Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF VEHICLE ACCIDENT ALERT USING VISIBLE LIGHT COMMUNICATION

SITI NUR AFIQAH BINTI AHMAD RIZAL

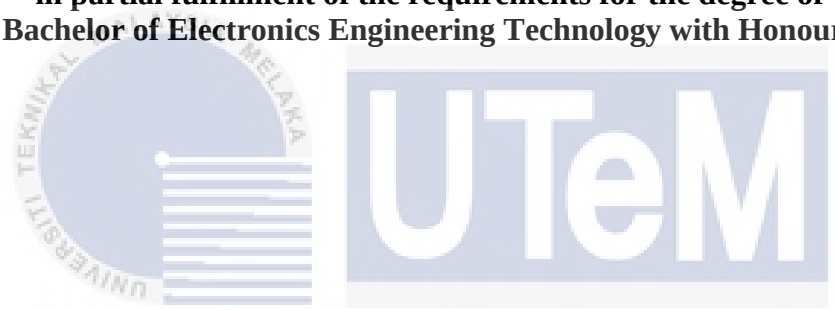
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2021

DEVELOPMENT OF VEHICLE ACCIDENT ALERT USING VISIBLE LIGHT COMMUNICATION

SITI NUR AFIQAH BINTI AHMAD RIZAL

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF VEHICLE ACCIDENT ALERT USING VISIBLE LIGHT COMMUNICATION

Sesi Pengajian : 2021/2022

Saya SITI NUR AFIQAH BINTI AHMAD RIZAL mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

Alamat Tetap:
NO 7 JALAN 4/11C,
SEKSYEN 4 TAMBAHAN,
43650 BANDAR BARU BANGI,
SELANGOR DARUL EHSAN

(COP DAN TANDATANGAN PENYELIA)

DR. SURAYA BINTI ZAINUDDIN
Pensyarah
Jabatan Teknologi Kejuruteraan Elektronik & Komputer
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 10 JANUARI 2022

Tarikh: 10 JANUARI 2022

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled “Development Of Vehicle Accident Alert Using Visible Light Communication” 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.

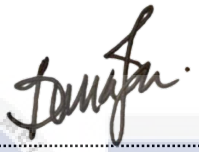
Signature : 

Student Name : SITI NUR AFIQAH BINTI AHMAD RIZAL

Date : 10 JANUARY 2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : 

Supervisor Name : DR SURAYA BINTI ZAINUDDIN

Date : 6 FEBRUARY 2022

Signature : 

Co-Supervisor Name (if any) : TS DR ZAITON BINTI ABDUL MUTALIP

Date : 10 JANUARY 2022

DEDICATION

I am indebted to ALLAH SWT for his mercy. I am Siti Nur Afiqah Binti Ahmad Rizal student of UTeM Malacca successfully completed the final year project report. For my family especially my loving mother, Mrs. Suriana Binti Sulaiman. To my father, Ahmad Rizal Bin Abdul Rashid, and my dearest brother, Ahmad Muhaimin Bin Ahmad Rizal, who have all provided me with great support, encouragement, and counsel in order for me to complete this project. And don't forget about all of my dearest fellow buddies that cheer me up when I'm stuck on a project. Thank you a lot.

ABSTRACT

The ability to own a vehicle increases the rate of usage on the road. Many accidents occur especially on highways due to the distance of vehicles that are too close to each other. If the driver in front of the car slows down or applies the brakes, the following vehicle driver finds it difficult to manage his car, resulting in a collision. In order to reduce road accidents in Malaysia, a car accident alert system is vital as a warning to the driver before the crash. This system is also important to flatten the curve rate of fatalities on road accidents in Malaysia. This project aims to design vehicle accident alert by using Visible Light Communication (VLC). As Malaysia is geographically located on the equatorial line and is receiving plenty of sunshine over the years, the VLC Technology is suitable for this system. So, the proposed project is hoped to save the development cost. The project is divided into four main parts comprises input (distance), microcontroller (Arduino Uno), Li-Fi transmitter and Li-Fi receiver part and output. The microcontroller acts like a brain that reads the input or signal from the Ultrasonic sensor. Then, the Li-Fi transmitter and Li-Fi receiver will make a data transfer by using light. Lastly, the microcontroller will operate to activate the buzzer as an alarm alert in this project.

ABSTRAK

Kemampuan pemilikan kenderaan meningkatkan kadar penggunaan di jalan raya. Banyak kemalangan berlaku terutama di lebuh raya disebabkan penjarakan kenderaan yang terlalu rapat di antara satu lain. Apabila pemandu di hadapan memperlahankan kenderaan atau menekan brek, ini mengakibatkan pemandu kenderaan berikutnya sukar untuk mengawal keretanya, lalu mengakibatkan perlanggaran. Bagi mengurangkan kemalangan jalan raya di Malaysia, sistem amaran kemalangan kereta adalah penting sebagai amaran kepada pemandu sebelum kemalangan. Sistem ini juga penting untuk melengkung lekukan kadar kematian akibat kemalangan jalan raya di Malaysia. Projek ini bertujuan untuk merekabentuk amaran kemalangan kenderaan dengan menggunakan Komunikasi Cahaya Terlihat (VLC). Memandangkan Malaysia secara geografi terletak di garisan khatulistiwa dan menerima banyak cahaya matahari setiap tahun, Teknologi VLC sesuai untuk sistem ini. Maka, projek yang dicadangkan ini diharap dapat menjimatkan kos pembangunan. Projek ini dibahagikan kepada empat bahagian utama merangkumi input (jarak), mikropengawal (Arduino Uno), pemancar Li-Fi dan bahagian dan output penerima Li-Fi. Mikropengawal bertindak seperti otak yang membaca input atau isyarat daripada penderia Ultrasonik. Kemudian, pemancar Li-Fi dan penerima Li-Fi akan membuat pemindahan data dengan menggunakan cahaya. Akhir sekali, mikropengawal akan beroperasi untuk mengaktifkan penggera amaran dalam projek ini.

.

ACKNOWLEDGEMENTS

I like to thanks my supervisor, Dr Suraya Binti Zainuddin, lecturer at the University of Technical Malaysia in Malacca's from the Electronic and Computer Engineering Technology Department, and my Co-Supervisor Ts Dr Zaiton Binti Abdul Mutalip from Electronic and Computer Engineering for their guidance and physical and mental support throughout my project work. During my Final Year Project, these two important people have been a source of motivation for me as long as my project has been in progress. They also prepared to give me some of their valuable time each week to check on my progress and offer advice when I'm stuck on how to finish the project. I am grateful and fortunate to have had the opportunity to work and learn under their direction and supervision for the project's duration.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

VLC	-	Visible Light Communication
AC	-	Alternating Current
DC	-	Direct Current
Li-Fi	-	Light Fidelity
LED	-	Light-Emitting Diode
LCD	-	Liquid Crystal Display
LDR	-	Light-Dependent Resistor
WHO	-	World Health Organization
Wi-Fi	-	Wireless Fidelity
WPT	-	Wireless Power Transfer
V2V	-	Vehicle to Vehicle
V	-	Voltage

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

During the past two decades, Malaysia has been one of the countries that extensively developed facilities and infrastructure, such as highway expansion, especially in the major metropolitan areas. However, the high traffic demand in certain areas resulted in an increased possibility cause of road accidents. From the road accident cases, people usually only know the cause and impact of an accident, without actually being aware of the main problem that brings to the road accident.

Based on Bloomberg (2017) reported that statistics from the World Health Organization (WHO) for 2013, Malaysia is among the emerging countries with the riskiest roads after Thailand and the Philippines. From the statistic, Malaysia registered 15 and 11 death rates, respectively. In addition, WHO's data released the average and estimated fatality in Malaysia, as illustrated in Figure 1.1 and Figure 1.2. The figure shows that Malaysia is one of the highest countries with a high fatality rate.

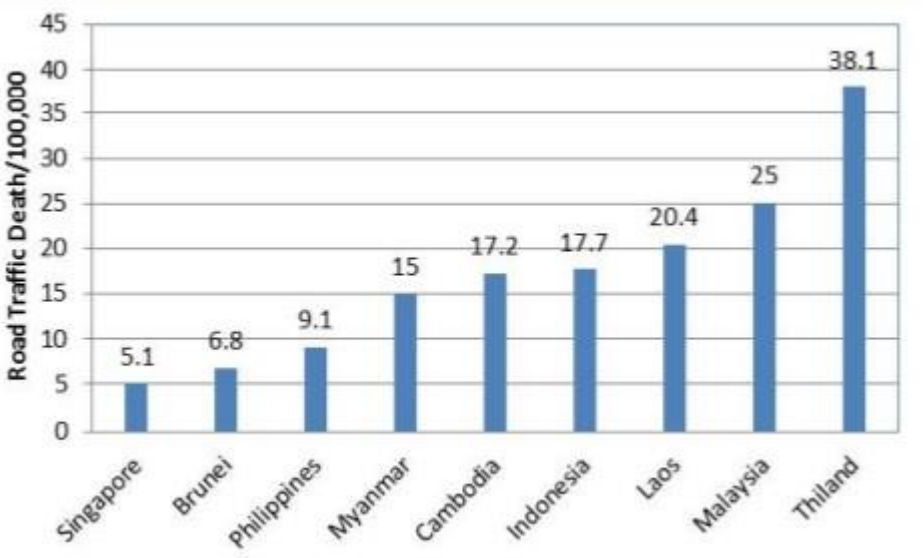


Figure 1. 1 Comparing the fatality rate in Malaysia with others Southeast Asia

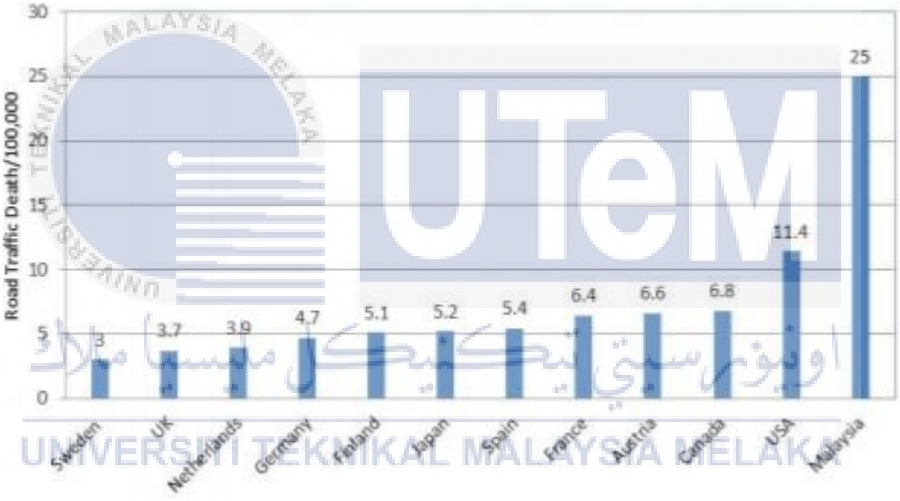


Figure 1. 2 Comparing the fatality in Malaysia to other developed countries

According to the Director General of Road Transport Department of Malaysia, 40% of road accidents in Malaysia are caused by following the front vehicles too closely. Sometimes, when the driver is not alert with the distance between vehicles are close, it can cause an accident. Ministry of Transport Malaysia also stated that the number of accidents in Malaysia has increased during the last ten years. Meanwhile, the number of fatalities has been reduced and achieved the lowest number of cases in 2019 with 6167 cases. Figure 1.3

shows the Malaysia road accident from 2010 to 2019, while Figure 1.4 shows the fatalities caused by road accidents in Malaysia from 2010 to 2019.

Figure 1. 3 Malaysia Road Accident from 2010 to 2019

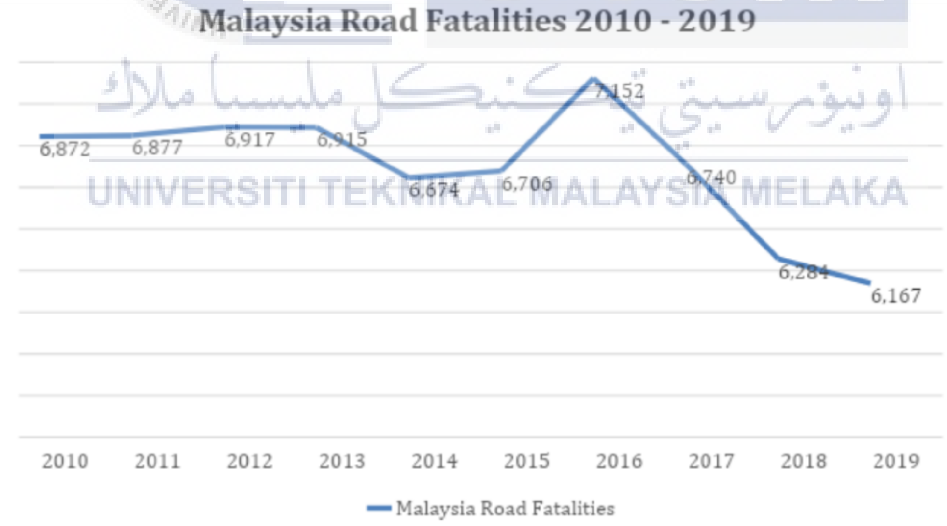


Figure 1. 4 Malaysia Road Fatalities from 2010 to 2019

Because of the cases of accident in Malaysia are increasing by the year, the Development of Vehicle Accident Alert using Visible Light Communication had been proposed to reduce the number of road accident in Malaysia. Visible Light Communication are choosen as a data transmission method for this project. The main parameters of this method is light as a data transmission. The light will used to transmit the data from one point to another point. To be clear, in this project basically light will transmit the data from the transmitter part to the receiver part. To proved that the data are successfully transmitted, the buzzer will produced a sound and the LCD Display is used to displayed the data successfully received as a notification.

1.2 Problem Statement

Most of these road incidents are now blamed on drivers over speeding and improper overtaking. Some locals living along the town and villages on the major highway have taken the law into their own hands to check some of these irritating drivers, due to their hazardous behavior on our roadways. Department of Road Transport established a goal of lowering fatalities by 30% by the end of the year. When comparing Malaysia's figures to those of several industrialized and developing countries, it appears that Malaysia falls somewhere in the middle of the two groups. However, Malaysia's accident mortality rate remains concerning, with a mortality rate per 10,000 vehicles far higher than the rest of the developed world.

Therefore, to reduce the cases of road accidents in Malaysia and the number of fatalities, an ideal car accident alert using Visible Light Communication has been proposed. It ensures a vehicle alert another vehicle before a collision happens. In line with the statistic by the Director General of Road Transport Department in Malaysia, 40% of road accidents

communication for data communication to minimise cost. In addition, visible light communication also doesn't have any radiation exposure, so that this technology is safe to be utilised.

1.3 Project Objective

Based on the problem statement discussed above, the objectives of this project are as follows:

a) To produce a concept design of Visible Light Communication technology for a vehicle accident alert system.
b) To develop the hardware of Visible Light Communication technology for a vehicle accident alert system utilizing a microcontroller.
c) To verify the capability of the developed hardware on sending and receiving data.

1.4 Scope of Project

The scope of this research is established based on the objectives mentioned above. Initially, a literature study was conducted to identify basic functional blocks for a vehicle accident alert system to produce the concept design. Then, upon finalizing the concept, a feasibility study on the hardware components was done.

The design circuit was simulated using Proteus 8 software before hardware development. The Arduino software was also utilised to develop programming code before it was flashed into the microcontroller.

Next, the hardware of a vehicle accident alert system applying the Visible Light Communication technology was built. Finally, the developed system was evaluated and verified on its transmitting and receiving capability.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will go over the literature review basics before delving into the construction of a vehicle accident alert system based on visible light communication. This section also includes the studied items and items important to the study. In order to build this project, it will be necessary to conduct some research linked to the project's proposed idea. The research will concentrate on the technology and software used to build this disaster alert. The mechanical portion that needs to be designed in a functional prototype is included in the hardware part.

2.2 Visible Light Communication

VLC is convinced as one of the important segments for academics and industry. This sector is more appropriate in having wireless communication techniques. A few types of wireless communication technologies have been proposed and also already look into for the ITS data exchange, for example, IEEE 802.11 or Wi-Fi, Bluetooth and also VLC. In terms of communication range, Radio Frequency is one of the most significant solutions for us to perform a Visible Light Communication system for high traffic to increase the number of users without any mutual interferences. Because of the rise of users, it will increase the latencies of the system. Due to this case, using visible light communication technology is an effective solution. This is because visible light communication mainly uses

a light-emitting diode (LED) as the connection to sending data and also can act as a wireless optical medium for the signal to transfer [1]

Other than that, from [2] Li-Fi, also known as Light Fidelity, is a new technology introduced, which refers to a Visible Light Communication (VLC) that uses light as a track to transfer data, especially at high speeds. Since this technology mainly uses light as the main parameter, it provides a wide range of frequencies and wavelengths. This paper also compares wireless communication technologies that have been used nowadays. The comparison is as in Table 2.1

Table 2. 1 Comparison of wireless communication technologies

Feature	**WiFi [5 – 8]**	**LiFi**	**Bluetooth [5]**	**ZigBee [5]**
Mode of Operation	Using radio waves	Using light waves	Using short wavelength UHF radio waves	Using radio waves
Coverage distance	32m	10m	10m, 100m, Based on classes	10 -100m
Frequency of operation	2.4GHz, 4.9GHz and 5GHz	10000 times radio waves	2.4 – 2.485 GHz	2.4GHz
Speed of transmission	150Mbps	1 Gbps	25Mbps	250 kbit/s

This paper also provides the physical layer of Li-Fi. The physical layer is responsible for taking over and handling the transmission part and data reception. There are three layers of the physical layer in the Li-Fi technology, as specified in Table 2.2

Table 2. 2 Physical Layer of Li-Fi

S.No.	Operating Mode	Application	Data rate
1	PHY I layer	Outdoor application	11.67 to 267.6 kbit/s
2	PHY II layer	Indoor application	1.25 to 96 Mbit/s
3	PHY III layer	Colour Shift Keying (CSK)	12 to 96 Mbit/s