UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY TO DESIGN AND FABRICATE A PROTOTYPE OF DRIVER DROWSINESS PREVENTER (DDP)

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

by

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I hereby, declared this report entitled "**A STUDY TO DESIGN AND FABRICATE A PROTOTYPE OF DRIVER DROWSINESS PREVENTER (DDP)**" 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 Mechanical Engineering Technology (Technology Automotive) with Honours. The member of the supervisory is as follow:

Muhammad Zaidan Bin Abdul Manaf

(Project Supervisor)

DEDICATION

This report is dedicated to my beloved family especially to my parents, Mr. Omar Bin Mat Aroff and Mrs. Norhayati Binti Mustafa for their endless support and opinion when completing this report. Next, I would like to thank to my supervisor, Mr. Muhammad Zaidan Bin Abdul Manaf and Co. supervisor Mr. Azman Bin Ibrahim for guidance and encouragement while doing this project. Lastly, special thanks to my friends that has help me in giving their ideas and opinion for completing this final year project.

ABSTRACT

Driving in a drowsy state is very dangerous and just like driving in a drunk or subconscious state. Therefore, the use of sleep safety devices for compact and adjustable drivers around the rear mirror or on the dashboard is highly recommended. It contains an electronic activation mechanism to help ease the drowsiness early. A detailed study will be made to illustrate this system, related issues and improvements that need to be made to create a robust system. Various factors will be taken into account to ensure that these devices can affect the drowning drivers. The Drowsiness Preventer Driver Project is basically an inspiration from the scent of freshness used in the home to enhance the home-freshness. This aroma is aimed at improving the air freshness through several techniques including spraying every minute. The Drowsiness Preventer driver works as drivers start to feel sleepy especially when they are on the highway and need some time before they get to rest and take care. In addition, drivers can maintain active driving power. In this writing, it will focus on the concept of prefix Concept Generation in designing the Drowsiness Preventer Driver. The first step is to determine the customer's need for this technology. Additionally, produce engineering specifications based on the customer's requirements. Then all the data obtained will be used in drafting the House of Quality and then producing Product Design Specification (PDS). Next the best concept will be selected through several methods such as Morphological Chart, Concept Generation, Concept Screening, and Concept Selection. Finally, the final concept sketch will be illustrated.

Keywords: driver drowsiness preventer; transportation safety: driver fatigue;

ABSTRAK

Memandu dalam keadaan mengantuk sangat berbahaya dan sama seperti memandu dalam keadaan mabuk atau separa sedar. Oleh itu, penggunaan alat pencegahan tidur bagi pemandu yang kompak dan boleh dipasang di sekitar cermin belakang atau pada papan pemuka sangat-sangat digalakkan. Ia mengandungi mekanisme pengaktifan elektronik untuk membantu mengurangkan kesan awal mengantuk. Satu kajian terperinci akan dibuat bagi memberi gambaran mengenai sistem ini, isu-isu yang berkaitan dan penambahan yang perlu dilakukan untuk membuat satu sistem yang mantap. Pelbagai faktor akan diambil kira bagi memastikan alat ini boleh memberi kesan kepada pemandu yang mengantuk. Projek *Driver Drowsiness Preventer* ini pada dasarnya inspirasi daripada aroma kesegaran yang digunakan di dalam rumah untuk meningkatkan kesegaran dalam rumah. Aroma ini bertujuan meningkatkan tahap kesegaran udara melalui beberapa teknik antaranya semburan setiap minit. *Driver Drowsiness Preventer* ini berfungsi sewaktu pemandu mula berasa mengantuk terutama semasa di atas lebuhraya dan memerlukan tempoh masa sebelum sampai di rehat dan rawat. Sebagai tambahan, pemandu dapat mengekalkan daya aktif semasa pemanduan. Di dalam penulisan ini, ia akan fokus pada konsep awalan iaitu *Concept Generation* dalam mereka bentuk *Driver Drowsiness Preventer*. Langkah pertama adalah menentukan keperluan pelanggan mengenai teknologi ini. Selain itu, menghasilkan spesifikasi kejuruteraan berdasarkan keperluan pelanggan tersebut. Kemudian kesemua data yang diperolehi akan digunakan dalam merangka *House of Quality* seterusnya menghasilkan *Product Design Specification (PDS)*. Seterusnya konsep yang terbaik akan dipilih melalui beberapa kaedah seperti *Morphological Chart, Concept Generation, Concept Screening,* dan *Concept Selection*. Akhir sekali, lakaran konsep terakhir akan dilukiskan.

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All praise belongs to ALLAH (SWT). Without the health, strength and perseverance He gave, I would not be able to complete this project thesis. I have taken efforts in this project and spend time wisely to complete this thesis. However, it would have not been possible without the kind support and help of many individuals. In particular, I want to thank to anyone that contributed in my project thesis. They have encouraged me and giving full thought during this project. First, I would like to express the deepest appreciations to my supervisor Encik Muhammad Zaidan Bin Abdul Manaf for his patient and endless supports that continually teaching me throughout my project. He gave me a necessary suggestions and constant supervision as well as for providing information regarding the project thesis. Without his guidance and persistent help this project thesis would not complete successfully. Besides that, I would like to thank to my co supervisor Encik Azman bin Ibrahim who introduced me to this project and he gave me an inspiration idea about the project. He also provides me an opportunity to cooperate with him on designing a project. By spending his valuable time, he shared his knowledge with his full attentions in carrying out this project thesis. I also want to express my gratitude towards my beloved parents and families for their kind motivation to go through all the hard works and they gave me their supports and positive vibes while carrying out this project. In addition, I am very grateful for those giving me a chance to ask information from basic conceptual idea of the project.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Drowsiness is a state of decreased awareness or alertness associated with a desire or tendency to fall asleep. Almost everyone has felt drowsiness before, usually due to normal tiredness from a long day or lack of sleep. Several approaches have been developed to detect drowsiness (Editor, 2014). Also because of that, this project is discovered to develop a device that can detect drowsiness especially in order to prevent accidental napping while driving. In addition, a device that can help prevent accidents due to drowsiness when driving a vehicle could realize a great saving in human life.

Road accidents are one of the disaster-prone in the country. According to statistical data of 849 accidents with 36 deaths were recorded on the East Coast Expressway Phase 2 (LPT2) from February 1st to November 2015. Works Minister Datuk Seri Fadillah Yusof said of the statistics, a total of 664 accidents were caused by human factors such as driving while drowsy, driving over the speed limit, careless and failed to comply with safety requirements. (Yusof, 2015)

It is undeniable that many accidents are caused by human negligence. In addition, humans are also considered to be careless when driving in a drunken state, vision and drowsiness. Many accidents occurred late at night and early morning. Losses are also substantial. The government had incurred losses estimated at RM9.1 billion due to

cases of road accidents during 2013 Acting Transport Minister Datuk Seri Hishammuddin Tun Hussein said that based on studies of Malaysia Institute of Road Safety (Miros), the overall loss of 6,917 cases involving RM1.2 million for each of the remaining cases of death and serious injury as well as light. (Malaysia, 2013)

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To achieve the objective of reducing road accidents, the researchers will conduct a study to design a tool to reduce the drowsiness of car drivers. This is because the factor that sleepiness is a major factor in causing road accidents. Further, to ensure the device works well, a number of methods will be used as a suitable position to be placed, the mechanisms that will be used, the power source is obtained, and the system to be adopted.

1.2 Problem Statement

At some point when driver drive at late night, they may unintentionally fall asleep while driving. Tired driver may have a tough time staying alert when they need to keep focus on road. Consequently, the vehicle may have lost control and it can be a distraction to other driver. Sleeping while driving also can cause accident and worse

can cause death. This is the motivation by doing this project; to create a system that can help driver to stay awake without causing disturbing to their surroundings.

1.3 Objective

The objectives of this project are:

i. To generate a concept design of Driver Drowsiness Preventer.

ii. To design a concept of Driver Drowsiness Preventer.

iii. To prototype the finalize concept of Driver Drowsiness Preventer by using handmade process.

1.4 Scope

This project is subjected to several scope and limitation that are narrowed down to the study. In addition, the scope of this project is developing a device. The system is consisted of components interfacing with each other. For designing and testing purpose, each component is divided into separate block.

i) Located Place is on dashboard for controller system.

ii) Simple Circuit without ECU

iii) Proton Iswara Aeroback 1300 CC

iv)Average height of driver is 165cm.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews on type of sensor, device concept, and alarm system. Improvement characteristics based on simple technology, power system, and control mechanism. Besides, this chapter brief more description about types of sensor, place located and control mechanism to alert driver.

2.2 Preview Research

The study is based on an already existing product. For drowsiness sensors, we can find products that have been produced according to the design and technology of its own. Each tool has its own advantages and disadvantages. Here I include several kinds of products that have been produced by other researchers who have the same objective.

2.2.1 Driver Drowsiness Detection Using the In-Ear EEG

This device is using Electroencephalogram (EEG) and signals to watch the sleepiness driver. Each type of signal has partial limits in terms of either convenience or accuracy. Idea of in-ear EEG raises expectations due to reduced cost. It is yet unclear

whether the in-ear EEG is effective enough for sleepiness detection in comparison with on-scalp EEG. In this device, they performance of the in-ear EEG in drivers' complete awakens and awareness-sleepiness classification. They also tested three signals including (ECG), photoplethysmogram (PPG), and exciting skin response (GSR) which have advantage inconvenience of measurement. The classification analysis using the in-ear EEG resulted in high classification almost the same as that of the individual on-scalp EEG channels. The ECG, PPG and GSR showed competitive performance but only when used together in pairwise combinations. End of the experiment, results suggest that the in-ear EEG would be possible other choice to the single channel EEG or the individual signals for the sleepiness supervising. Since their study contained a limited number of people and used standard electrodes with wired connections, the complete and total performance in their results may not be expected in more realistic conditions with simpler sensors. They focused more on the comparison of performance in your mind under the same experimental conditions. By including the in-ear EEG, our results may provide a bit expanded performance of the candidate bioelectrical signals and in that way inspire sensor use military service way for the and convenient driver sleepiness supervising.(Hwang et al. 2016)

2.2.2 An Improved Drowsiness Detection Scheme

With simultaneous monitoring the driver's status, the alarm is activated once the driver is classified as drowsy. The mechanism of DDD can protect the public in real-time. The stages of sleep are defined as wake, sleep stage 1, sleep stage 2, sleep stage 3, sleep stage 4, and rapid eye movement. To avoid confusion, it is worth to distinguish

fatigue and drowsiness. Drowsiness is a tendency to fall asleep and it is categorized as sleep stage 1. Most of the DDD focus on analyzing sleep stage 1 because human is awakened easily at this stage. DDD can be categorized into 3 types: image-based, vehicle-based and biosignal-based detections. The first two types are non-intrusive and the third type is intrusive. To verify whether the measured data can reflect the human status accurately, the measurement stability (MS) has been defined which is determined by the proportion of successful data recording. It was concluded that the detection using Electrocardiogram (ECG) attains the highest MS which is more than 97%. For the detections based on eye and Electroencephalography (EEG), the corresponding MSs are 59% and 85%. ECG signal is a reliable signal to reflect the human's status and it has been widely adopted in medical applications. Therefore, an ECG-based DDD using support vector machine (SVM) is proposed. A penalized cross-correlation kernel (KPC) has been proposed for drowsy driver detection (DDD) using support vector machine (SVM). In KPC, cross-correlation is carried to extract the similarity information of ECG signals. The relationship of the ECG signals can be reflected in the resultant cross-correlation coefficients because of the property of cross-correlation in time domain. Penalization is utilized to further suppress insignificant information in the cross correlation coefficients. The testing results demonstrate that KPC achieves improvement in accuracy. The proposed method has highest accuracy of 81% comparing to other approaches. (Wu et al. 2016)

2.2.3 Real Time Driver Drowsiness Detection Using a Logistic-Regression-Based Machine Learning Algorithm

An automated non-contact system that can detect driver's drowsiness early could be lifesaving. Motivated by this dire need, they propose a novel method that can detect driver's drowsiness at an early stage by computing heart rate variation using advanced logistic regression based machine learning algorithm. Their developed technique has been tested with human subjects and it can detect drowsiness in a minimum amount of time, with an accuracy above 90%. For this device, they examined HRV to detect driver drowsiness. The accuracy was above 90% with minimum window of 20 seconds (ECG signal). Multiple tests were performed with data comprising of different age and gender. Study also confirms the importance of low frequency (0.05 Hz – 0.1 Hz) and high frequency (0.16Hz-0.2Hz) areas. It also reveals that ultra-lower band ULF and VLF do not carry important information for drowsiness detection. Logistic regression provided 90% accuracy, however, accuracy can be improved if more training data regarding different psychological states of driver is collected. (Babaeian et al. 2016)

2.2.4 Design of Drowsiness, Heart Beat Detection System and Alertness Indicator for Driver Safety

The main objective of this device is to reduce the accidents caused due to human abnormalities. This is done by monitoring the driver's head movements in order to detect drowsiness and heart beat rate by employing image processing techniques. Drowsiness detection is accomplished by head motion detection using frame

difference algorithm and heart rate detection is carried out using R-peak detection algorithm. If any abnormalities are found during detection, an alert is given to the driver through a buzzer for the safety of the driver along with the passengers. Due to the human error's while driving, accident rates are increased and also there is no safety for the driver and passenger. Hence through continuously monitoring the driver by detecting drowsiness and heart beat rates and also alerting the driver when he is deviating from his normal circumstance, accidents rates can be minimized.(Anilkumar et al. 2016)

2.2.5 Driver Drowsiness Detection Based on Time Series Analysis of Steering Wheel Angular Velocity

Based on time series analysis of the steering wheel angular velocity, the researcher is able to produce a device called Driver Drowsiness Detection Based on Time Series Analysis of Steering Wheel Angular Velocity. Firstly, the steering behavior under the fatigue state is analyzed, followed by the determination of the temporal detection window; and then, the data series of the steering wheel angular velocity in the temporal detection window is selected as the detection feature. If the detection feature satisfies the extent constraint and the variability constraint in the temporal window, a drowsiness state is detected accordingly. At last, experiment tests validate our method has good performance and could be well used in the real world. This device proposes a method for detecting the driver's drowsiness based on a time-series analysis of the steering wheel angular velocity. It proposes using the temporal

detection window to determine the steering wheel angular velocity during a time-series, at which time appear specified indicators of the driver's drowsiness. The specified indicators must satisfy certain figures showing that the driver has gone beyond stable status, gained the threshold value, and then returned to the stable status (Zhenhai et al. 2017). When accompanied with traditional methods, this method provides few advantage:

- No use of external equipment is required.
- Dependably realistic
- Uses steering wheel angular velocity over time as an indicative characteristic of drowsiness.
- Reflects the driver's movements immediately
- Enhances the accuracy of recognition of drowsiness

2.3 Device Concept

2.3.1 Function of Device

Driver drowsiness preventer is a technology which helps prevent accidents caused by the driver getting drowsy. Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads. Various technologies can be used to try to detect driver drowsiness.

2.3.2 Location

2.3.2.1 Device Position

Queensland's Transport Operations (Road Use Management - Road Rules) Regulation 2009 states that: A driver must not drive an engine vehicle unless the driver has a reasonable perspective of the street, and activity ahead, behind and to each side of the driver. The establishment directions furnished with numerous gadgets are very dubious with regards to satisfactory areas, and just, as vehicle and versatile outline differs impressively, as does the driver's stature and seating position, it's unrealistic to select an area that will be worthy to each vehicle.

2.3.2.2 Choosing A Suitable Position

It will be up to the driver to decide revise situation. A couple focuses are thinking about in choosing a position.

•If fitted to the windscreen, it ought to be wicked good to limit the interruption into the driver's field of view

•Consider putting it in the lower right corner of the windscreen to limit block to the driver's vision

•Do not find units where they may bring about harm in a crash. This incorporates potential head strike zones or on the windscreen or other area where a conveying airbag may get in touch with them. Where a traveler airbag is fitted, this incorporates anyplace to one side of focal point of the windscreen

•High up on the windscreen ought to be maintained a strategic distance from as this will regularly meddle with back view mirrors and sun visors and result in the power rope trailing over the driver's vision range

2.3.3 Portable

Portable mean simple to bear or move. So compact gadget implies a gadget that effectively to bear with no issue. Compact gadget likewise ends up plainly usable when worn. For instance, most walkie talkies accompanied a voice worked transmit ability so they will work sans hands, when utilized with a wearable receiver. Many phones, for example, the Sony likewise highlight an earpiece that enables the telephone to be worn and utilized sans hands. Portable PCs are PCs that can be hand-held, utilized on a lap, or worn in a pocket, belt, or something like that, for example, Personal computerized aides (PDAs).

•Portable: hand-held or wearable;

•Mobile: vehicular mounted (e.g. a vehicle radiotelephone);

•Base station or desktop units: building-mounted.

2.3.4 Fixed

Fixed mean arranged or decided already and not able to be changed. So fixed device mean device that cannot be carry around and stay at one place only.