UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DRIVING MOTION SIMULATOR

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor Degree In Electrical Engineering Technology (Industrial Power) (Hons.)

by

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I hereby, declared this report entitled “Driving Motion Simulator” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

……

(Project Co-Supervisor)

DEDICATION

I would like to thank God for his blessing and guidance throughout this completion of the project. To my beloved family who support in term of budget and encouragement to complete this project, thank you so much. This work is dedicated to my beloved project supervisor, Madam Intan Mastura Binti Saadon and Mr Fazly. Their guidance, assistant, encouragement and support has plays a major role in completing this project. Not forgetting for the Co-supervisor, Puan Amalia Aida who also give encouragement and support in this project report completetion. I would like to dedicate my thesis to all lecturers and friends who gives me support and guidance in any situation.

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ABSTRAK

Projek ini mencadangkan perlaksanaan simulasi pergerakkan pemanduan. Penggunaan simulasi pemanduan telah digunakan sebagai alat untuk mengajar di pusat latihan memandu. Penambahbaikan yang dijalankkan atas simulasi pemanduan telah meningkat mengikut peredaran zaman. Penambahan simulasi pemanduan dalam kalangan pusat latihan juga semakin meningkat untuk dimasukkan dalam kurikulum. Tetapi, kebanyakkan simulasi pemanduan yang ada hanya menyediakan stering, pedal dan perisian. Penambahan pergerakan dalam simulasi pemanduan akan meningkatkan kerja lebih untuk pemandu kerana pemandu perlu fokus dan memastikan tingkah laku ketika memandu simulasi pemanduan. Pergerakkan akan dihasilkan oleh putaran motor arus terus di mana akan mengerakan rangka kerusi. Potensiometer digunakan sensor maklum balas untuk mengawal darjah untuk pusingan motor arus terus. Pengawal yang digunakan dalam projek ini adalah Arduino Uno R3 dan pemanduan untuk motor areus terus adalah Moto Monster. Simulasi yang digunakkan dalam projek ini adalah Live for Speed dan perisian untuk mengeluarkan data untuk pergerakkan adalah SimTools.

ABSTRACT

This project propose the development of driving motion simulator. Driving simulators are increasingly being used as a didactic tool in driver training and education. Because the hardware has become more affordable and the quality of the simulator has improved over the past years, more and more driving instructors have decided to add simulator training to their curriculum. However, most of the driving simulator offer virtual driving car using only steering wheel, pedal and simulator software. The presence of motion increase the workload of the driver as driving simulator with motion offers a lot more focus and improve the driver behaviour hence speed up the learning process and minimize the chances of accident as the driver has learned to control the car as in various situation during training. The motion is created by using the rotation of DC motor that actuate the frame seat. Potentiometer is used as the feedback sensor to control the angle of the DC motor driver rotation. Microcontroller used in this project is Arduino Uno R3 and the motor driver used is Moto Monster Driver which support 30 ampere of current to control both of the DC motor. The simulator used in this project is Live for Speed and the software to extract the motion data from the simulator is Simtools. This project may contributes some idea on how to build a more realistic motion simulator. In real situation, this project does increase the focus and behaviour during in driving simulator training.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

DC	-	Direct Current
PWM	-	Pulse Width Modulation
DOF	-	Degree Of Freedom
USB	-	Universal Serial Bus
I/O	-	Input or Output
COM	-	Communication
MCA	-	Model Cueing Algorithm
MPC	-	Model Predictive Control
RX	-	Receive
TX	-	Transmit

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The uses of dynamical driving simulators is mutual in many diverse application fields, such as driver training, vehicle improvement, medical studies and for entertainment. The efficiency of such devices is linked to their abilities of well imitating the driving ambiances, and hence, it is vital that the motion control planscreate both realistic and practicableresponses to the stage, to make sure that it is kept within its limited procedure space.

Basically, this project aim to allow the existence of motion on seat being a driver in racing games or virtual car driving simulation by using the available market steering wheel console. SimTools is a software that provides the user on extracting data from the simulation or games. The extracted data can be manually setup from 1 degree of freedom to 6 degree of freedom. The data extracted from the software or games is a value that indicates the degree of freedom value shows on the monitor. The value from SimTools is then transmit to the Arduino Uno R3 via serial communication. The Arduino reads the data sent through serial communication port by SimTools and directs it to the potentiometer and motor driver. It perform a feedback control by reading the values of the potentiometer that are coupled to the motors shaft. The initial position of the potentiometer is compared to the set point, if the value is difference, the dc motor will rotate to the position of the new potentiometer value, therefore actuate the frame seat of the driving simulator seat. Hence, if the value of potentiometer keep update with different value of potentiometer, the dc motor will rotate as to find the updated potentiometer value. As to sum up, it will create a motion to the seat of the driving simulator.

1.2 Problem Statement

The process of training drivers for today's complex vehicles is a fairly time-consuming and expensive task. The actual solution to this problem is creation of simulators that make learning more convenient and cheaper, and less dangerous, especially when training actions in various emergency situations. Nowadays simulators where the trainee cabin is mounted on a movable platform are wide spread.

To utilize the idea of motion simulator, a driving seat motion simulation is build. In Europe, this project have been developed. However, the driving motion simulator is in six degree of freedom. Therefore, a two degree of freedom motion simulation is designed. Two DC motor will rotate based on the value of potentiometer that deliver bySimTools to the Arduino Uno R3 microcontroller. The rotation of the dc motor will allow the existence of motion of the seat of the driving motion simulator.

1.3 Objective of the Study

The objective of this project are:

1. To control the angle of DC motor.
2. To study the SimTools interface software.
3. To design the frame of the seat.
4. To develop a driving motion simulator seat.

1.4 Work Scope of the Study

As to smoothen the flow of the project according to the project objective, several scope must be done within the project area. This project will be focused on the way to design on how to create motion on the seat. A study on the SimTools software and DC motor driver connection with the potentiometer. Moreover, programming codes for Arduino Uno R3 microcontroller should be consider to allow the motor driver and potentiometer work together to control the angle of the DC motor.

To develop a driving motion simulator, a designed seat frame is needed to integrate the motor with the seat to create motion. Then, the driving motion simulator seat are sketched and designed. By using SimTools software as an input signal to provide data and Arduino Uno R3 as a microcontroller, the driving motion simulator seat can be develop.

1.5 Contribution

As a result, a driving motion simulator seat was designed and developed. This project will contributes idea to others in developing a more than two degree of freedom driving simulator. The project shows modern and advanced technology in its system. In this project, most of the theoretical knowledge and engineering technology will be applied. Hopefully, this project will successfully achieved its goal and vision to make a motion on the driving simulator.

1.6 Thesis Outlines

This thesis consists of five chapters. The following chapters are the outline of the implementation of Driving Motion Simulator.

Chapter 1: This chapter will discusses clearly the summary of this project such as introduction, objectives, problem statement, and scope of work, methodology and thesis outlines.

Chapter 2: This chapter comprises the research and information about the project on numerous important ideas of Driving Motion Simulator, technology and tools used in the study. This chapter also includes details in software and hardware design for Driving Motion Simulator.

Chapter 3: This chapter will discuss more about methodology used to resolve the project problem. All those methodology should be conducted to get improved performance.

Chapter 4: This chapter will discuss result and analysis detailed on designing driving motion simulator model. Hardware and Software result will be discussed in this chapter. All construction circuit, analysis, observation and design are denoted in this chapter. The results presented in this thesis are based in the design procedure that has been specified before.

Chapter 5: This chapter will discuss about the discussion, problem, conclusion and suggestion of this project. Any observation or proposal can be devoted in instruction to expand the project in the future.

CHAPTER 2

LITERATURE REVIEW

This chapter contains the sum up of the previous research and information on the project related to several important concepts of driving motion simulator, technology and materials to be used in this study. As a necessary of the project, description of software and hardware also includes in detail for the motion driving simulator.

2.1 Introduction

Steering wheel gamepad is a device that allow the user to navigate the virtual car through the steering wheel controller to add a realistic experience as the user imitate to drive a real car. This project is to construct a driving motion simulator which the user simulator seat allow a more realistic sensation in driving a virtual car by creating a motion tilting on the seat.

This chapter cover the previous study of the related work based on the application of motion driving simulator.. The motion in the driving simulator are controlled based on the configuration and set-up of the hardware and software indirectly the implementation for understanding of the hardware and software is a must. This is to ensure that a more efficient and practical application toward the contribution of the study.

2.2 Related Work

2.2.1 Motion-Base Simulator Evaluation of an Aircraft Using an External Vision System

Motion-Based Simulator Evaluation of an Aircraft Using an External Vision by Lynda J. Kramer, (2015) evaluation method is quite similar with the current project which uses the motion-based platform using Cockpit Motion Facility (CMF) to create the motion of the aircraft based on the pilot desired direction. External Vision System is a combination of sensor and display technologies intended to provide an equivalent level of safety and performance to that provided by forward-facing windows in today's aircraft. (Lynda J. Kramer, 2015)

2.2.2 Development of a Motion System for a Training Simulator Based on Stewart Platform

Another similar project by Evgeny I. Krasnov, (2015), in which the main goal for this project is to creates an illusion of the given movement for the driver. The platform consist of six identical legs. The length of each leg can vary by rotating a ball screw driven by a servo motor. Each motor operate independently, having its own position, velocity and acceleration rotation in a time unit. (Evgeny I. Krasnov, 2015)

2.2.3 A Nonlinear, MPC-Based Motion Cueing Algorithm for a High-Performance,Nine-DOF Dynamic Simulator Platform

Model predictive control (MPC) based motion cueing algorithm aim to relate to their capabilities of well reproducing the driving sensations, and hence, it is crucial that the motion control strategies generate both realistic inputs to the platform, to ensure that it is kept within its limited operation space. The Nine-DOF dynamic simulator platform architecture's allows to obtain large travels along those directions that are particularly relevant for applications in the automotive field with reduced overall dimension. (Mattia Bruschetta,2016)

2.2.4 State of the Art and Simulation of Motion Cueing Algorithms for a Six Degree of Freedom Driving Simulator

In a meantime, a project by Konrad Stathl, (2014), algorithms for a six degree of freedom driving simulator aim to compare the classical Washout algorithm, optimal algorithm and predictive washout. The result can be used to design the simulator system and the model can be used to test other algorithm.

2.3 Driving Motion Simulator

A driving simulator is a dynamic virtual reality system which provides the ability to test many driving situations under safe conditions. Therefore, it can be used in many different areas such as for research purposes to study the behaviour of the driver or develop and evaluate the new subsystems of the vehicle, or they can be used for training of drivers or for entertainment as in video games. (Imad Al Qaisi, 2012)

The development of the driving simulator can be applied to many field such as flight simulator since the purpose of motion simulator is to develop a motion for the user to experience the surrounding environment virtually before conducting the vehicle to a real world. The process of training drivers for today's complex vehicles is a fairly time-consuming and expensive task. The actual solution to this problem is creation of simulators that make learning more convenient and cheaper, and less dangerous, especially when training actions in various emergency situations. (Evgeny I. Krasnov, 2015)

In human factor study, the driving motion simulator are used to study the human behaviour when driving a vehicle be it in the specific state such as driving during lack of sleep, alcohol influence and many behaviour state. These simulators are an essential tool in the research of human factor related to car driving. Advantages of using a driving simulator are safety (there are no traffic accidents during driving) and simple collecting of data related to the driver's behaviour. (Lejla Banjanovic, 2016)