in a way as close to the real world as possible. Different reasons exist for using a driving simulator, some of these are that it is a lot safer than testing in a real world driving situation, it can be easier to collect driving data from each test, it is a cheaper way of testing new in vehicle systems and it gives the option to reconstruct specific driving situations. The purpose of the research is to design and develop rig and driving simulator which fit local anthropometry for further research study driving behavior and comfort. The development of this project is because, the distress on study driving behavior in real driving which is dangerous and unreliable driving simulators on the market which lead the development of driving simulator. The correct identification of a sitting position and position accommodation is one of the key elements for an ergonomically designed driver workspace. The current practice of car manufacturers uses standard practice and design guidelines globally. However, the use of such guidelines developed according to North American people found are not fit the local sample anthropometry and stature. This research aims to tackle this problem by looking at existing standards and proposing a new design parameter that is better suited to local anthropometry. From study found the local sample is shorter as compared to the SAE J833 standard. The local data collection used to develop driving rig simulator to be test on further research study.

DEDICATION

Every challenging works need efforts as well as guidance of beloved parents who close were especially close to our heart. My humble effort I dedicate to my sweet loving and caring parents.

Father and Mother,

Whose affection, love, encouragement, hard works and prays of day and night make me able to get success and honour,

Along with all the hardworking and respected teachers and lecturers including my final year project supervisor Dr Nurhazwani Mokhtar and also my friends who supports.

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LIST OF ABBREVIATIONS

Missouri S&T	Missouri University of Science and Technology
LCD	Liquid Crystal Display
NADS	National Advanced Driving Simulator
HMI	Human Machine Interface
SHERPA	Systematic Human Error Reduction and Prediction Approach
PBRT	Perception Brake Reaction Time
UTeM	University Technical Malaysia Melaka
US	United States
PVC	Polyvinyl chloride
EDS	Ergonomic Design Score
SAE	Society of Automotive Engineers
MS ISO	Malaysia Standard International Organization for Standardization
PC	Personal Computer
pcs	pieces
mm	millimetre
cm	centimetre

CHAPTER 1

INTRODUCTION

1.0 Background

A driving simulator is an operating device that enables the user to interact with a monitor screen as actual as possible to the real world. Various levels of driving simulators may be used, from very advanced movement control and a 360 degree viewing angle driving simulators, to simple, fixed-base movement simulators with a single screen in front of the user. A driving simulator can be used for various purposes such as assessing new cars in the car industry, testing new in vehicle assistance systems or training. There are many reasons for using a driving simulator. Some of them are that testing in a real world driving situation is much safer, driving data can be collected more easily from each test, new in car system can be tested cheaper and certain situations can be reconstructed.

The advance in the setup should be determined when developing a driving simulator. On a general basis, a very advanced driving simulator would be expected to achieve the best results in realistic terms. But the very advanced driving simulators are also very expensive and take huge hours to build and maintain. Therefore, it is necessary to consider how advanced you need a driving simulator to meet your testing requirements. This research describes how a driving simulator is developed and assesses the user driving experience. The aim was to develop a low budget drive simulator that would give the configuration and software a realistic impression.

1.1 Problem Statement

Driver workspace is a critical element in designing a vehicle. Driver workspace give impact to the driver comfort and driving behaviour. There is a standard data measurement in designing workspace which is SAE J833:1989. Basically the standard data measurement is from the sample of North American. Therefore, the aim of this study is to to evaluate the existing standard data and prove that it is not suitable for the local anthropometry which can lead to the discomfort and make it hard for the drivers to achieve the right posture.

The research will start by studying on local anthropometry and compare with the standard data SAE J833: 1989 thus design and develop a driving simulator that fit the local anthropometry measurement.

1.2 Objective

The objectives of this research are as follows:

1. To study on local anthropometry measurement for driving simulator.
2. To design rig and driving simulator for local anthropometry.
3. To develop rig and driving simulator for further research study in driving behaviour and comfort.

1.3 Scope of Project

The scope of this project is to help on study of driving behaviour and comfort by developing driving simulator for local society with studying on local anthropometry data, designing rig for driving simulator and analysis driving simulator.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

The literature review can be categorizing into three main categories which is the anthropometric design study, driving simulator and the rig design and materials to develop driving simulator. The first part of literature review is anthropometric study about human physical dimension parameters. The second part of literature review is driving simulator which cover subtopic about types of driving simulator, the application of driving simulator and the current study that use driving simulator. Driving simulators are utilized to recreate situations intended to depict reality in the most ideal manner. A common challenge to develop driving simulators is usually the effort you need to put into developing the simulator to create the most realistic representation of an actual world scenario. Many previous article regarding driving simulators were concerned about developing advanced components such as motion control, specifically improving sound realism, creating 360 degree viewing angle, seating position and accommodations where these elements take a lot of effort. The last part of this literature review is rig design and materials to develop the driving simulator. The flowchart below in Figure 2.1 shows that the subtopic which cover in this chapter.

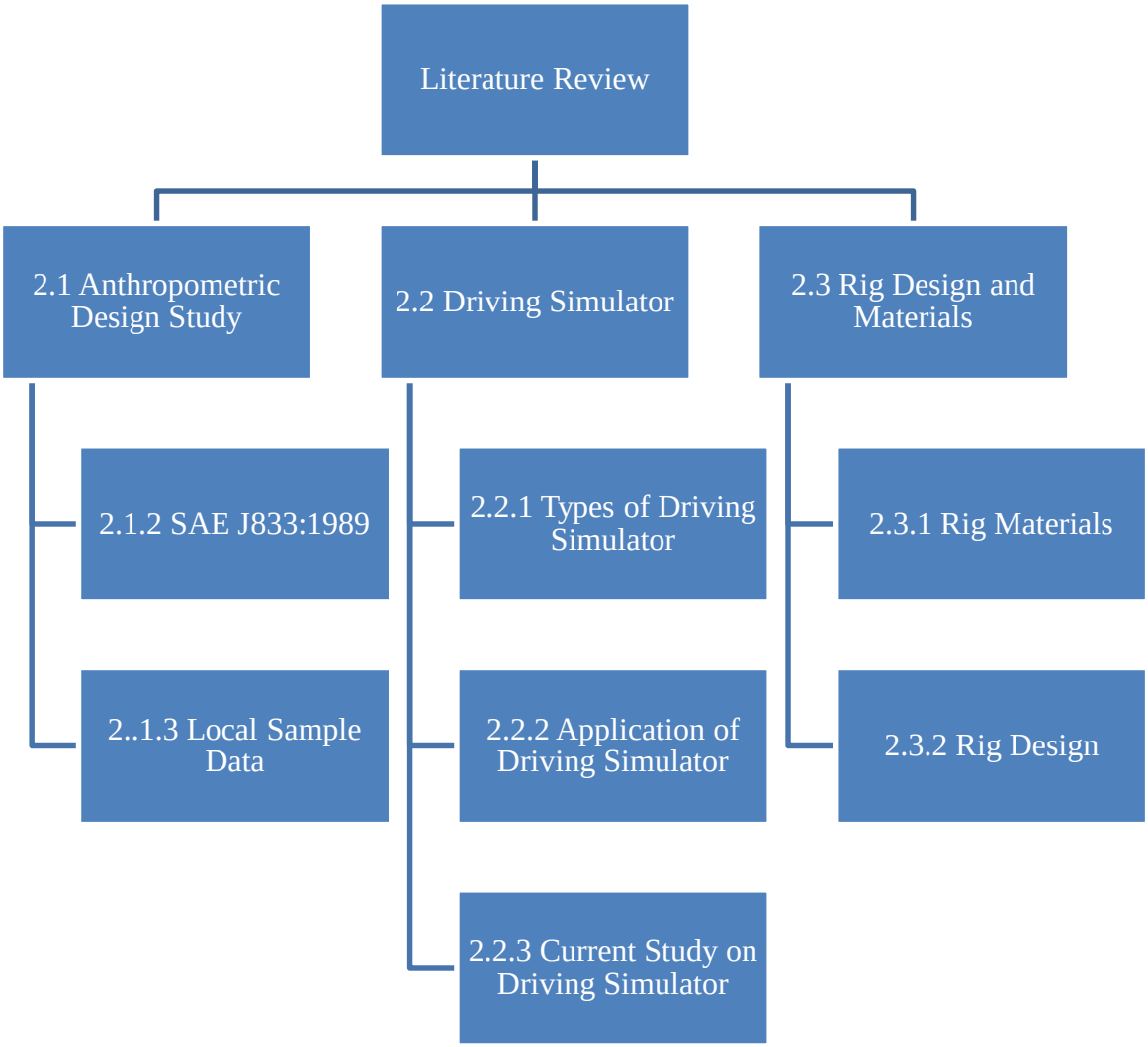

Figure 2.1: Literature review flowchart

2.1 Anthropometric Design Study

Populations are classified by size in anthropometric dimension, which is usually described as percentile (Zulizam, 2017). This is obtained by defining the range from the smallest 5th percentile, normally the 5th percentile for women to the largest 95th percentile, usually the 95th percentile for males as illustrated in Figure 2.2.

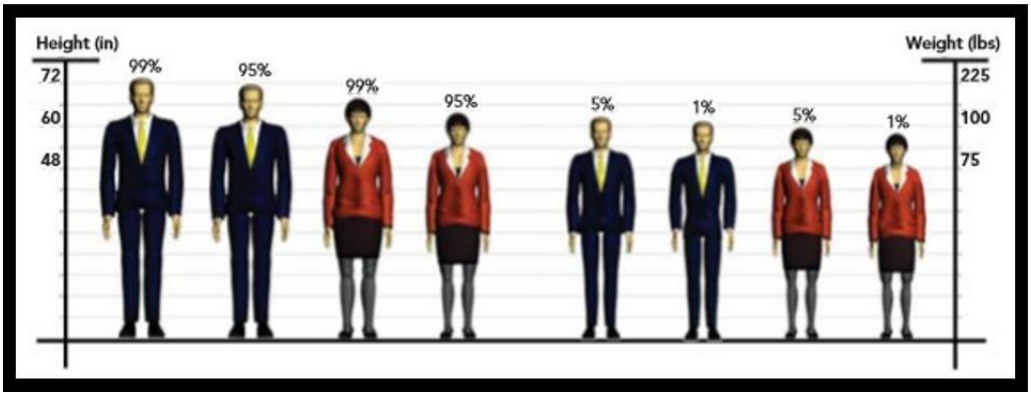

Figure 2.2: Relative sizes of different human percentile (Source: Local Journal of Public Health Medicine 2018)

Anthropometry is essential when it comes to product and workplace variations. Anthropometric data varies significantly from region to region. The Scandinavian population, for example, tends to be larger than the Asian and Italian populations (Openshaw and Taylor, 2006). Anthropometry is a science which measures the range of sizes in the body of an individual, and the wide range of sizes contributes to the body (Openshaw and Taylor, 2006).

The two main contributing factors to body size variations are usually sex and race. (Fatollahzadeh, 2006). Therefore, many countries make great efforts to establish anthropometric databases for different populations such as civilians, the military, staff students and workers. In addition, ethnic diversity can also be an important factor for a particular country in terms of its usefulness and anthropometric data in a certain region.

The variations in body dimensions of different groups can be found in total body size and body proportions according to Pheasant (1996). Since natural postures and movements are based on the trunk, arm and leg position, it is important that the workplace is adapted to the operator's body size (Grandjean, 1988; Fatollahzadeh, 2006).

The anthropometric dimensions of stature and sitting height are the most typical distinction between ethnic groups. Another significant ethnic difference is the ratio of body size or proportion. Body proportion is a ratio of scaling between one dimension of the body and one specific reference dimension.

A Li et al. (2004) study found that, even if from the same region, significant differences exist between the body and body size of the East Asian populations (Japanese, Chinese, Korean and Taiwanese). The Chinese people were found to have a small torso with moderate limbs, whereas the Japanese have a wider torso and short limbs and the body shape is mild, but the upper limbs are longer, while the Taiwanese population has large shoulder and narrow hips with long legs and large hands.

According to Ziaolek et al. (2014), the database for the North American population is unsuitable for the Asian population. Using regional databases from other regions can generally lead to problems. Therefore, the use of the relevant anthropometry and variability of potential target users is required for designing certain target population for maximum accommodation.

In the 90s, ergonomic studies in Malaysia began with the collection and anthropometric studies of data from the selected population of Malaysia. In order to assess male and female differences in body weight, height and percentage of fats from various sports, Wan Nudri et al. (1996) carried out anthropometric measurements and body compositions of selected athletes.