Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF ALCOHOL DETECTION SYSTEM WITH VEHICLE IMMOBILIZATION AND IOT

MUHAMMAD SAUDI LAI BIN MOHD FIKRI

Bachelor of Electrical Engineering Technology with Honours

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

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DATIN DR. FADZILAH BINTI SALIM
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektrik
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Alamat Tetap:

LOT 335, BLOK B8, LORONG 7C,
TAMAN WAWASAN PH2,
89807 BEAUFORT, SABAH.

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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 Electrical Engineering Technology with Honours.

Signature :

Supervisor Name : Fadzilah Salim

Date : 11/1/2022

Signature :

Co-Supervisor :

Name (if any) NURUL KAUSAR BINTI AB MAJID

Date : 11/01/2022

DEDICATION

This project is dedicated to both my parents. My mother, Dayang Saloma Binti Abg Abu Baker who did not only raise and nurture me but also a source of motivation and strength during moments of despair and discouragement. Her motherly care and support have been shown in incredible ways recently. My father, Mohammad Fikri Lai Bin Mohd Fikri has been supporting me in my education and intellectual development by going through blood, sweat and tears over the years.

ABSTRACT

In 1987, the Malaysian government passed the Road Transport Act 1987 where it is considered an offence when a person drink and drive. Through decades of research, it is concluded that drink-drivers have a higher risk of being involved in a traffic accident than non-drinking drivers. Hence the need for prevention of these accidents should be enacted in order to minimize the damaging effects of alcohol to our society. There are several ways drunk driving can be prevented, first is to designate a non-drinking driver, another is to call a taxi or a car-sharing service such as Grab. However, these methods have no way to prevent a drunk person from driving their own vehicle. Therefore, the purpose of this project is to develop an alcohol detection system with vehicle immobilization. The goal of the project is to develop a system based on a microcontroller, to monitor alcohol level in a person's breath, to create a lock mechanism on a vehicle's ignition and to evaluate the effectiveness of the project to prevention of drunk driving. The system utilizes an Arduino Uno as a microcontroller to control the input and output of the system and an alcohol sensor to measure the level of alcohol in a person's breath, moreover, an OLED will display the value of the alcohol level gained from the alcohol sensor then a servo motor is used as an automatic lock on a vehicle's ignition. This project is suitable as a method for recovering alcoholics or a person with a drunk driving offence to prevent themselves from commandeering a vehicle.

ABSTRAK

Pada tahun 1987, kerajaan Malaysia meluluskan Akta Pengangkutan Jalan 1987 di mana ia dianggap sebagai kesalahan ketika seseorang memandu dalam keadaan mabuk. Menurut kajian, didapati bahawa pemandu mabuk mempunyai risiko yang lebih tinggi untuk terlibat dalam kemalangan jalan raya daripada pemandu yang tidak minum mabuk. Oleh itu, pencegahan kemalangan seperti ini harus dikembangkan agar dapat mengurangkan kesan alkohol yang merosakkan masyarakat kita. Terdapat beberapa cara untuk mencegah daripada berlakunya pemanduan dalam keadaan mabuk, pertama adalah menetapkan seorang pemandu yang tidak minum minuman beralkohol, terdapat juga cara menghubungi teksi atau perkhidmatan e-hailing seperti Grab. Walau bagaimanapun, kaedah-kaedah tersebut tidak mempunyai cara untuk mencegah orang yang mabuk untuk memandu kenderaan mereka sendiri. Oleh itu, tujuan projek ini adalah untuk mengembangkan sebuah sistem pengesanan alkohol dengan penghalang pergerakan kenderaan. Matlamat projek ini adalah untuk mengembangkan sistem berdasarkan mikrokontroler, memantau tahap alkohol dalam nafas seseorang, membuat mekanisme kunci daripada motor servo pada penyalaan kenderaan dan menganalisis keberkesanan projek ini untuk mencegah pemanduan dalam keadaan mabuk. Sistem ini menggunakan Arduino UNO sebagai mikrokontroler untuk mengawal input dan output sistem dan sensor alkohol untuk mengukur tahap alkohol dalam nafas seseorang, lebih-lebih lagi, OLED menunjukkan nilai tahap alkohol yang diperoleh dari sensor alkohol dan motor servo digunakan sebagai kunci automatik pada pencucuhan kenderaan. Projek ini sesuai sebagai kaedah untuk memulihkan orang yang mempunyai masalah alkoholik atau kepada orang yang mempunyai sejarah jenayah pemandu mabuk.

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MPa	-	Water pressure
L/m	-	Flow rate

LIST OF ABBREVIATIONS

BAC	-	Blood Alcohol Content
OLED	-	Organic Light-Emitting Diode
V	-	Voltage
PIC	-	Programmable Interface Controllers
MCU	-	Microcontroller Unit
EML	-	Emitting Layer
HTL	-	Hole-Transporting Layer
ETL	-	Electron-Transporting Layer
HIL	-	Hole-Injection Layer
EIL	-	Electron-Injection Layer
LCD	-	Liquid Crystal Display

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CHAPTER 1

INTRODUCTION

1.1 Background

Alcohol when consumed can wreak havoc in the human body, rendering them incapable of making rational decisions and when combined with the act of driving a vehicle could not only cause harm to the consumer but also to surrounding people ultimately causing injury and worst case is death. Blood Alcohol Content (BAC) is a measure of alcohol content in a person's blood, as the level of BAC rises, the worse the effect of alcohol inflicts on a person. In Malaysia, the prescribe limit of alcohol is 35 micrograms of alcohol in 100 millilitres of breath according to Section 45G of the Road Transport Act 1987.

There are several preventive measures to this problem which include enacting higher penalties for drink-drive offences, licence suspension or revocation and use of designated drivers. However, the vulnerability through these methods is that the penalties are enforced in hopes of people might think twice before committing the act itself but in the case of a person under the heavy influence of alcohol, rational thinking is out of the question. While for the use of designated non-drinking drivers, this is a reliable way of having a safe transport following a drinking event where one person in a group will abstain from drinking and provide safe transport for others and there is also ride service such as Grab available. The downside of this method is it is vulnerable to human error such as the designated driver might be prone to drinking as well.

Thus, to mitigate the problem of drinking and driving, this project is proposed to overcome this issue by developing a system where a person must blow through a water flow sensor to an alcohol detecting sensor to get an estimated reading of BAC to unlock a vehicle's ignition. The central controlling mechanism in this project is the Arduino UNO where it monitors and controls every input and output sent to it. An MQ-3 gas sensor is used in this project to detect the presence of alcohol, it suitable for this project as it has a range of 25 until 500 ppm and sensitive to alcohol presence in the air. Then, as the locking mechanism on the vehicle's ignition, this project will be using the SG90 Metal Gear Servo. An Organic

Light-Emitting Diode (OLED) is also used to display the value of BAC picked up by the MQ-3 gas sensor and the status of the servo motor position.

1.2 Problem Statement

Transport accidents has been a major contributor to deaths in Malaysia since the year 2006. Drinking and driving adds to the fatality rate of not only to drivers but also to pedestrians. Depending on how much alcohol is ingested, the acute effects on the brain are either depressing or relaxing. In any case, alcohol causes impairment, which raises the risk of a crash by impairing judgement, increasing response time, lowering attention, and lowering visual acuity. Alcohol lowers blood pressure and depresses consciousness and respiration on a physiological level. Alcohol is both an analgesic and a general anaesthetic. Even at low blood alcohol concentrations, alcohol can affect judgement and increase the likelihood of a crash. Drivers who have consumed alcohol have a much greater risk of being involved in accidents than those who have not consumed alcohol, and this risk increases exponentially as blood alcohol content rises. Hence this project aims to detect the presence of alcohol in a person's breath to prevent the usage of a vehicle by an intoxicated person to preserve the safety of the driver and the surrounding people.

1.3 Project Objective

The objectives of this project are:

a) To design an alcohol detection system with vehicle ignition locking capabilities based on the microcontroller Arduino UNO and NodeMCU.
b) To develop a system capable of measuring blood alcohol content using MQ-3 gas sensor and vehicle tracking.
c) To evaluate the effectiveness of the alcohol detection system to drink-drive prevention.

1.4 Scope of Project

The aim of this project's scope is to provide information about the features and components that will be used. One of the scopes of the project is to utilize the Arduino Uno microcontroller as the main part of the project where it is used to process the information gained from the sensor and control the components in this project. In addition, a water flow sensor is for detecting the motion of a human blowing through to the MQ-3 gas sensor used in this project to collect the level of alcohol content in the air then sends the information to the Arduino UNO microcontroller to be monitored. Depending on the value of the alcohol detected by the MQ-3 gas sensor, an SG90 Metal Gear Servo act as the moving mechanism for the lock on the ignition of the vehicle. While the OLED is used to display information such as the level of BAC gained from the MQ-3 gas sensor and the status of the lock. Users will also be able to monitor the vehicle in real-time and send notification to the smartphone if the alcohol level is over the permissible limit.

1.5 Project Outline

This report is divided into five chapters. All these chapters are discussed in detail through the course of the project's implementation. The explanation of each chapter in this report is as follows:

Chapter 1 provides an overview of this project which includes a background statement, a problem statement, objectives of the project, scope of the project and a project outline.

Chapter 2 discusses some literatures of past studies. Some journals which are related to this project have been gathered and investigated. Technical details about materials, devices and technologies used, will be studied.

The methods utilized to complete this project is detailed in Chapter 3. The hardware and software are discussed in detail in this chapter. Additionally, materials such as project planning flowchart, block diagram and circuit diagram are also shown in this section.

While in chapter 4, the process of the system development is shown, and the results gained from testing the project components are recorded and compared to observe the impact of the project.

Lastly, chapter 5, concludes this project by revisiting the objectives of this project. The limitations of this project and recommendation for future work will also be highlighted.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the definition of alcohol in general, the impact of alcohol in the human body, its effect during driving and drunk driving regulations. This chapter also provides a summary of currently available instruments, microcontrollers in general, and alcohol sensor technologies. In addition, several previous associated works, papers, and publications related to this project will also be included.

2.2 Effects of Alcohol on The Human Body

The abuse of alcohol inflicts various harmful effects to the human body, alcohol itself is an organic compound that carries at least one hydroxyl functional group bound to a saturated atom in terms of chemistry. The term alcohol comes from the primary alcohol ethanol (ethyl alcohol). This compound is the main ingredient found in alcoholic beverages hence the name. Table 2.1 summarizes the various predictable effects of alcohol during driving on different concentration measured in Blood Alcohol Content (BAC) [1].

Table 2.1: Concentration of Alcohol and Effects on Driving

Blood Alcohol Concentration (BAC)*	• Effects	**Predictable effects on driving**
.02% Approximately equal to two alcoholic beverages	• Impairment of judgement, relaxation • small increase in body temperature • changed mood	• Impairment of visual functions • Decreased capacity to do two activities concurrently
.05% Equivalent to three alcoholic beverages	• Exaggerated behavior • Possible loss of small-muscle control (e.g., focusing your eyes) • Impairment of judgement • Usually, a pleasantsensation • Decreased attentiveness • Inhibition release	• Impairment of coordination. • Impairment in tracking moving objects. • Steering difficulty • Decreased response time in emergency driving circumstances
.08% Approximately equal to four alcoholic beverages	• Muscle coordination deteriorates (e.g., balance, speech, vision, reaction time, and hearing) • Difficulty in detecting danger. • Impairment of judgement, self-control, logic, and memory	• Impairment of concentration • Impairment of short-term memory • Impairment of speed control • Impairment of information processing abilities (e.g., signal detection, visual search)
.10% The equivalent of five alcoholic beverages	• Significant decline in reaction speed and control • Slurred speech, impaired coordination, and sluggish thinking	• Reduced ability to maintain proper lane position and apply the brakes when necessary
.15% Equivalent to seven alcoholic beverages	• Significantly less muscular control than normal (unless this level is reached slowly, or a person has developed a tolerance for alcohol)	• Significant impairment in vehicle control, concentration on the driving task, and processing of important visual and aural information

Alcohol (ethanol) is a chemical whereby it is a thin, water-soluble molecule that absorbs slowly in the liver, absorbs faster in the small intestine, and is widely spread throughout the body. Since alcohol is absorbed in the body's water, most tissues, including the heart, brain, and muscles, are subjected to the same concentration of alcohol as the blood. The liver is an exception since blood is delivered directly from the stomach and small bowel through the portal vein [2].

2.2.1 Laws and Regulations on Drunk Driving

Different jurisdictions have different standards for what constitutes a legal alcohol intake before driving. Where the alcohol concentration of a person's breath, blood, or urine crosses the permissible amount under the Road Transport Act 1987, it is illegal to drive a vehicle in Malaysia. This crime is generally referred to as "drunk driving," "drunk driving," or "driving while intoxicated." An individual who causes the death or disability of another person when driving a vehicle while under the influence of alcohol to the degree that they are incapable of maintaining proper control of the vehicle, or has an alcohol concentration in their saliva, blood, or urine that exceeds the permissible limit, commits an offence under Section 44 of the Road Transport Act 1987.

Under Section 45G of the Road Transport Act 1987, the prescribed limit for alcohol is 35 micrograms per 100 millilitres of breath; 80 milligrams per 100 millilitres of blood; or 107 milligrams per 100 millilitres of urine. If a person is detained by appropriate authorities and determined to be more than the authorised alcohol limit, the penalty is as specified in table 2.2 [3].

Table 2.2: Penalty for Drunk Driving Conviction

Offence	Penalty
Section 44 Offence (Causing Death/Injury)	• Three to ten years in prison and a fine of between RM8,000 and RM20,000. • For a period of not less than five years from the date of conviction, you are prohibited from possessing or getting a driver's licence. If convicted again, shall be permanently barred from possessing or acquiring a driver's licence for a period of ten years from the date of conviction.
Section 45A Offence	• Imprisonment for a maximum of 12 months and a fine ranging from RM1,000 to RM6,000. If convicted again subsequently, • A period of imprisonment of no more than two years and a fine of between RM2,000 and RM10,000. • For a period of not less than 12 months from the date of conviction, you are prohibited from possessing or getting a driver's license.

To obtain a sample of a breath test, a police officer or other appropriate authority will demand a person to provide a sample of his or her breath by breathing into a breath analyser. The breath analyser will produce an approximation of the amount of alcohol in a person's blood (BAC). If his or her blood alcohol level exceeds the legal limit of 80 milligrams of alcohol per 100 millilitres of blood, he or she will be prosecuted with drunk driving.