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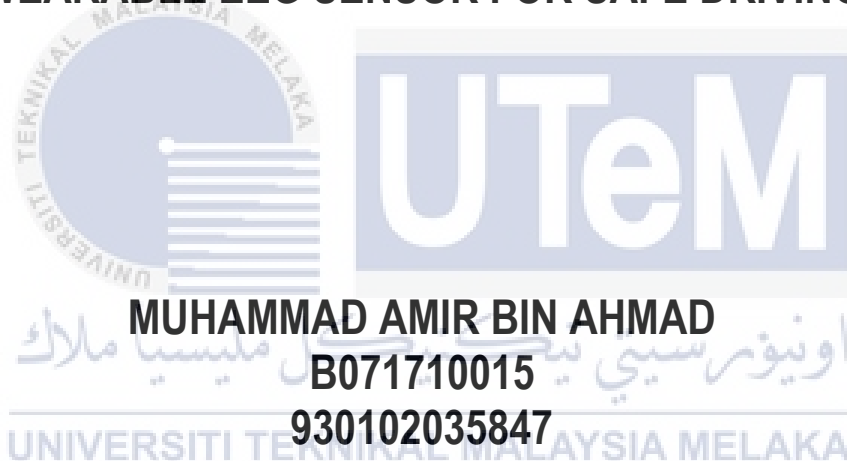
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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BACHELOR DEGREE IN COMPUTER ENGINEERING TECHNOLOGY (COMPUTER SYSTEMS) WITH HONOURS

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Faculty of Electrical and Electronic Engineering Technology

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Bachelor Degree of Computer Engineering Technology (Computer Systems) with Honours

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DROWSINESS DETECTION AND ALERT SYSTEM USING WEARABLE EEG SENSOR FOR SAFE DRIVING

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**A thesis submitted in fulfillment of the requirements for the degree of
Bachelor of Computer Engineering Technology (Computer System) with Honours**

Faculty of Electrical and Electronic Engineering Technology
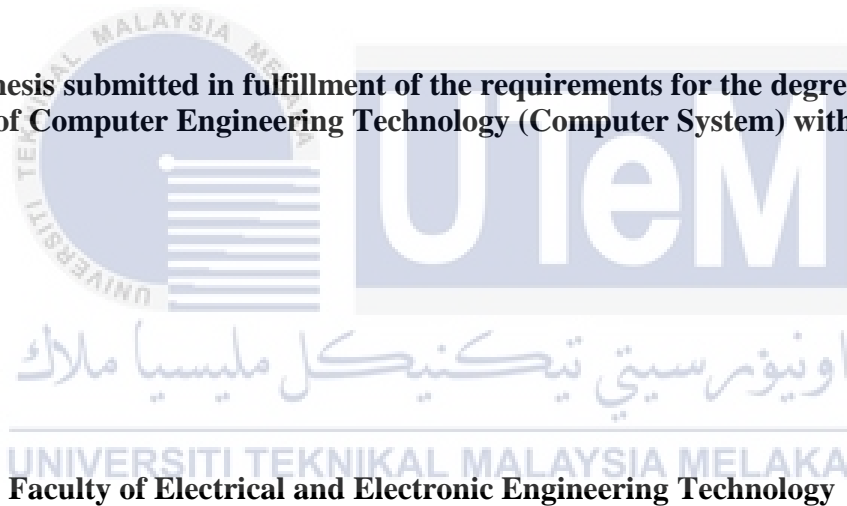
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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DROWSINESS DETECTION AND ALERT SYSTEM USING WEARABLE EEG SENSOR FOR SAFE DRIVING

Sesi Pengajian: 2019

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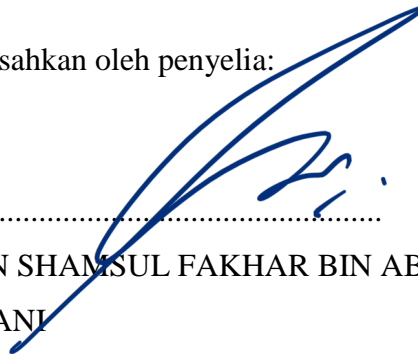
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DECLARATION

I declare that this report entitled Drowsiness Detection And Alert System Using Wearable Eeg Sensor For Safe Driving is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:	
Name	:	*MUHAMMAD AMIR BIN AHMAD*
Date	:	12 February 2021
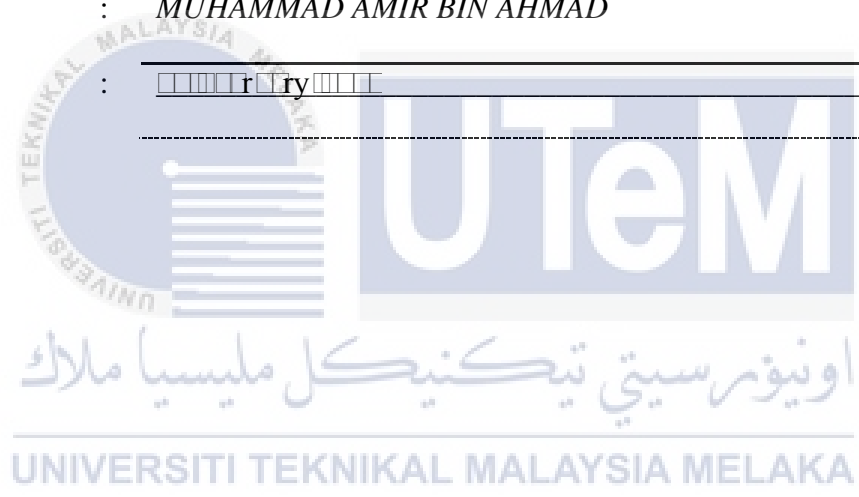
APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of University Teknikal Malaysia Melaka (UTeM) as partial fulfilment of requirement for the degree of Bachelor of Computer Engineering Technology (Computer System) with Honours. The member of supervisory is as follow:

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Date   : 12 February 2021

اونيؤم سيتي تيكنيكل مليسيا ملاك

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DEDICATION

I dedicate this thesis to my parents, supervisor, co-supervisor, and my fellow friends. May Allah
bless them all.

ABSTRACT

Major factor that cause road accident is drowsiness. This can be prevented if the driver get enough sleep before driving, consume energy drink or coffee and resting when experiencing drowsiness. Most regular method used to detect sleepiness is by eyelid blinking and ECG. The main purpose of this project is to create a system that can identify a driver that experiencing drowsiness. The techniques use is based on real-time system that monitoring and analysis the EEG signal from driver that wearing EGG headband. By using this system, we are able to identify the drowsiness level. When the signal from EEG sensor is process and identify the drowsiness, the system will alert driver by producing audible alarm, displaying on LCD and generating light indicator. This project is using an Arduino as microcontroller. By using this technique, it can give precise measurement. This method is less complex, time efficiency and more affordable.

Keywords – Drowsiness Detection, EEG sensor, Arduino.

i

ABSTRAK

Faktor utama yang menyebabkan kemalangan adalah mengantuk. Ini boleh dihalang dengan mendapatkan tidur yang mencukupi sebelum memandu, mengambil minuman bertenaga dan berehat sekiranya berasa mengantuk. Kaedah mengesan mengantuk biasanya berdasarkan kelipan mata dan ECG. Tujuan utama projek ini adalah untuk menghasilkan satu sistem yang dapat mengenal pasti pemandu yang mengalami rasa mengantuk. Teknik yang digunakan berdasarkan sistem masa sebenar yang mana memantau dan menganalisa isyarat EEG dari pemandu yang memakai ikat kepala EEG. Dengan menggunakan sistem ini, kita dapat mengenal pasti tahap rasa mengantuk pemandu. Bilamana isyarat dari sensor EEG diproses dan mengenalpasti rasa mengantuk, sistem akan menghasilkan amaran kepada pemandu dengan mengeluarkan bunyi, memaparkan pada lcd, dan menghasilkan indikasi bercahaya. Projek ini menggunakan Arduino sebagai mikrokontroler. Dengan menggunakan kaedah ini, ia dapat menghasilkan ukurun yang jitu. Cara ini juga kurang susah, kecekapan masa dan lebih mampu milik.

Kata kunci – Pengesanan Mengantuk, Pengesan EEG, Arduino.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES


LIST OF ABBREVIATIONS

CHAPTER 1

INTRODUCTION

1.1 Research Background

One major cause behind casualties in road accidents is driver's drowsiness. Drowsiness is the abnormally tired or fatigued feeling. Driving is associated with fatigue and which weaken the ability and willingness to perform the task. The symptom of drowsiness include changing in mood, personality or behavior, fatigue, low energy. The drowsiness occur to the driver because of the long journey to reach the destination. This resulted lack of concentration during driving and cannot be able to control the speed of vehicle. Today, with advance technology, using physiological measurement considered as one of the best way to measure the drowsiness level among the drivers. EEG is can give better and reliable method to detect the drowsiness. It is important to have a real time system that monitor driver's sleepiness continuously. By getting the data from the sensor, it enable to make system that detect early sign of drowsiness. This can prevent the accident occur by producing the alert to the user.
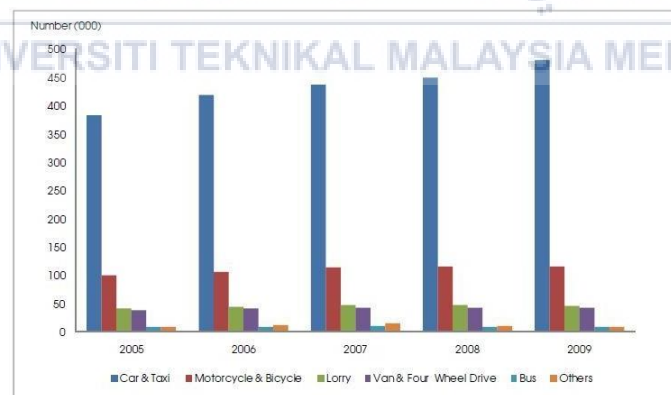
Source: Department of Road Safety Malaysia

Figure 1.1 Statistic of Road Accident from 2005 to 2009

Figure 1.1 shows the statistics provided by MIROS (Malaysia Institute of Road Safety) regarding road accidents in Malaysia from 2005 to 2009. Every year the number of vehicles involved in road accidents continues to increase. From Figure 1.1, vehicle type car and taxi shows about

1

400,000 road accident cases had been record. It continues to rise each year and shows the number by 2009. It keeps growing every year and state the road accident record by MIROS is close to 500,000 by the year 2009.

Years	Death	Total Number Of Registered Vehicles Accumulating	Index
2011	6,877	21,401,269	3.21
2012	6,917	22,702,221	3.05
2013	6,915	23,819,256	2.90
2014	6,674	25101192	2.66
2015	6,706	26,301,952	2.55
2016	7,152	27,613,264	2.59

Figure 1.2 Index of death in Malaysia from 2011 to 2016

Figure 1.2 show the index of death in Malaysia from the year 2011 to 2016 provided by MOT (Ministry Of Transportation Malaysia). The number of death caused by road accident in 2016 show over 7000 cases and it increasing in previous year.

1.2 Problem Statement

Many accidents cause by the drowsiness of the drivers. This may lead to the fatal or injuries, it can cause danger to other drivers too. The drivers are usually unaware that they are drowsy or experiencing micro sleep while driving. The current detection system using complex computation and expensive equipment and is not suitable for certain condition; for example, webcam placed in front of the driver and electrocardiography (ECG), i.e. detecting the eyelid behavior and evaluating the rhythm of heart.

1.3 Objective

The objective of this project are:

1. To develop a system that detects driver drowsiness by using an EEG sensor

2. To alert the driver from the drowsiness and prevent micro-sleep

2

1.4 Scope

The scope of this project is:

1. System that detect drowsiness

2. Determine the sign of drowsiness by using brain waves

3. Applying to vehicle drivers

4. Develop and testing code

5. Complete of testing and enhancement

CHAPTER 2

LITERATURE REVIEW

Previous work is focused on the sleepiness detection system, which can be applied as a guide to designing and developing a system for detecting sleepiness among drivers. There are many ways in which the signs of sleepiness can be identified.

2.1   Drowsiness

Drowsiness is a transitional state between awakening and sleep, during which a general decrease of awareness is observed. An individual would be almost as intoxicated after staying awake for 24 hours straight, it similar to that person has exceed acceptable alcohol limit, says a report. Australian study examined 40 people to establish a 'blood alcohol standard' with various rates of sleeplessness impairment. (Dr. Santosh Kumar Dhavala et al, 2011).

Major problem in road crash is drowsy driving, since it is a deadly compound between driving and drowsiness or tiredness. Alarming is the possibility of drowsy driving and its dangerous effects. Developing intelligent transport systems require a lot of real-time monitoring of driver alertness to prevent a huge number of accidents (Oviyaa *et al.*, 2020).

Throughout the day feeling abnormally sleepy or exhausted is generally known as drowsiness. Drowsiness can lead to further symptoms, such as inattention or falling asleep at inappropriate times. (Awais, Badruddin and Drieberg, 2014)

2.2   EEG sensor

Electroencephalography (EEG) has proven very accurate amongst them. The modern vehicle and vision-based drowsiness warning are very effective even if the drivers is going to drowsy and sometimes very late in avoiding deaths on the road (M. Oviyaa et al, 2020)

On a real-time system that tracks and examines the driver's EEG signal using a single EEG headset with dry sensors. Competent of sensing driver's condition in real time. When the driver is nearly to the sleepy stage, the alert alarm are trigger, this will alert the drivers. The

4

result record that the system give accuracy about 97.6% to recognize sleep in test of 60 participant by using EEG wave. The suggested technique it is more affordable, time-efficient and less complex as compared to similar techniques (Abdel-Rahman, Seddik and Shawky, 2015).

The EEG sensor detects and amplifies the small voltages of electricity generated by the brain cells (neurons) when they fire. Neurons from different locations can fire in the same way as muscle fibers. The most frequently found frequencies, for EEG, are between 1 and 40 Hz. The EEG sensor captures a "raw" EEG signal, which is the continuously changing potential difference between the positive and negative electrode, and the program uses the signal to obtain frequency-domain information by adding a series of digital filters to the reported signal.

Abnormalities associated with brain electrical signal is test by using an electroencephalogram (EEG). This technique records and detects variations in brain waves. The sensor make of sensor disk is placed on the head include thin wire (electrodes), as the computer starting to record the record from incoming signals. The pattern that produce by the brain by regular electric activity will be recognize. Doctors can identify the abnormal pattern indicating seizures and other problem by using EEG. In neurology, the primary diagnostic application of EEG is in the case of epilepsy, since epileptic activity in a standard EEG study can give specific anomalies. A key health use of EEG is coma treatment, and death of the brain. (Dr. Santosh Kumar Dhavala et al, 2011).

Figure 2.1: EEG Sensors

Physiological signals frequently used, a record of the brain electrical signal, producing strong relation to sleepiness. Consequently, drowsiness, fatigue and performance by using EEG regarded as a precise measurement. There are many type of wave, such as delta, theta, and alpha

5

derived from EEG low-frequency bands. Especially, on alpha bands that will rising in band power for the sleepiness condition compared to the alert. On high frequency bands (beta and gamma), particularly on beta band, drowsiness indicate a reducing in the band power. in brain part, by frontal, parietal and occipital are recommended insightful. The discovery of sensitive brain part among different frequency bands would thus help to lower the amount of electrodes required to establish an efficient EEG-based drowsiness detection and alarm device (Majumder *et al.*, 2019).

2.3   Microcontroller Board

Microcontroller is a microcontroller built on a single circuit board. It contain a processor, ram, memory, clock generator, and input/output peripherals. The board is design for instant use to any application that use by developer, time-efficient and effort to develop new controller hardware. Microcontroller very known in education and low cost for developing a project. It enable programmer or develop to generate code to fulfill the own condition. Arduino UNO and Raspberry Pi.

2.3.1   Arduino

Arduino is one of popular open-source electronics platform based on easy-to-use hardware and software (Arduino, 2017). Arduino was design and produce by Massimo Banzi, David Cuartielles, Tom Igoe, Gianluca Martino, and David Mellis (Kushner, 2011)
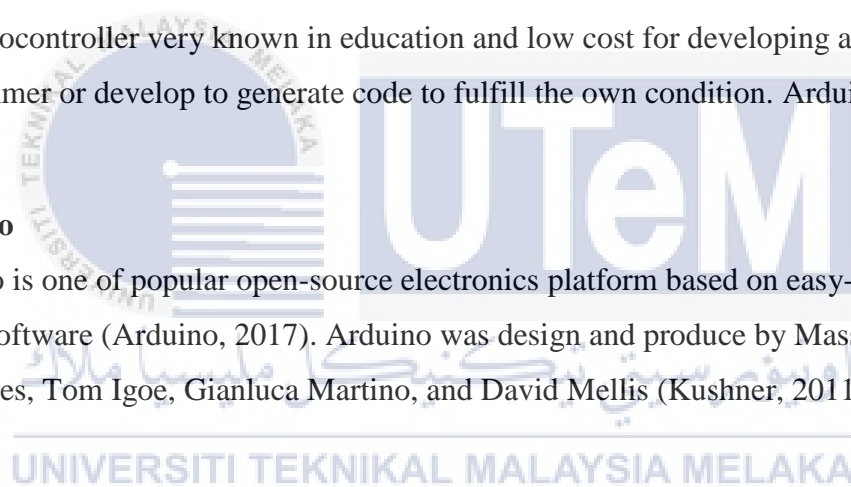

Figure 2.2: Arduino logo

6

Arduino board is capable to read digital and analog signal from sensor to output devices. It can conduct any input such as temperature sensor or button and return the output like displaying, light up LED and activating a motor. The instruction can be done in the Arduino Software (IDE), later will be upload to the microcontroller.

2.3.2   Raspberry Pi

Raspberry is designed in United Kingdom by Raspberry Pi Foundation is a UK charity, this microcontroller is low-cost, high performance small single board computer. It help people to learn, solve issues, computing and getting fun.
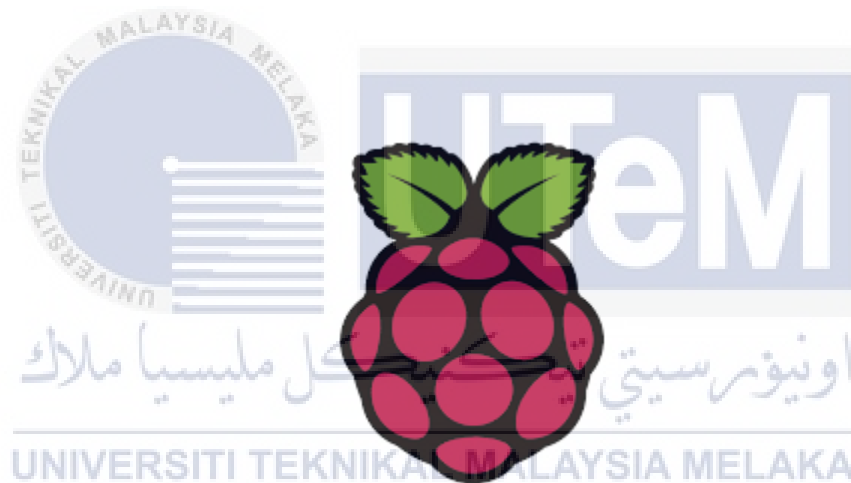

Figure 2.3: Raspberry Pi logo

Raspberry pi come with high-speed single-core processor, large size of RAM and the cost are not expensive. Raspberry come with new generation with upgraded specification. Raspberry is open source ecosystem that run linux (Upton, 2016)

2.4   Brain Wave Type

Brain wave is generate by synchronized electrical pulse from number of neuron communicating each other. Brain waves, is spotted by place sensor on the head scalp. Brainwaves change based on the activity were doing and feeling. Feeling tired, exhausted, slow