DIRECT CURRENT MOTOR CONTROLLER USING ALCOHOL SENSOR

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DECLARATION

I declare that this thesis entitled "DIRECT CURRENT MOTOR CONTROLLER USING ALCOHOL SENSOR " is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours.

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Supervisor Name : Ts. Dr. Nur Rashid bin Mat Nuri @ Md Din

Date : 17 January 2024

DEDICATION

A lot of thank you to my irreplaceable family especially my parents, Mr. Mohamad Amran bin Che Hassan, and Mrs Rosma binti Yaacob for giving me full support to manage my final year project well. And to the fellow friends and housemates, who give cooperation and knowledge sharing in completing this project.

ABSTRACT

To combat the widespread problem of drunk driving, this study integrates an alcohol sensor with a motor control system in vehicles. By automatically modifying the motor's movement in response to the driver's blood alcohol content (BAC), the goal is to improve road safety. The system measures the BAC in the car using a MQ-3 alcohol sensor and an Arduino UNO microcontroller. The motor will stop and prevent driver from running the vehicle if the BAC is higher than the set level which 0.08% following Malaysia legal restriction. Drivers may disable the system by pushing a push-to-off button if their high tolerance for alcohol leads the system to incorrectly indicate them as intoxicated. The process includes configuring hardware and using the C++ programming language. The system's effectiveness in detecting alcohol levels and its potential to reduce drunk driving are demonstrated by result findings. 40% alcohol-content liquor was used for the sensor's calibration in either direct and breath. Breath and direct are measured at 435 ppm and 645 ppm. The direct reading is higher than the breath reading theoretically proves how effective the sensor functions.

ABSTRAK

Untuk memerangi masalah pemanduan mabuk yang meluas, kajian ini mengintegrasikan sensor alkohol dengan sistem kawalan motor dalam kenderaan. Dengan mengubah suai pergerakan motor secara automatik sebagai tindak balas kepada kandungan alkohol darah pemandu (BAC), matlamatnya adalah untuk meningkatkan keselamatan jalan raya. Sistem ini mengukur BAC dalam kereta menggunakan sensor alkohol MQ-3 dan mikropengawal Arduino UNO. Motor akan berhenti dan menghalang pemandu daripada menjalankan kenderaan jika BAC lebih tinggi daripada paras yang ditetapkan iaitu 0.08% mengikut sekatan undang-undang di Malaysia. Pemandu boleh melumpuhkan sistem dengan menekan butang tekan untuk mati jika toleransi tinggi mereka terhadap alkohol menyebabkan sistem secara salah menunjukkan mereka sebagai mabuk. Proses ini termasuk mengkonfigurasi perkakasan dan menggunakan bahasa pengaturcaraan C++. Keberkesanan sistem dalam mengesan tahap alkohol dan potensinya untuk mengurangkan pemanduan dalam keadaan mabuk ditunjukkan melalui penemuan keputusan. 40% minuman keras kandungan alkohol digunakan untuk penentukuran sensor sama ada secara langsung dan nafas. Nafas dan terus diukur pada 435 ppm dan 645 ppm. Bacaan langsung lebih tinggi daripada bacaan nafas secara teorinya membuktikan keberkesanan fungsi sensor.

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LIST OF SYMBOLS AND ABBREVIATIONS

DC	-	Direct Motor
LCD	-	Liquid Crystal Display
BAC	-	Blood Alcohol Content
ppm	-	Parts per Million
IR	-	Infrared
GPS	-	Geographical Positioning System
GSM	-	Global System for Mobile Communication
LED	-	Light Emitting Diode
SRAM	-	Static Random Access Memory
EEPROM	-	Electronically Erasable Programmable Read-Only Memory

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CHAPTER 1

INTRODUCTION

1.1 Background

Drunk driving is an increasing issue all around the world, causing endless accidents and deaths. This project addresses the problem by incorporating an alcohol sensor that monitors a driver's alcohol levels and automatically controls the speed of the DC motor accordingly. If the sensor detects a high alcohol concentration, the motor's speed will be decreased or stopped, assuring the driver's and other drivers' safety.

In this project, alcohol sensor will detect the alcohol level in the vehicle and decide wether the driver is intoxicated or not. If the driver has been found intoxicated, then the alcohol sensor will rely the info to the Arduino to process then delivered the data to the motor for further action. The motor presenting the engine of the vehicle will stop operating completely as soon as the alcohol level surpass the limit value that have been set in the programme. However, user can turn off the system by activating the push to OFF button in case of high level of alcohol detected but the driver is sober and have high tolerance towards alcohol. This will allow the motor to run normally again.

This application will fill the research gap by providing driver-specific customization that allows drivers with high tolerance to drive the car comfortably even when the alcohol sensor reading is high. Next, implication for ethic and law can be confronted by allowing the user to enter the legal amount of alcohol content in the country in which they reside. Each country have different law that allow different level of alcohol content for driver. Drivers can choose whether to set the alcohol level in accordance with the law or to lower the level for better security.

In conclusion, this project provides an innovative approach to address the issue of drunk driving by integrating alcohol sensing technology with motor control. The method attempts to improve safety and reduce the risks associated with drunk driving by automatically modifying motor speed based on alcohol content. The project has plenty of potential applications and assists to create a safer environment in a variety of circumstances.

1.2 Problem Statement

Accidents involving drunk driving present a serious danger to public safety and are responsible for many injuries and fatalities on a global scale. Accidents involving intoxicated drivers continue to be an issue despite current legislation and awareness initiatives. This continuous problem is worsened by the lack of policies that effectively stop people from operating vehicles while under the influence of alcohol. There are limitations to how well current strategies like law enforcement and public education can prevent people from engaging in this risky behaviour. As a result, it is vital to create new approaches that may proactively address the issue of drunk driving accidents and reduce the threats related. The suggestion for new proactive approach is develop an alcohol detection system in the vehicle.

According to data provided by the World Health Organization (WHO), harmful consumption of alcohol causes around 3 million deaths annually, or 5.3% of the total deaths worldwide (World Health Organization, 2022). Furthermore, the National Highway Traffic Safety Administration reported that alcohol-impaired driving accidents resulted in 10,511 deaths in the United States alone in 2018, accounting for 29% of all deaths involving motor vehicles. These numbers highlight the serious and widespread impact of alcohol-related accidents (Center for Disease Control and Prevention, n.d.).

On the other hand, referring to the WHO's Global Status Report on Road Safety for 2015, South Africa is one of the world's most dangerous countries for road accidents, with 25.1 deaths per 100,000 inhabitants each year. Surprisingly, alcohol drinking is responsible for approximately 6 out of every 10 traffic deaths (58 percent) in South Africa (McCarthy, 2016).

1.3 Research Objective

This research offer a few amount of objective that can be convenient for the safety of the user and other driver. The objective are:

1. To study the alcohol detection system in automotive.

2. To develop a device to detect the alcohol in the car.

3. To test the effectiveness of the system.

1.4 Scope of Research

The scope of this research are as follows:

Region: Malaysia (Legal BAC level = 0.08%)

• System design:

The project involves designing the overall system architecture that connects the alcohol sensor to the DC motor controller. Selecting appropriate sensor technology, determining sensor positioning for precise alcohol detection, and creating the connection and methods for communication between the sensor and the motor controller are all part of this process.

• Control Mechanisms:

The project involves developing of control systems within the DC motor controller to respond to alcohol impairment. This may entail installing safety measures such as speed restriction, acceleration limiting, or activating safety processes to avoid accidents caused by drunk driving.

• Performance Optimization:

The project scope includes improving system performance through the refinement of algorithms, calibration procedures, or control mechanisms. Identifying areas for improvement, correcting limits, and improving the system's responsiveness and efficacy in detecting and preventing alcohol-impaired operation are all part of this process..

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A driver's incapacity to operate a vehicle safely has been related to high levels of alcohol consumption, which increases the likelihood that the driver may be involved in accidents. Because drinking and driving increases the probability of accidents that result in injury or death. 44 people lost their lives in 771 incidents of alcohol-related accidents between 2016 and 2020, according to Datuk Seri Ismail Abd Muttalib, the deputy minister of housing and local government (KPKT). According to data from The Royal Malaysian Police (PDRM), 8 fatalities resulted from 21 incidences of drunk driving that were recorded between January 2020 and May 2020. In order to address this issue, the Malaysian government implement a new regulation in the updated Road Transport Act 2020 that propose severe penalties for irresponsible driver who are drunk driving (TheMole, 2019). In addition, the government will reduce the allowed level of alcohol from 35 micrograms to 22 micrograms per 100 ml of breath.

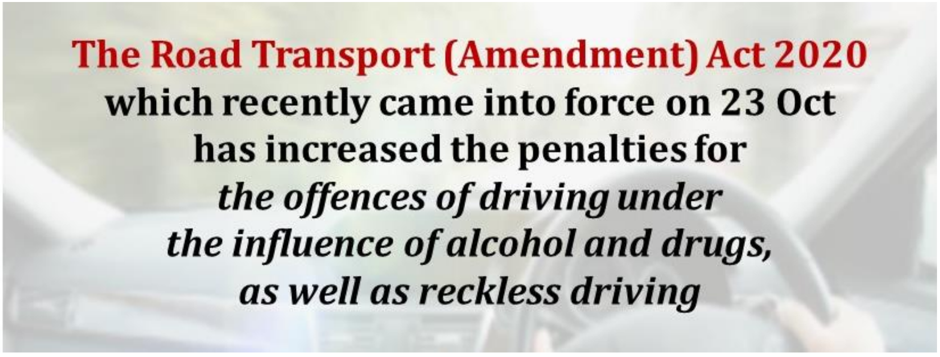


Figure 2.1 The Road Transport (Amendment) Act 2020 (Lie, 2020)

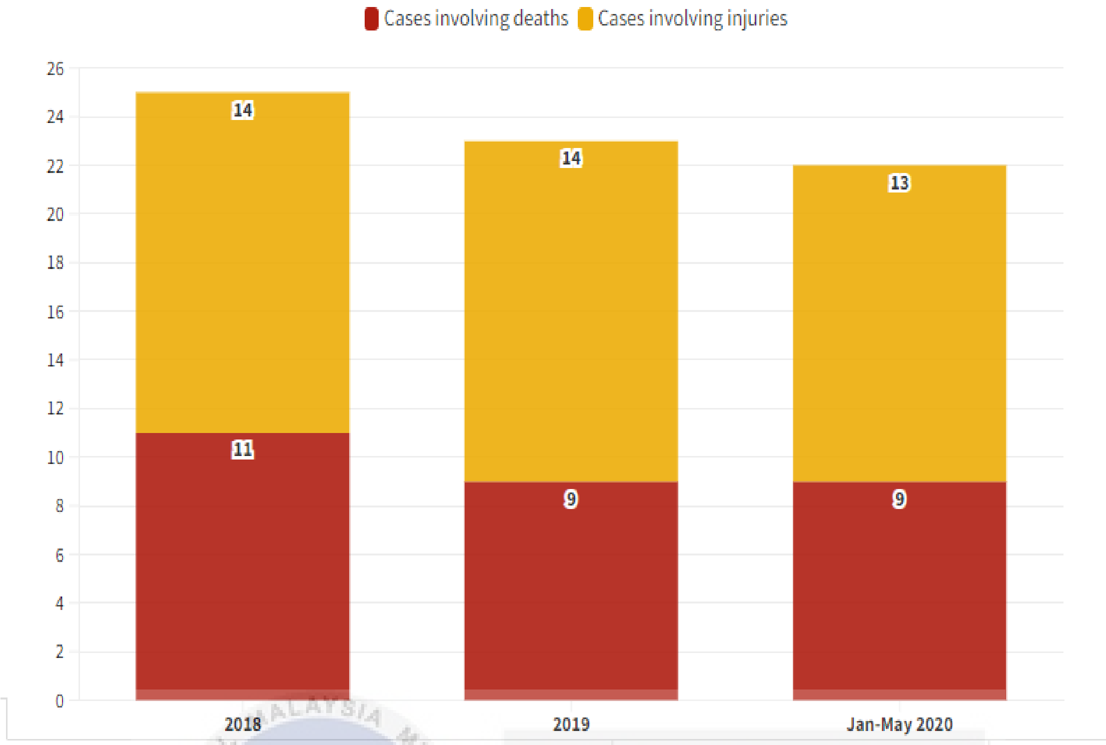


Figure 2.2 Total driving case involving deaths or injuries in Malaysia

2.2 Measurement of Alcohol Content

The term "blood alcohol content" (BAC) refers to the measurement of the amount of alcohol in the blood, expressed in milligrammes per litre (mg/L). Blood alcohol levels are affected by a number of variables, including the quantity of drinks consumed, the drunken person's weight, gender, body fat, and the meal they eaten shortly before drinking. Since alcohol reaches into the bloodstream slowly on an empty stomach, a person is more likely to have a higher blood alcohol content. Blood alcohol content had a legal limit as early as 0.15%. According to Section 45G of the Road Transport Act of 1987, the government of Malaysia has released a new amendment to the restrict upon alcohol consumption, which is now set at 22 micrograms per 100 millimetres of breath, 80 milligrammes per 100 millilitres of blood, and 67 milligrammes per 100 millimetres of urine (Fan, 2022). Given that the legal limit for blood testing is 80 milligrammes, there is a way to assess blood alcohol content.

Firstly, it should be mentioned that a typical conversion factor of 2100:1 is used to estimate blood alcohol content. This means that 1 millilitre of lungs' air contains 2100 times as much alcohol as 1 millilitre of blood. 210 litres of breath are measured in grammes to calculate the ethanol weight that serves as the BAC representation. Next, multiply the result by mg/L of breath and divide 210 by 1000 to determine the BAC percentage. The following formula can be used to determine the percentage of BAC:

$$\%BAC = breath \text{ (mg/L)} \times \frac{210}{1000} \qquad Eq.\ 1$$

$$0.08 = \text{breath(mg/L)} \times \frac{210}{1000}$$

Breath(mg/L) = 0.381

Malaysia's average BAC is typically reported to be 0.08%. When the breath (mg/L) for a 0.08% BAC is corresponding to 0.381 for the equivalent level of BAC, the equation can be used to determine the parts per million (ppm). To convert breath (mg/L) to ppm, we need to know the conversion factors for alcohol which is ethanol.

Table 2.1 Chemical properties of Ethanol (T.James, 1996)

Synonym	Ethyl alcohol
Formula	CH3CH2OH
CAS number	64-17-5
Molecular weight	46.07
Boiling point	78.5°C
Melting point	-114.1 °C
Specific gravity	0.789 at 20°C
Vapor pressure	43 torr at 20°C
Solubility	Miscible with water and most organic solvents
Conversion factors	1 ppm = 1.88 mg/m3 = 0.00188 mg/L 1 mg/m3 = 0.531 ppm = 0.001 mg/L

Ppm = Breath(mg/L) × $\frac{1\,ppm}{0.00188 mg/L}$ $Eq. 2$

Ppm = 0.381 × $\frac{1\,ppm}{0.00188 mg/L}$

Ppm = 202.6596 ppm

2.3 Review of the Previous Research

The sensor that detects the existence of alcohol in the automobile, which is used by numerous researchers to determine the alcohol level, has been the subject of lots of study that can be accessed online. Furthermore, even if the legislation has been altered, there are still incidents when drunk driving is involved. The purpose of the literature review for this study is to gather data or research on earlier studies that have been relevant to the in-car alcohol detection system. This research will also determine how to enhance the process of detecting alcohol present and supplying a better comprehension of the research study that has been discussed and summarized, as in Table 1. Table 1 provides an overview of previous attempts to develop an alcohol detection system. It can be observed from the table, the only variation between all the studies is the mechanism for notification, which makes use of the communication features. However, there is research that does not employ notifications in preference for concentrating more on how to start a car's engine. To sum up, a few of the characteristics may be used to the bachelor's degree project to create an alcohol detection system.

Table 2.2 Comparison between Arduino mega vs Arduino uno

ARDUINO	UNO	MEGA
Microcontroller	ATmega328	ATmega2560
Operating Voltage	5V	5V
Input Voltage	7-12V	7-12V
Digital I/O Pins	14	54
Analog Inputs Pins	6	16
DC Current per I/O Pin	40mA	40mA
DC Current for 3.3V Pin	50mA	50mA
Flash Memory	32KB	256KB
SRAM	2KB	8KB
EEPROM	1KB	4KB
Clock Speed	16MHz	16MHz

Table 2.3 Components used by previous research

Article 1	Article 2	Article 3	Article 4
Power Supply	Power Supply	Power Supply	Power Supply
Atmega2560 of Arduino Mega	Atmega328 of Arduino Uno	AT89S51	PIC 16F876A
Alcohol Sensor (MQ-3)	Alcohol Sensor (MQ-3)	Alcohol Sensor (MQ-3)	Alcohol Sensor (MQ-3)
GSM Module	SIM900A module.	Comparator	Ignition System
DC Motor	DC Motor	Ignition System	Alarm
LED	LED	Relay	LCD
GPS Tracker	Ultrasonic Sensor	Buzzer	
Buzzer	LCD		
LCD			
Push Button			

2.4 Summary of Article 1

The article by Muthukarpan et al. (2021) investigates the problem of drunk driving accidents on Malaysian roads. The country has a high death rate from traffic accidents, with drunk driving being a major factor. Using a breathalyzer to detect alcohol in drivers is an ineffective and unworkable method. As a result, the article offers a new system that detects alcohol in the driver's breath and perspiration using alcohol sensors such as MQ-3 and IR sensors. For thorough detection and warning, the system also includes a mobile phone accelerometer, ignition lock, GPS tracker, GSM module, LED lights, and a buzzer.

The study approach includes integrating and controlling the system's multiple parts utilizing an Arduino Mega board and microcontroller. Flowcharts show the overall system process, GPS tracking, and GSM module functionality. The alcohol sensor monitors the amount of alcohol in the driver's breath and, based on the results, the system activates alerts, controls the engine, tracks the vehicle's location, and sends SMS notifications to police and relatives.

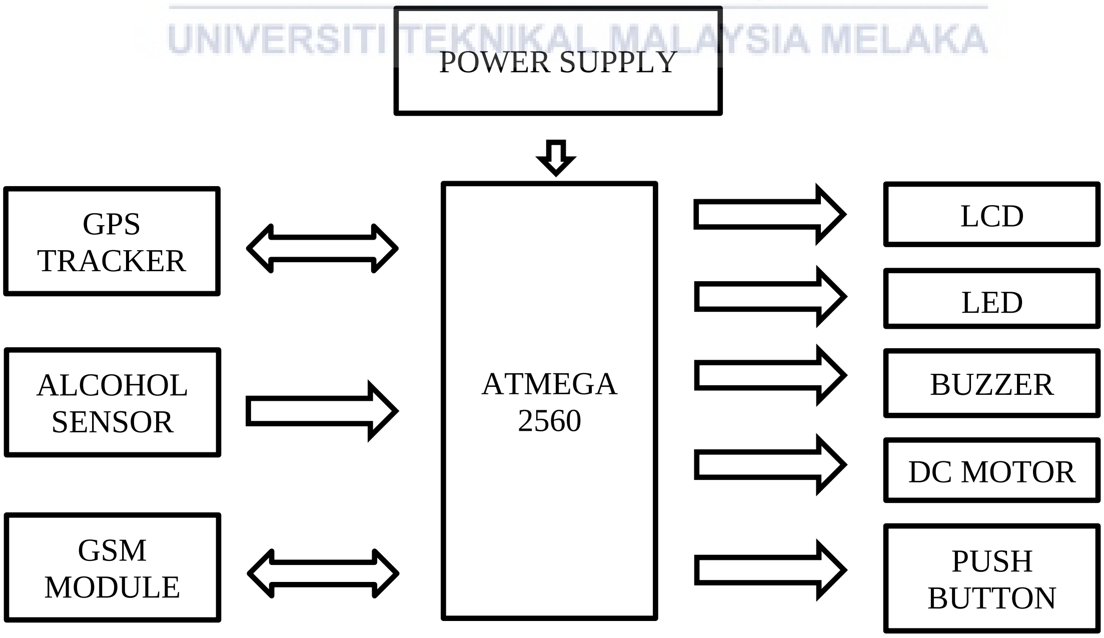


Figure 2.3 Block diagram of the system

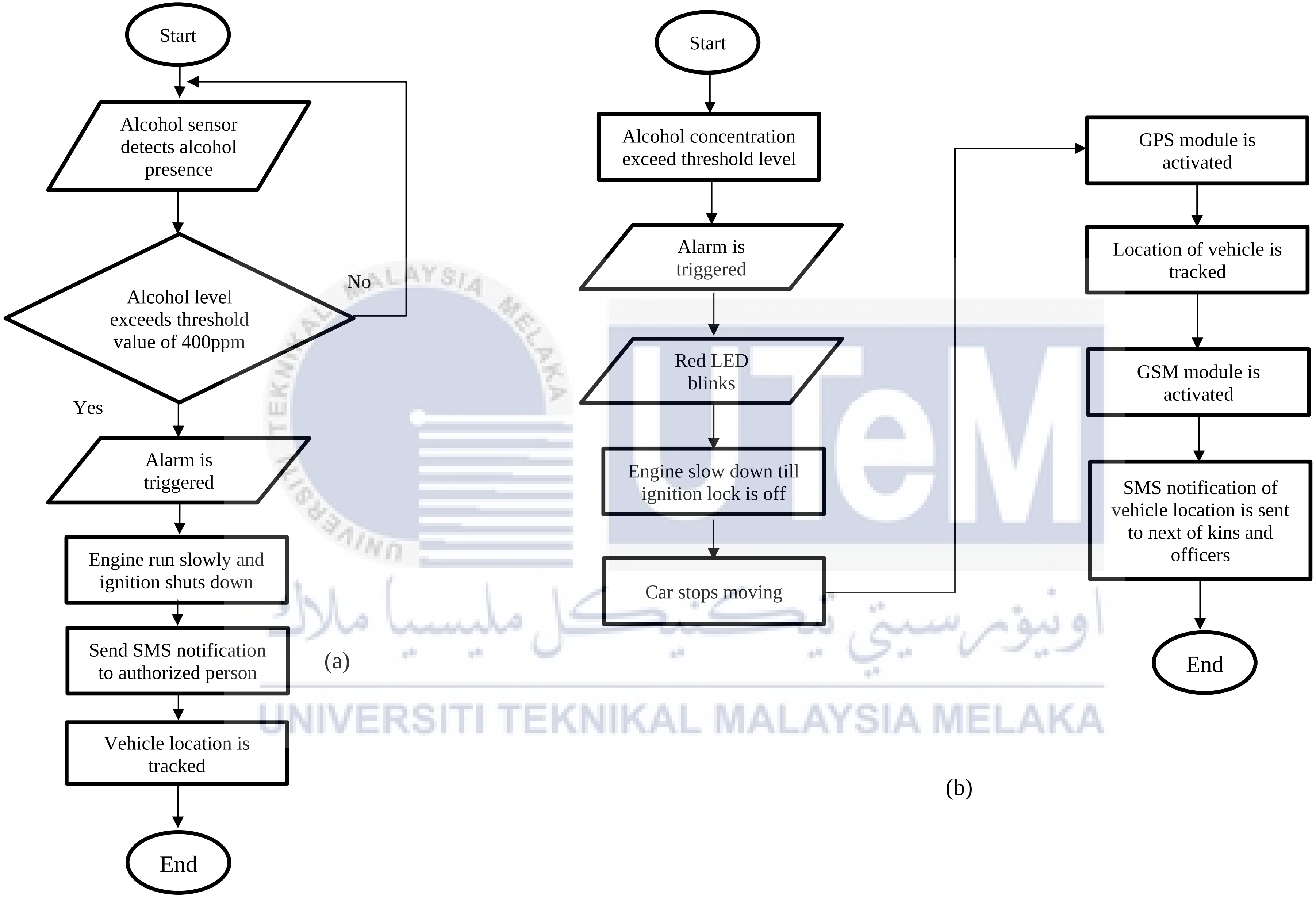


Figure 2.4 Flowchart of overall system (a) and GPS and GSM (b)

2.5 Summary of Article 2

According to Kumar et al. (2019), drunk driving is a major cause of traffic accidents, putting both the driver and other road users at danger. Due to the restricted ability of police officers to detect intoxicated drivers immediately, the enforcement of laws prohibiting drinking and driving has been difficult. This paper investigates the need for an alcohol detection system that is not limited by space or time, with the goal of lowering the number of accidents caused by drunk driving.

The research goes through the major components of the alcohol detection system. It focuses on the Arduino Uno microcontroller, which serves as the system's main development board. The ultrasonic sensor, MQ-3 sensor for alcohol detection, buzzer to indicate alcohol presence, DC motor for engine locking, SIM900A module for providing alerts, and LED for visual indication.

The literature review provides a summary of related works in the topic. It provides an overview of various research papers and the contributions they make to alcohol detection systems. The application of various sensors, such as the MQ-3 sensor, GPS module integration, helmet-based alcohol detection systems, heart rate monitoring, and image processing for avoiding crashes are all discussed.

The methodology chapter covers the alcohol detection system's detailed process. It explains how the MQ-3 sensor detects alcohol concentration and, if it exceeds a certain threshold, the Arduino Uno stops the DC motor and triggers the red LED to signal a dangerous distance. The SIM900A module oversees delivering a message to authorities informing them of the dangerous vehicle.

This article investigates the applications and benefits of the alcohol detection system. It emphasizes its possible deployment in numerous vehicles, its role to preventing drunk driving incidents, and its utility for law enforcement. Further development possibilities are also considered, such as integrating a GPS module for location tracking. In addition, the system's code, written in the C programming language, is shown.

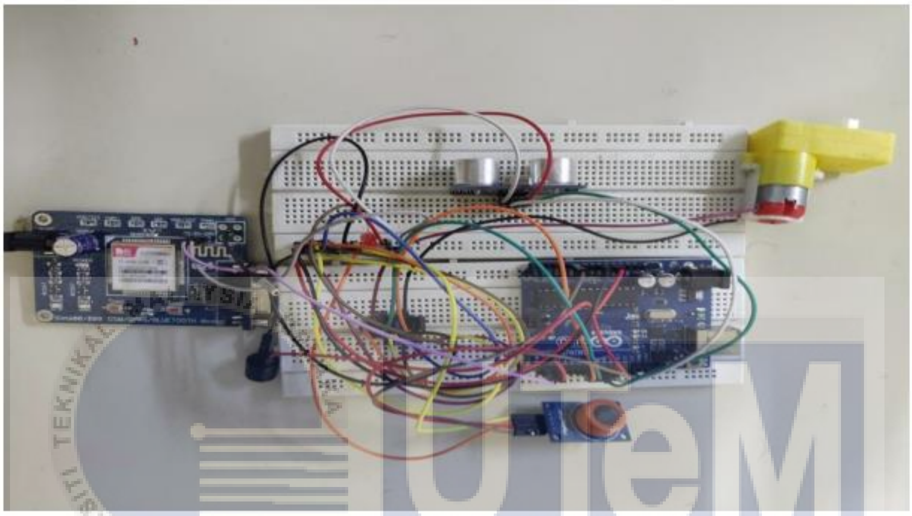


Figure 2.5 Image of the whole system

The implementation of an alcohol detection system is an effective method for reducing road accidents caused by drunk driving. The system's ability to detect alcohol concentration and respond immediately by shutting the engine and alerting authorities improves vehicle safety. GPS integration for real-time location tracking may be added in the future. Overall, this method helps to develop vehicle safety and accident prevention.

2.6 Summary of Article 3

Referring to S. V. Altaf et al. (2017). The essay points out the problem of drunk driving accidents and the importance for a mechanism to detect and prevent such instances. The authors suggest a system that detects the driver's alcohol consumption using a microcontroller and a MQ3 alcohol sensor. The device is intended to shut off the vehicle's engine if alcohol is discovered, and it also includes capabilities such as monitoring the vehicle and decreasing fuel delivery.

The paper's related work section summarises past research in this field. PIC 16876A controller, GSM and GPS technology, IR LED 894, IR sensor, and a real-time online prototype driver-fatigue monitor are among the works described. These earlier studies used sensor-based systems to detect alcohol use, monitor driver weariness, and ensure driver safety.

The suggested alcohol detection and motor locking system's architecture is given, which contains components such as the AT89S51 microprocessor, alcohol sensor (MQ3), LCD display, fuel supply blocker, and relay. The central control unit is the AT89S51 microprocessor, and the alcohol sensor monitors alcohol concentration in the driver's breath. When alcohol is discovered, the fuel supply blocker cuts off fuel delivery to the engine, and the LCD display displays signals and warning messages to the driver.

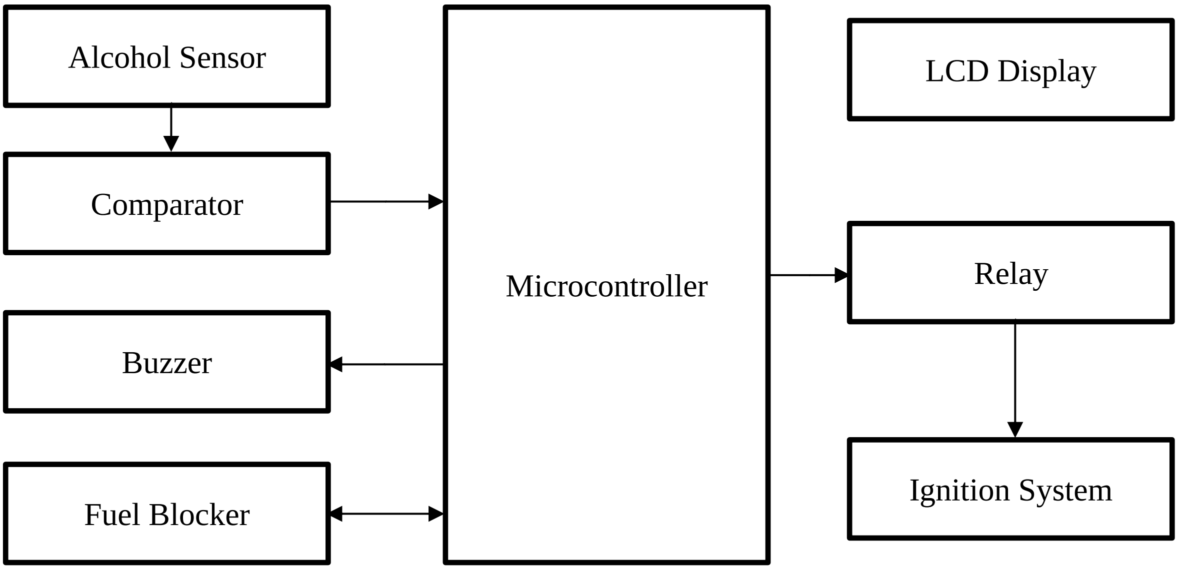


Figure 2.6 Block diagram of alcohol detection and Engine locking with fuel blocker

According to the report, installing the proposed system in automobiles can lead to safer journeys, fewer injuries during accidents, and a lower accident rate due to drunk driving. The system's capacity to detect alcohol on the driver's breath and halt the ignition or cut off fuel supply seeks to reduce drunk driving incidents.

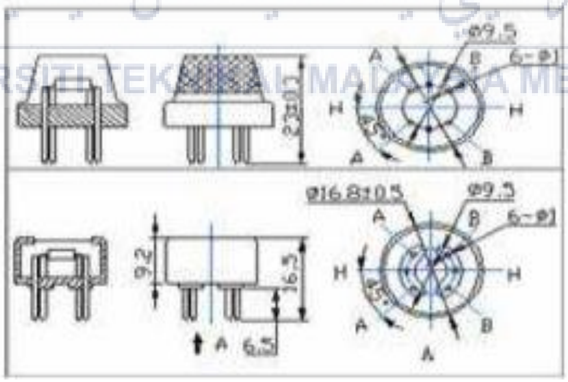


Figure 2.7 Overview of MQ-3 sensor

Although the literature review offers an overview of the suggested alcohol detection and motor locking system, it is crucial to highlight that to obtain a deeper understanding of the topic, a more extensive assessment of existing literature and research in this field should be done.

2.7 Summary of Article 4

A car accident prevention system incorporated with an alcohol detector is discussed by M.H Mohamad et al. (2013). The goal of this approach is to prevent traffic accidents related by drinking and driving. The project combines an alcohol sensor (MQ-3) with a microcontroller to detect the presence of alcohol in human breath. It also has an ignition mechanism that is controlled by the level of blood alcohol content (BAC) detected by the alcohol sensor.

The analysis emphasises the rise in traffic accidents in Malaysia as a result of variables such as population expansion and higher living standards. Driving under the influence of alcohol is a major contributor to these collisions. The review cites data from the Malaysian Institute of Road Safety Research (MIROS) that show a considerable percentage of accidents and deaths are caused by drunk drivers.

The suggested system incorporates many components to overcome this issue. The MQ-3 alcohol sensor detects alcohol in human breath and transmits the information to a microprocessor (PIC 16F876A). An LCD display reveals the driver's level of drunkenness, and an alarm system warns the driver and others close. If a particular BAC level is detected, the ignition system is designed to disable the vehicle's engine.

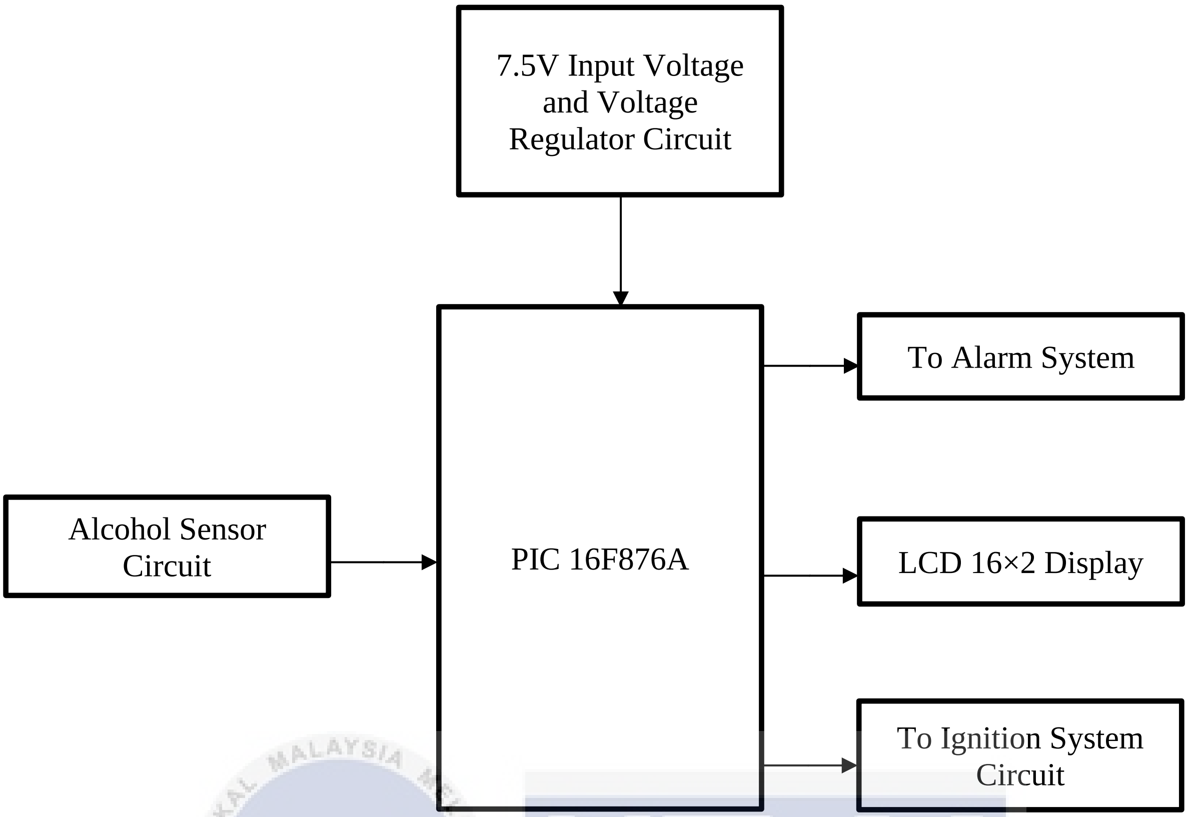


Figure 2.8 Block diagram of the system

The system's hardware development entails designing the circuit and printed circuit board (PCB). The software development process is focused on simulating the circuit and designing the code that will be incorporated in the hardware. PIC C Compiler is used to write instructions, while PIC Kit 2 Programmer is used to load the programme into the microcontroller.

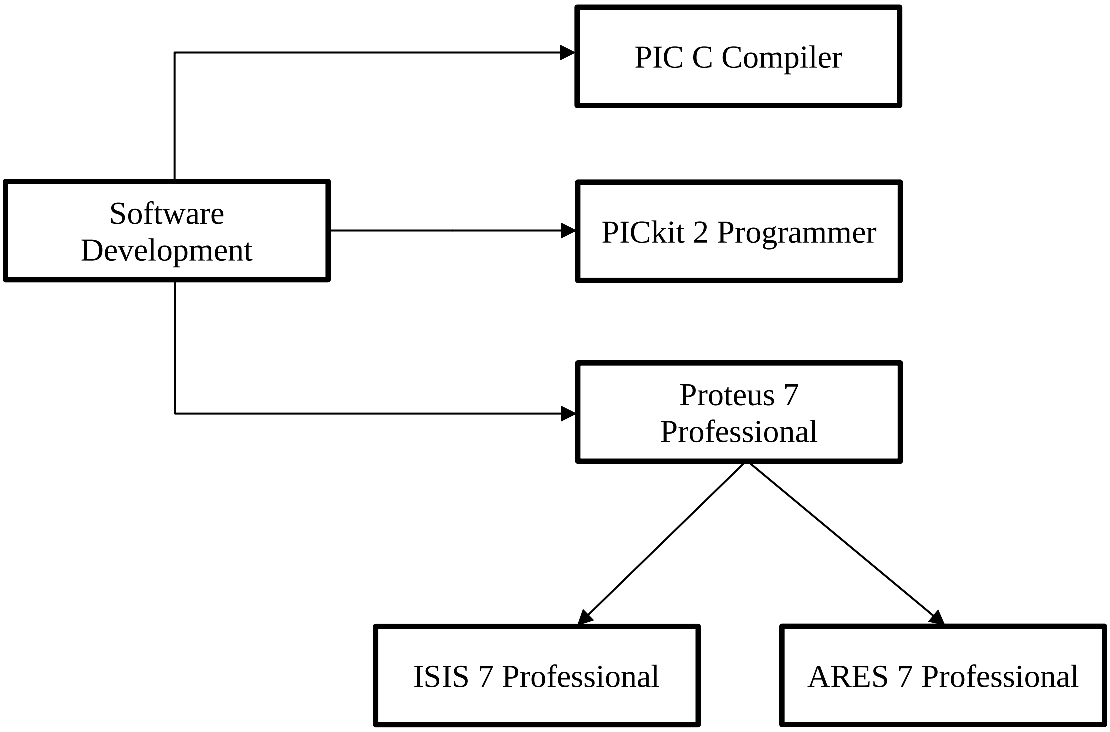


Figure 2.9 Software development

The experimental part explains the system prototype's construction, which contains the PIC 16F876A microcontroller, an alcohol sensor circuit, an alarm system, an LCD display, and an ignition system. The flowchart of the system depicts the response based on the voltage output of the alcohol sensor. The approach divides BAC values into three categories: intoxication, mildly intoxicated, and drunkenness.

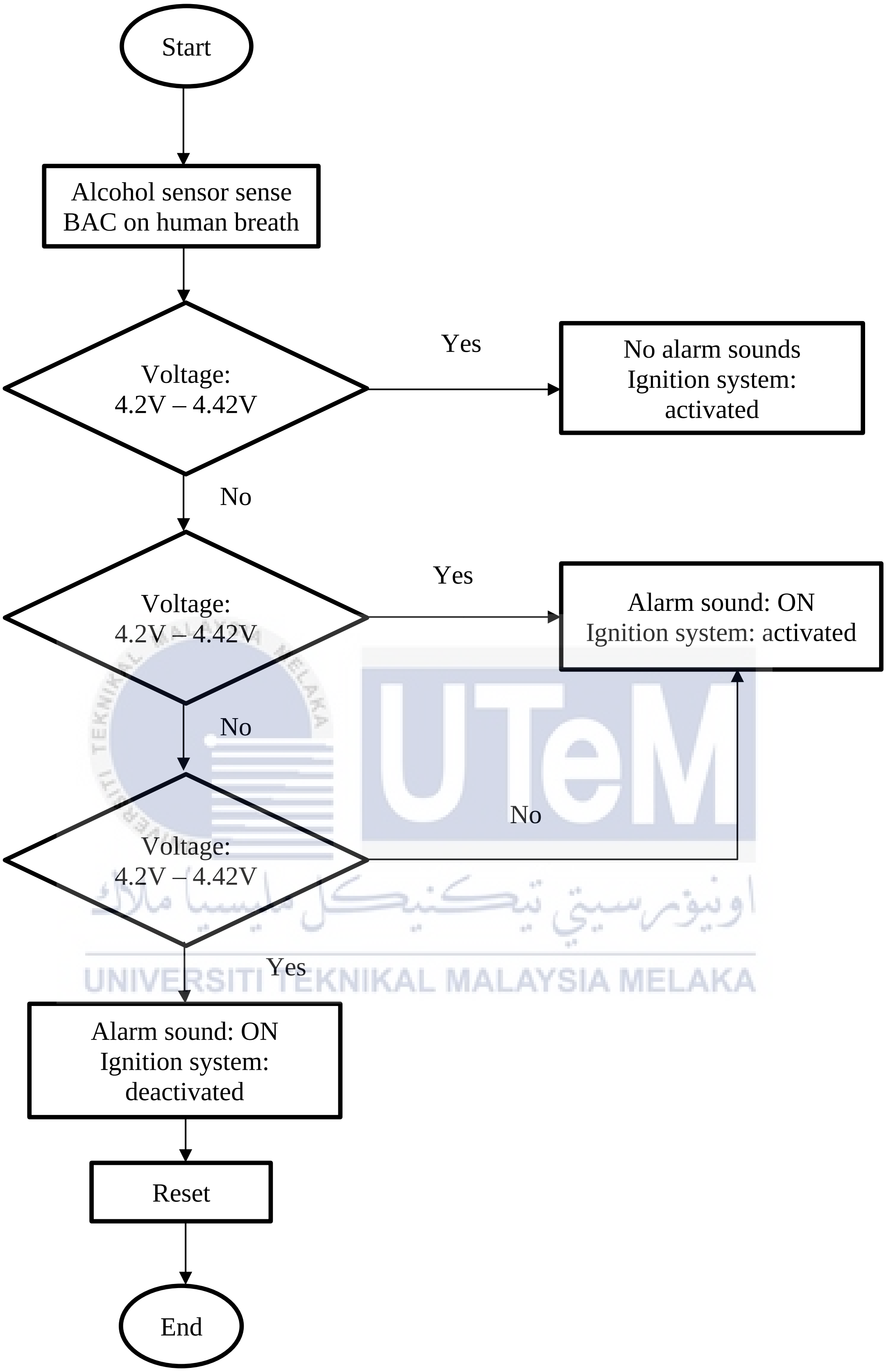


Figure 2.10 Flowchart of the system

Figure 2.11 Prototype overview

The findings and discussion section displays the obtained results for various levels of intoxication based on the ppm (parts per million) values observed by the alcohol sensor. Based on the BAC level, the system successfully displays the related conditions on the LCD display, triggers the alarm system, and enables or disables the ignition system.

Table 2.4 Result achieved in different level of drunkenness in ppm

Output	Level of Drunkenness		
	130 ppm - 260 ppm	261 ppm - 390 ppm	391 ppm - 650 ppm
LCD Display	“intoxication”	“slightly drunk”	“drunkenness”
Buzzer	Off	On	On
Ignition System	enable	enable	disable

To summarise, the vehicle accident prevention system equipped with an alcohol detector provides an effective answer to the problem of drunk driving. The technology cautions the driver, warns others nearby, and ultimately prevents very drunk drivers from starting the vehicle's engine, lowering the likelihood of an accident.

Table 2.5 Comparison of previous research for detecting alcohol

Article	Operation of the System	Microcontroller and sensor	Ignition System
1	The system detects the presence of alcohol using a microcontroller and a sensor and utilizes IOT components to notify officers of the intoxicated driver's present location. The system also displays notifications when the alcohol level is high or low.	ATMEGA 2560 of Arduino Mega as controller and use sensor MQ-2 first and then change to MQ-3 sensor for better detection.	Turn off the ignition system when the prescribed limit is more than 400 ppm.
2	The MQ-3 sensor analyses the presence of alcohol in the environment. If the alcohol concentration is high, the sensor will send the reading to Arduino, and the DC motor, which represents the car's engine, will stop. The location will be sent to the civil forces for action using the notification system.	Arduino Uno as microcontroller, MQ-3 sensor as sensor for the detection system.	Turn off the DC motor when the reading of alcohol is greater than the threshold level.

3	Microprocessor and MQ-3 sensor used to detect alcohol level in the vehicle. If alcohol is discovered, the system shuts down the engine and adds function like vehicle monitoring and decreased fuel delivery.	AT89S51 as microcontroller and MQ-3 sensor for the alcohol detection.	When alcohol is detected, the system turns off the engine, monitors the car, and reduces fuel delivery.
4	The system combines a microcontroller and a MQ-3 sensor to detect alcohol in the driver’s breath. It contains an ignition mechanism that been controlled by the detected BAC. When alcohol is detected, the system will warn the driver and disable the engine at certain BAC levels.	PIC 16F876A act as microcontroller and MQ-3 sensor to detect alcohol level in surrounding.	Detects alcohol in human breath, shows the driver's level of intoxication, alerts the driver and others, and turns off the vehicle's engine if a specific BAC level is discovered.

2.8 Research Gap

Drunk driving seems to be the leading cause of accidents, injuries, and fatalities on the road. Excessive alcohol consumption blocks a driver's ability to operate a car safely, increasing the chance of an accident. Acknowledging the severity of the situation, governments have implemented harsher laws and regulations to discourage and prevent drunk driving incidences. As a result, researchers have investigated the development of alcohol detecting devices for vehicles in order to improve safety measures. However, there are significant research gaps in this subject that require further exploration and innovation.

While the studies described above offer alcohol detection devices for vehicles, there is a need for more study on real-time monitoring of alcohol levels while driving. Existing research focuses mostly on detecting alcohol in the driver's breath and acting, such as locking the vehicle or shutting off the fuel supply. However, there is a lack of attention to continuous, real-time alcohol monitoring during the whole journey. Researchers can get useful insights on the driver's impairment and intervene proactively by using technologies that enable continuous monitoring, such as wearables or sensors integrated in the vehicle's interior.

In addition, while present research relies on alcohol sensors, microcontrollers, and basic display systems, modern technologies have the potential to improve the accuracy and effectiveness of alcohol detection systems. The application of intelligent technology, machine learning, or data analysis may provide opportunities for greater detail alcohol level and pattern analysis. These technologies have the potential to increase detection accuracy, offer specific boundaries based on individual driver characteristics, and enable rapid responses.

The next research gap is driver-specific customization. Individual alcohol tolerance levels and reactions to alcohol use are likely to differ from driver to driver. As a result, it is critical to create systems that can be personalised to specific driver profiles. Weight, gender, metabolism, and personal traits should all be considered when establishing personalised criteria for alcohol detection and intervention. It is possible to provide more accurate and effective monitoring by adapting the system to the individual demands and features of each driver.

Furthermore, another research gap that we face is user acceptability and behaviour change. Investigating drivers' attitudes, beliefs, and behaviours regarding alcohol detecting technologies. Understanding how drivers view these technologies, their acceptability levels, and any behaviour changes they may cause can provide significant insights into their effectiveness and identify any obstacles to their acceptance.

Finally, the research gap is the implications for ethics and law. Installing alcohol detecting devices in vehicles creates ethical and legal concerns. It is critical to investigate the potential consequences of these systems, including as privacy, consent, reliability, and the legal implications for drivers. Understanding and addressing these concerns is critical for successful alcohol detection system implementation and acceptance. To effectively move through these ethical and legal obstacles, research should focus on constructing strong privacy frameworks, assuring transparency, and setting legal rules.

In conclusion, numerous research gaps must be filled in order to develop alcohol detection systems for vehicles. Researchers can promote advancement in this field by focusing on real-time monitoring, integrating advanced technology, applying driver-specific modification, evaluating system effectiveness, and considering ethical and legal consequences. These initiatives are going to assist in developing effective, dependable, and socially acceptable alcohol detection devices that will improve vehicle safety, reduce drunk driving incidences, and ultimately save lives on the road. Constant research and collaboration among academics, business, and regulators is critical to meeting these objectives in order to create a safer driving environment for everybody..

2.9 Summary

Excessive alcohol consumption is among the leading causes of traffic accidents and fatalities. To address this issue, the Malaysian government enforced tighter laws, including lowering the legally allowed maximum of alcohol consumption. Several experiments have been undertaken in order to develop alcohol detecting devices for vehicles. Certain research suggests a device that detects alcohol intake and immediately shuts down the engine using a microcontroller and a MQ3 alcohol sensor. Other research has concentrated on combining alcohol sensors with microprocessors, LCD screens, and alarm systems to alert the driver and prevent ignition. However, there are several research gaps in this topic. Existing research does not include continuous, real-time alcohol monitoring throughout the journey, and there is an opportunity for improvement by incorporating intelligent technologies and machine learning for more accurate identification. It is also critical to customise the system to driver characteristics. More study is required to assess the acceptance and behaviour change of the user, as well as to address ethical and legal concerns. Alcohol detection systems can be enhanced by solving research gaps in order to improve vehicle safety, minimise drunk driving occurrences and save lives on the road.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In general, there are too many obstacles in this topic to create a complete or perfect mechanism to reduce drunk driving incidents. Some of them are real-time monitoring of alcohol levels while driving, accuracy and effectiveness of alcohol detection systems, driver-specific customization, user acceptance and behavior change and implications for ethics and law. Therefore, to minimize the gap in this research, an approach is made to fulfil at least one of the gaps. The general concept behind the proposed model is to tackle research gap which is driver-specific customization. As we know that each person has their own tolerance towards the alcohol. The question is how do we determine that the driver is sober enough to drive the vehicle normally? In order to complete the project, it was finalized which type of hardware and software specification would best suit the mechanisms. The specification is described below.

Table 3.1 Specification of hardware and software

Hardware	Software
Arduino UNO as microcontroller	Arduino IDE
MQ-3 Alcohol Sensor	Fritzing
DC Motor	
LCD	
Push to OFF Button	
Relay Module	

3.2 Proposed Methodology

3.2.1 Block Diagram

Figure below shows the block diagram of the proposed system. Microcontroller used in this project is ATmega328 of Arduino UNO. All the components are embedded to this microcontroller. Since it recognises the presence of alcohol in the driver's breath and transmits information to the microcontroller for additional actions, the alcohol sensor which is MQ-3 will act as the microcontroller's input. The LCD and DC motor are linked to an output from the microcontroller, as can be witnessed in the block diagram.

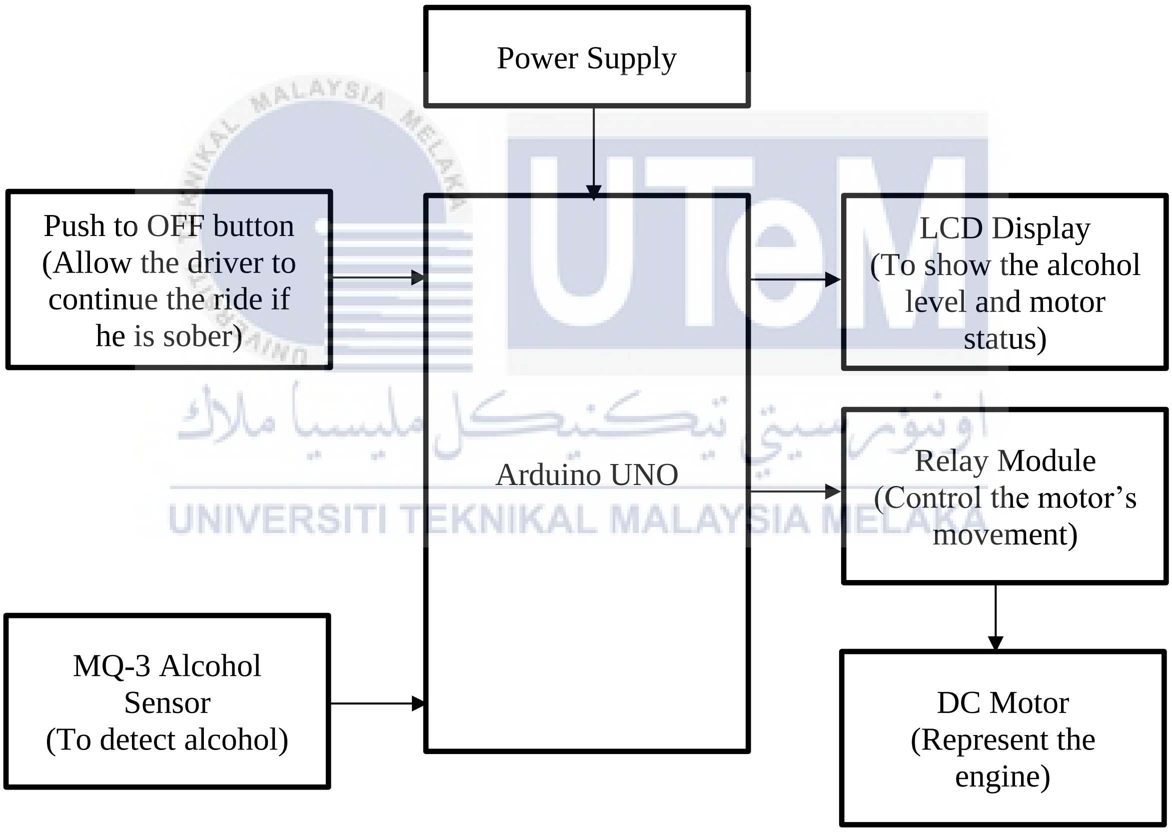


Figure 3.1 Block diagram of the system

3.2.2 Flowchart

There are two possible results from this experiment. Either a low or a high level of alcohol present is detected. Firstly, user will have to enter the BAC following the legal BAC level of the country. If the reading is lower than the setting BAC level, the motor will continue to run normally. On the other hand, if the sensor detects BAC higher than the value that have been set, the motor will shut down on its own except if the push to OFF button is activated then the driver will be able to drive the car normally. This flowchart is applicable to both simulation and experimental.

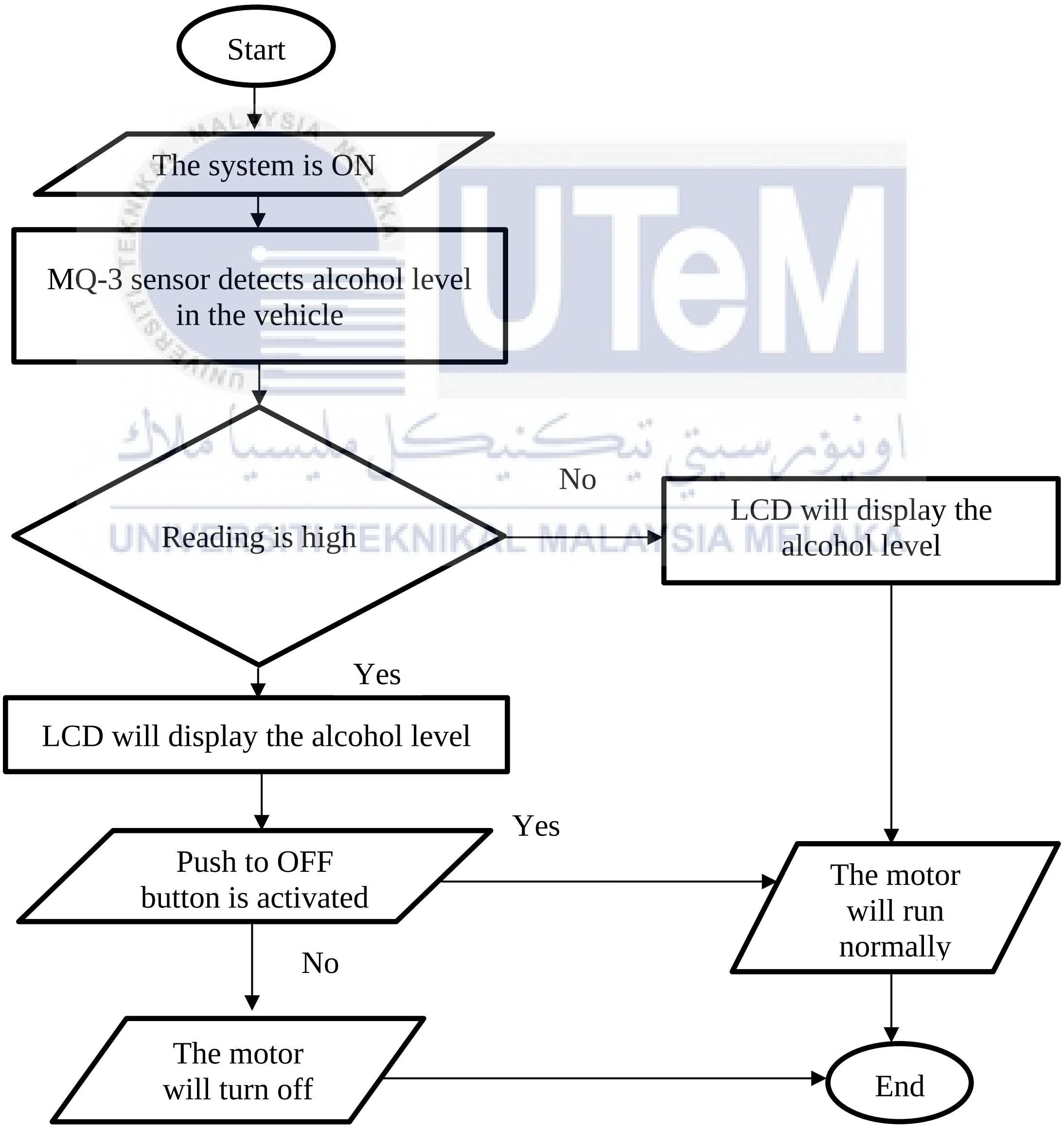
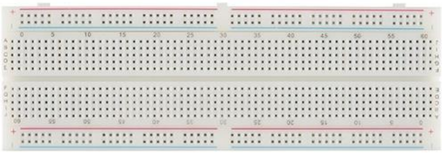
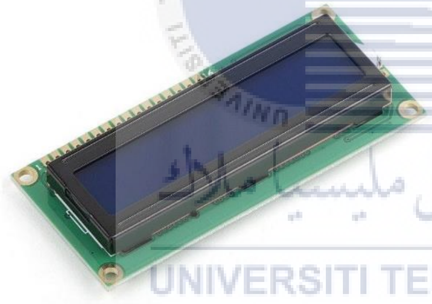


Figure 3.2 Flowchart of the system

3.2.3 Function of Every Components

Table 3.2 List of function for each components used

Component	Function
Breadboard 	Utilize multi-port metal sockets to connect components. The breadboard's conductive sections let electrons to flow between the components you insert into it.
Jumper wire male to male and male to female 	There are three types of jumper wire that are male-to-male, male-to-female, and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.
PBS-11B Push to OFF Button 	Disconnecting the circuit when you press it. When you release the button, you will be connected again.
DC motor 12V 	Converting direct current into mechanical energy otherwise.

ATmega328 Arduino UNO 	Programmes can be loaded into it using the simple Arduino computer software.
MQ3 Alcohol Sensor Module 	Detecting the amounts of alcohol gas in the air and delivers the reading as an analogue voltage.
LCD 1602 	To display letters, numerals, and characters and more.
Relay Module 5V 	To control a load such as a lighting system, motor, or solenoid.

3.3 Summary

The proposed system utilizes an ATmega328 microcontroller, specifically from the Arduino UNO board. An alcohol sensor, specifically the MQ-3 sensor, provides input to the microcontroller by detecting the presence of alcohol in the driver's breath. The detected data is then transferred to the microcontroller for processing. The block diagram shows the connection of various output devices to the microcontroller, including an LCD display and DC motor. The limit of BAC will follow the legal regislation in Malaysia which is 0.08%. If the alcohol sensor detects a lower level of alcohol that the customized BAC, showing that the driver is not intoxicated, the motor which represent the car engine will continue to operate normally. When the alcohol sensor detects a high level of alcohol, implying that the driver is intoxicated, the microcontroller activates a relay connected to the circuit. This relay will effectively disable the driver's ability to operate the car by shutting down the motor. However, if the push to OFF button is activated during high level of alcohol detected will allow the motor to run normally indicating that the driver is under tolerance and sober enough to drive the vehicle safely. Overall, this system combines an alcohol sensor and a microprocessor to monitor alcohol levels in the driver's breath and take immediate action to ensure road safety.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

By presenting a preliminary result of the findings collected thus far, we can assess the usefulness of this system in detecting and responding to high alcohol levels, thereby improving road safety, and lowering the hazards associated with drunk driving. The initial findings will offer insight on the system's performance and potential, providing the groundwork for future study and development in this critical field. The circuit simulation and coding are crucial part that will determine the way this project will be headed. Improvement will be made if the testing indicates any error or mistake in the project method. The implementation of push to OFF button in the system will assist in the effort to counter the driver-specific customization gap. Future research will refine computer programming and simulation to provide a better insight and understanding of the implementation of alcohol sensor and motor controller in the car.

4.2 Simulation

In this research, Proteus 8 Professional is utilized to run the simulation. Figure 4.1 shows the simple simulation which connect the MQ-3 alcohol sensor to the Arduino UNO. It shows how to connect the Arduino UNO which act as the microcontroller to other components like the LCD, DC motor and push to OFF button.

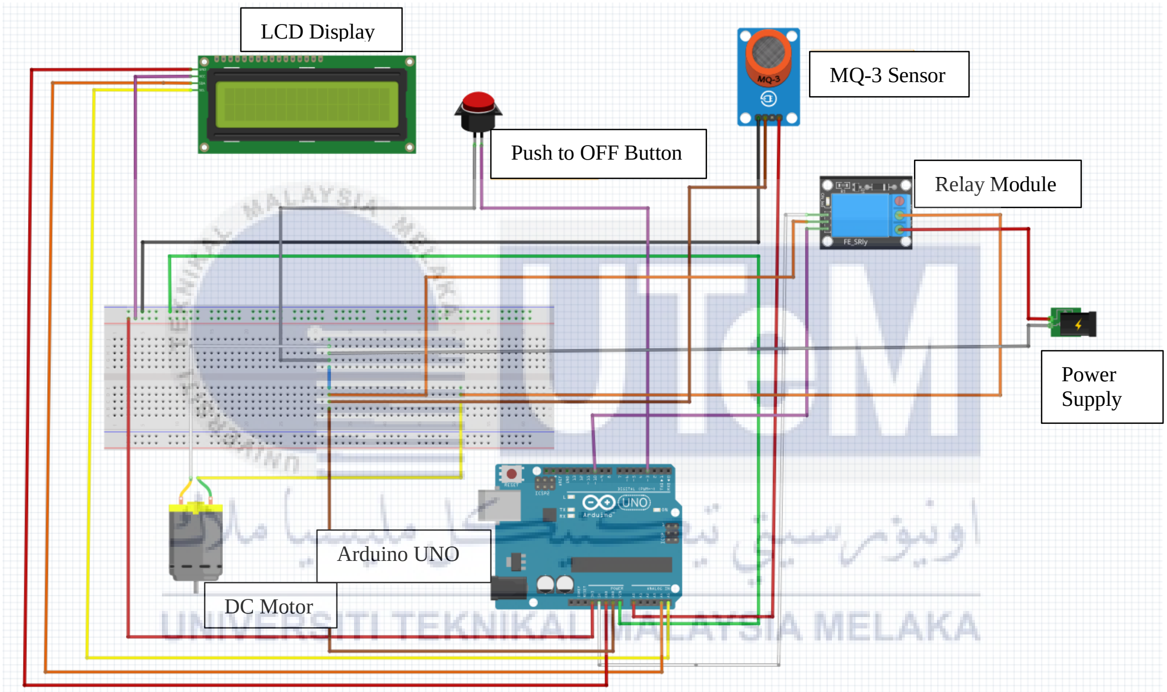


Figure 4.1 Full simulation of alcohol sensor and Arduino UNO

4.3 Coding

C++ is the computer language used to create a coding to implant into the Arduino UNO. Using an Arduino board, the code generates an alcohol detection system. It makes use of a MQ3 sensor, which can detect alcohol vapors in the air, and a relay to regulate a motor. A Liquid Crystal Display (LCD) is also included into the system to visibly indicate the alcohol detection status. The analogue readings from the MQ3 sensor are compared to set limits to calculate the alcohol content in the surrounding.

The code starts an alcohol detection system with an LCD display that reads "Alcohol Detection" at first and then switches to "Detecting..." to signify readiness. A button allows the user to regulate the activation of the alcohol sensor. The loop function reads sensor data continuously. By pressing the button, you may enable or disable alcohol detection. Sensor readings are compared to sober and intoxicated limits. If the sensor is turned off or detects a sober level, the motor starts, indicating that the environment is safe.

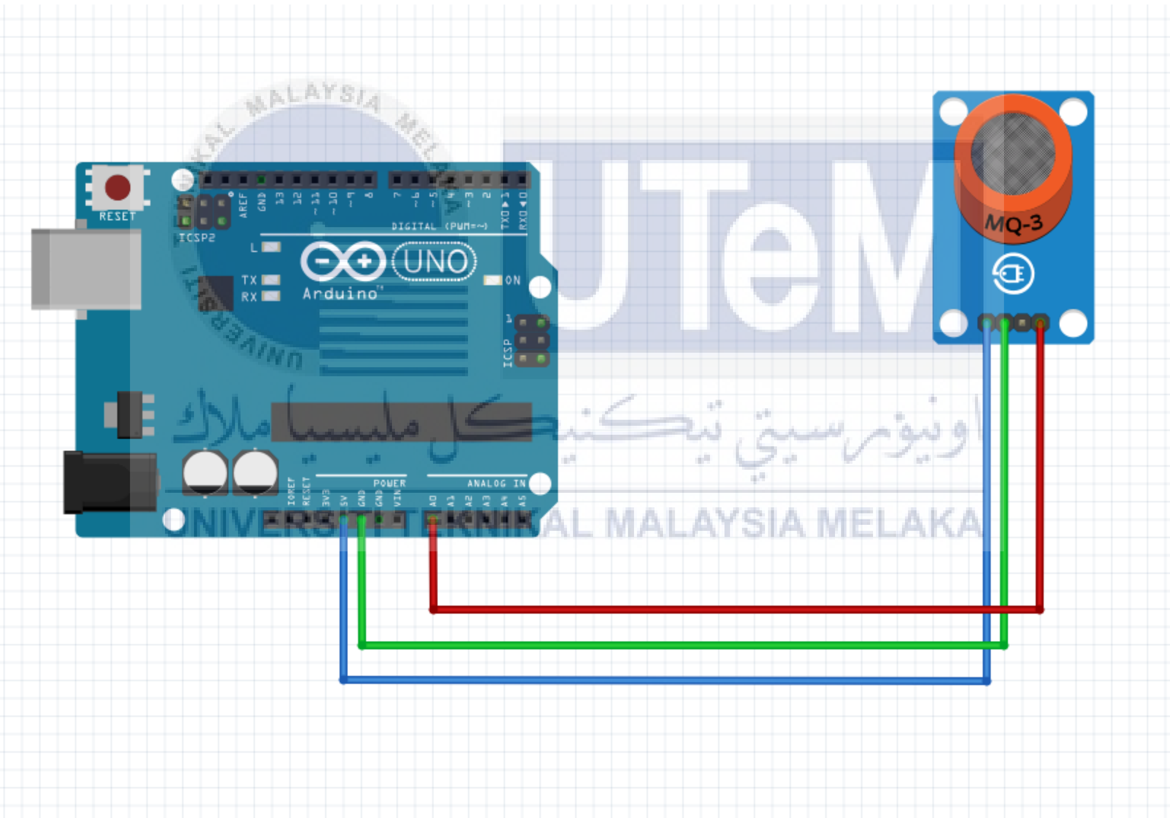
If the alcohol content exceeds the high threshold and the sensor is activated, the system's response differs based on whether the button is pushed. Motor will be able to run again if the button is pressed indicating that the driver is in sober state. These circumstances are displayed on the LCD panel. It shows real-time alcohol readings in parts per million (ppm) and status updates such as "Drive safely," "Motor running again," or "Drunk! Motor stop," which represent the current scenario observed by the sensor and the system's response. This system provides for real-time monitoring of alcohol levels as well as the capacity to act in potentially dangerous circumstances by interrupting the motor. For full coding of the system, refer to the Appendix E.

4.4 MQ-3 Alcohol Sensor Calibration

Due to the MQ3 is a heater-driven sensor, its calibration could become inaccurate if it is stored for a long duration of time. To achieve the best accuracy, the sensor must be thoroughly warmed up for 24-48 hours after being stored for a long period of time which is more than a month. It will only take 5-10 minutes for the sensor to fully warm up if it has recently been used. The sensor normally reads high during the warm-up phase and progressively reduces until it stabilises.

4.4.1 Experiment 1: Measuring Alcohol Concentration Using Analog Output (A0)

4.4.1.1 Connection Between MQ-3 Sensor and Arduino



4.4.1.2 Coding for The Connection

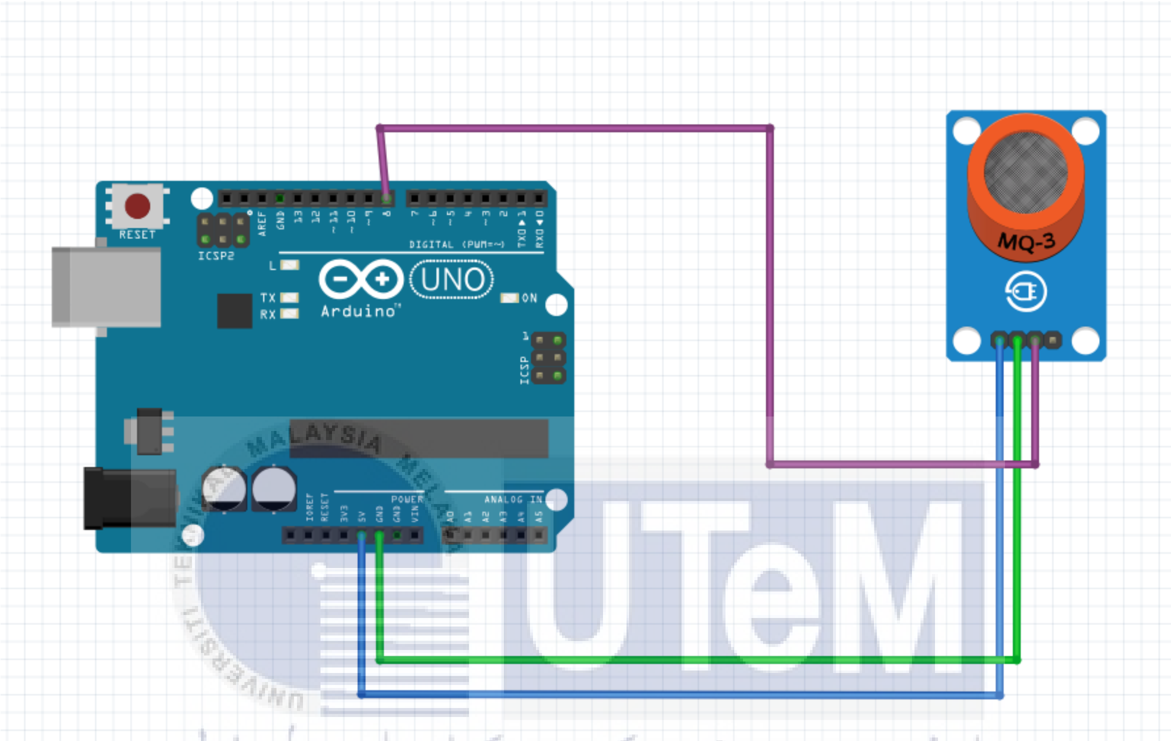
```
#define Sober 120   // Define max value that we consider sober
#define Drunk 400   // Define min value that we consider drunk

#define MQ3pin 0

float sensorValue;  //variable to store sensor value

void setup() {
  Serial.begin(9600); // sets the serial port to 9600
  Serial.println("MQ3 warming up!");
  delay(20000); // allow the MQ3 to warm up
}

void loop() {
  sensorValue = analogRead(MQ3pin); // read analog input pin 0

  Serial.print("Sensor Value: ");
  Serial.print(sensorValue);

  // Determine the status
  if (sensorValue < Sober) {
    Serial.println("  |  Status: Stone Cold Sober");
  } else if (sensorValue >= Sober && sensorValue < Drunk) {
    Serial.println("  |  Status: Drinking but within legal limits");
  } else {
    Serial.println("  |  Status: DRUNK");
  }

  delay(2000); // wait 2s for next reading
}
```


4.4.1.3 Output for Experiment 1

```
MQ3 warming up!
Sensor Value: 90 | Status: Stone Cold Sober
Sensor Value: 117 | Status: Stone Cold Sober
Sensor Value: 139 | Status: Drinking but within legal limits
Sensor Value: 296 | Status: Drinking but within legal limits
Sensor Value: 403 | Status: DRUNK
Sensor Value: 440 | Status: DRUNK
Sensor Value: 483 | Status: DRUNK
Sensor Value: 487 | Status: DRUNK
```

4.4.2 Experiment 2: Detecting Presence of Alcohol Using Digital Output (D0)

4.4.2.1 Connection Between MQ-3 Sensor and Arduino



4.4.2.2 Coding for The Connection

```
#define MQ3pin 8

int sensorValue;  //variable to store sensor value

void setup() {
  Serial.begin(9600); // sets the serial port to 9600
  Serial.println("MQ3 warming up!");
  delay(20000); // allow the MQ3 to warm up
}

void loop() {
  sensorValue = digitalRead(MQ3pin); // read digital output pin
  Serial.print("Digital Output: ");
  Serial.print(sensorValue);

  // Determine the status
  if (sensorValue) {
    Serial.println("  |  Alcohol: -");
  } else {
    Serial.println("  |  Alcohol: Detected!");
  }

  delay(2000); // wait 2s for next reading
}
```


4.4.2.3 Output for Experiment 2

```
MQ3 warming up!
Digital Output: 1 | Alcohol: -
Digital Output: 1 | Alcohol: -
Digital Output: 1 | Alcohol: -
Digital Output: 1 | Alcohol: -
Digital Output: 1 | Alcohol: -
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
Digital Output: 0 | Alcohol: Detected!
```

4.4.3 Testing on Different Parameters

Parameters	Sensor Reading (ppm)
Sanitizer (72%) 	710
Perfume (N/A) 	698
Deadorant (N/A) 	647
Liquor (40%) 	Direct: 645 Breath: 435

4.5 Result

Scenario	Input		Output	
	MQ-3 Sensor	Push to OFF Button	DC Motor	LCD
The driver is normal.	Low	Deactivated	Running	
The driver is drunk.	High	Deactivated	Stop running	
The driver is sober but the passenger is drunk.	High	Activated	Running	

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, the combination of motor control and alcohol detecting technologies represents a big step forward in the struggle against drunk driving. This research offers an innovative approach to improve road safety and lessen the dangers of driving while intoxicated. This technology prevents accidents brought on by drunk driving by including an alcohol sensor that tracks the driver's blood alcohol levels and automatically modifies the motion of the DC motor.

The project fills a research gap by providing driver-specific customization, allowing individuals with high alcohol tolerance to drive comfortably even when the alcohol sensor readings are high. This customization is accomplished by installing a push-to-off button that deactivates the device when a high BAC level is detected but the driver is in sober state. This feature offers flexibility and guarantees that responsible drivers are not excessively restricted.

The methodology involves employing an ATmega328 microcontroller and a MQ-3 alcohol sensor to interact with and interpret alcohol level input. The motor, which represents the automobile engine, is regulated based on the amount of alcohol detected. If the alcohol level exceeds the predetermined limit, the engine shuts down entirely, prohibiting the driver from running the car. This quick reaction helps to reduce the risks of intoxicated driving.

The preliminary result from this study offers useful information for developing and improving the integration of alcohol sensor and motor control in the vehicle. The results provide the basis for developing the hardware and conducting experimental testing for the second phase of this project. The coding may be improved by implying other computer language to decide on the better coding which is suitable for this project.

Overall, this study highlights the possibility for integrating alcohol sensor in order to make the road a safer place. While it focuses on drunk driving, the idea of merging sensor technology with motor control has broader implications for enhancing road safety in a variety of scenarios. Such devices can play a critical role in minimizing accidents, saving lives, and encouraging safe driving behavior by actively monitor alcohol levels and taking important responses.

5.2 Recommendation

Advances in technology contributed to the development of alcohol detection devices suited into automobiles in efforts of reducing drunk driving incidents. The current approach focuses on driver-specific customization, considering individual alcohol tolerance levels, but subsequent improvements can increase its effectiveness. Some of the recommendations are by using IoT connection for smooth data transfer, refining the push button mechanism for increased dependability, and incorporating machine learning techniques to personalize alcohol detection levels. These suggested improvements aim to transform the system's capabilities, providing a better solution to prevent drunk driving and improve road safety.

The use of IoT technology can considerably improve the performance of an alcohol detection system. When this technique is combined with IoT, it enables for remote monitoring and real-time reporting of the driver's alcohol levels to appropriate authorities or designated persons. The system might transfer data to smartphones or central databases by merging IoT-enabled devices and cloud connection, guaranteeing that those involved individuals, such as law enforcement or family members, are swiftly notified in the event of alcohol detection over acceptable limits. This connectivity enables quick response or corrective action, boosting road safety measures and helping to accelerate anti-drunk driving efforts. The system becomes part of a broader network because of IoT integration, increasing its total influence on road safety.

Improving the push-to-OFF button mechanism can significantly enhance system functionality and human engagement. Adding a fingerprint or additional identification system to the push button can help to confirm the driver's intoxication more precisely. As part of the push button system, this might include fingerprint scanning or breathalyzer testing. The system becomes more reliable by adding extra verification mechanisms, efficiently distinguishing between real attempts by a sober driver to operate the car and illegal attempts to evade the alcohol detection function. This improvement increases the system's dependability while decreasing the likelihood of harm or abuse.

Using machine learning algorithms can transform the system's capacity to accommodate individual variances in alcohol tolerance. The system may continuously change its threshold for detecting alcohol levels by constantly learning and modifying to the driver's individual features, such as metabolic rates or physiological changes. This personalization provides a more customized and precise evaluation of the driver's soberness, reducing errors and issues. Furthermore, machine learning algorithms may analyze patterns in alcohol detection data over time to provide insights into user behavior and improve the system's prediction capabilities. This use of adaptive learning techniques improves the system's effectiveness in maintaining road safety.

Each of these suggestions has the potential to dramatically improve the operation and effect of the alcohol detection system in terms of avoiding drunk driving incidents. Integrating IoT capabilities, enhancing the push button mechanism, and integrating machine learning algorithms all work together to improve the system's performance, assuring a safer driving environment while solving major problems in alcohol detection technology.

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APPENDICES

APPENDIX A Ganttchart for PSM 1

Task name	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14
FINAL YEAR PROJECT BRIEFING														
CHAPTER 1														
1.1 BACKGROUND														
1.2 PROBLEM STATEMENT														
1.3 RESEARCH OBJECTIVE														
1.4 SCOPE OF RESEARCH														
CHAPTER 2														
2.1 INTRODUCTION														
2.2 MEASUREMENT OF ALCOHOL CONTENT														
2.3 REVIEW OF PREVIOUS RESEARCH														
2.4 SUMMARY OF ARTICLE 1														
2.5 SUMMARY OF ARTICLE 2														
2.6 SUMMARY OF ARTICLE 3														
2.7 SUMMARY OF ARTICLE 4														
2.8 RESEARCH GAP														
2.9 SUMMARY														
CHAPTER 3														
3.1 INTRODUCTION														
3.2 PROPOSED METHODOLOGY														
Subtask 3.2.1 BLOCK DIAGRAM														
Subtask 3.2.2 FLOWCHART														
Subtask 3.2.3 BILL OF MATERIAL														
Subtask 3.2.4 FUNCTION OF EVERY COMPONENTS														
3.3 SUMMARY														
REFERENCE														
APPENDICES														
SUBMISSION														
PRESENTATION														

APPENDIX B Ganttchart for PSM 2

Task name	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14
PREPARATIONS														
PURCHASE COMPONENTS														
CONTRUCT SIMULATION														
BUILD THE CODING														
CIRCUIT CONSTRUCTION														
COMPONENTS CONNECTION														
CIRCUIT INSPECTION														
TROUBLESHOOTING														
ADJUSTMENT														
REPORT														
PARTS PER MILLION CONVERSION														
SIMULATION														
CODING														
CALIBRATION														
SCENARIO RESULT														
UPDATE ANY IMPROVEMENT														
APPENDICES														
SUBMISSION														
PRESENTATION														

APPENDIX C   BAC level in different country (rhinocarhire.com, n.d.)

Country	BAC	Country	BAC
Albania	0.01%	Macedonia	0.05%
Algeria	0.02%	Madagascar	0.08%
Andorra	0.05%	Malawi	0.08%
Angola	0.06%	Malaysia	0.08%
Antigua	0.08%	Mali	0%
Argentina	0.05%	Mallorca	0.05%
Aruba	0.05%	Mallorca	0.05%
Australia	0.05%	Malta	0.08%
Austria	0.05%	Martinique	0.05%
Azerbaijan	0%	Mauritius	0.05%
Bahamas	0.08%	Mexico	0.08%
Bahrain	0%	Moldova	0.03%
Belarus	0%	Montenegro	0.03%
Belgium	0.05%	Morocco	0%
Belize	0.08%	Mozambique	0.06%
Bolivia	0.05%	Namibia	0.05%
Bosnia and Herzegovina	0.05%	Netherlands	0.05%
Botswana	0.08%	New Caledonia	0.05%
Brazil	0.02%	New Zealand	0.05%
Bulgaria	0.05%	Nicaragua	0.05%
Cambodia	0.05%	Nigeria	0.05%
Cameroon	0.08%	Northern Ireland	0.04%
Chile	0.03%	Norway	0.02%
China	0.08%	Oman	0%
Colombia	0.04%	Pakistan	0%
Congo	0.01%	Panama	0%
Costa Rica	0.08%	Papua New Guinea	0.08%
Curacao	0%	Paraguay	0.08%
Cyprus	0.05%	Peru	0.05%
Czech Republic	0%	Philippines	0.05%
Denmark	0.05%	Poland	0.02%
Dominica	0.05%	Portugal	0.05%
Dominican Republic	0%	Puerto Rico	0.08%
Ecuador	0.04%	Qatar	0%
Egypt	0.05%	Reunion	0.05%
El Salvador	0.05%	Romania	0%
England	0.08%	Russia	0.03%

Estonia	0.02%	Samoa	0.08%
Faroe Islands	0.05%	Saudi Arabia	0%
Fiji	0.08%	Scotland	0.05%
Finland	0.05%	Serbia	0.03%
France	0.05%	Seychelles	0.08%
Gabon	0.08%	Sicily	0.05%
Germany	0.05%	Singapore	0.08%
Gibraltar	0.05%	Slovakia	0%
Greenland	0.05%	Slovenia	0.05%
Grenada	0.08%	South Africa	0.05%
Guadeloupe	0.05%	South Korea	0.05%
Guam	0.08%	Spain	0.05%
Guatemala	0.08%	Sri Lanka	0.06%
Guernsey	0.08%	St Lucia	0.08%
Holland	0.05%	St Maarten	0.05%
Honduras	0.07%	St Vincent and the Grenadines	0.08%
Hong Kong	0.05%	Swaziland	0.05%
Hungary	0%	Sweden	0.02%
Ibiza	0.05%	Switzerland	0.05%
Ibiza	0.05%	Syria	0%
Iceland	0.05%	Taiwan	0.05%
India	0.03%	Tanzania	0.08%
Indonesia	0%	Tasmania	0.05%
Ireland	0.05%	Tenerife	0.05%
Isle Of Man	0.08%	Trinidad and Tobago	0.08%
Israel	0.02%	Tunisia	0%
Italy	0.05%	Turkey	0%
Jamaica	0.04%	UAE	0%
Japan	0%	Uganda	0.08%
Jersey	0.08%	UK	0.08%
Jordan	0.05%	Ukraine	0%
Kazakhstan	0%	Uruguay	0%
Kenya	0.08%	Venezuela	0.08%
Kosovo	0.01%	Vietnam	0%
Kuwait	0%	Wales	0.08%
Lanzarote	0.05%	Yemen	0%
Latvia	0.05%	Zambia	0.08%
Lebanon	0%	Zimbabwe	0.08%
Lesotho	0.08%		
Luxembourg	0.05%		

APPENDIX D Bill of Material

NO	COMPONENTS	QUANTITY	COST
1	Bread board	1	RM 10.00
2	Jumper wire male to male and male to female	1	RM 6.00
9	PBS-11B Push to OFF Button	1	RM 7.00
4	DC motor 12V	1	RM 15.00
5	ATmega328 Arduino UNO	1	RM 55.00
7	LCD 1602	1	RM 20.00
8	MQ3 Alcohol Sensor Module	1	RM 10.00
9	Relay Module 5V	1	RM 3.90
Total Cost		RM 126.90	

APPENDIX E   MQ-3 Sensor Datasheet (sparkfun, n.d.)

TECHNICAL DATA   MQ-3 GAS SENSOR

FEATURES

* High sensitivity to alcohol and small sensitivity to Benzine .
* Fast response and High sensitivity
* Stable and long life
* Simple drive circuit

APPLICATION

They are suitable for alcohol checker, Breathalyser.

SPECIFICATIONS

A. Standard work condition

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
V_H	Heating voltage	5V±0.1	ACOR DC
R_L	Load resistance	200KΩ	
R_H	Heater resistance	33Ω±5%	Room Tem
P_H	Heating consumption	less than 750mw	

B. Environment condition

Symbol	Parameter name	Technical condition	Remarks
Tao	Using Tem	-10℃-50℃	
Tas	Storage Tem	-20℃-70℃	
R_H	Related humidity	less than 95%Rh	
O_2	Oxygen concentration	21%(standard condition)Oxygen concentration can affect sensitivity	minimum value is over 2%

C. Sensitivity characteristic

Symbol	Parameter name	Technical parameter	Remarks
Rs	Sensing Resistance	1MΩ - 8 MΩ (0.4mg/L alcohol)	Detecting concentration scope: 0.05mg/L—10mg/L Alcohol
α (0.4/1 mg/L)	Concentration slope rate	≤0.6	
Standard detecting condition	Temp: 20℃±2℃ Vc:5V±0.1 Humidity: 65%±5% Vh: 5V±0.1		
Preheat time	Over 24 hour		

D. Structure and configuration, basic measuring circuit

	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

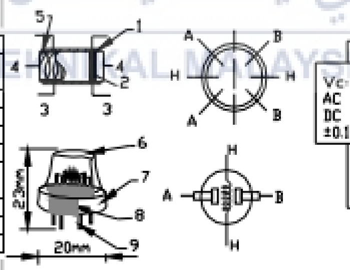


Fig. 1

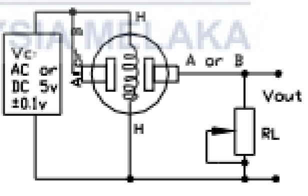
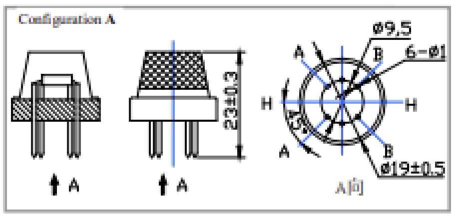
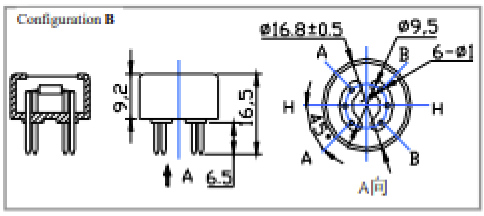


Fig.2





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Structure and configuration of MQ-3 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-3 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

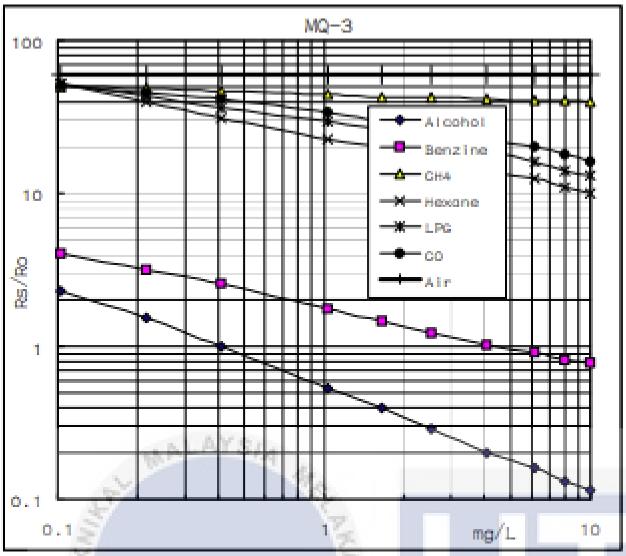

Fig.2 sensitivity characteristics of the MQ-3

Fig.3 is shows the typical sensitivity characteristics of the MQ-3 for several gases.
in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=200kΩ
Ro: sensor resistance at 0.4mg/L of Alcohol in the clean air.
Rs:sensor resistance at various concentrations of gases.

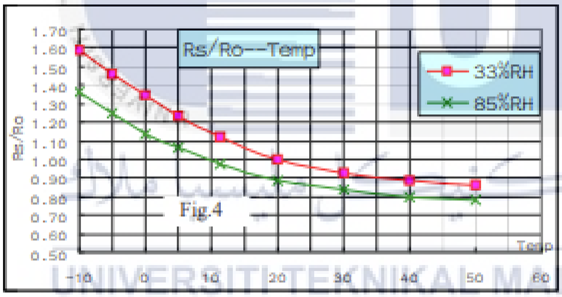

Fig.4 is shows the typical dependence of the MQ-3 on temperature and humidity.
Ro: sensor resistance at 0.4mg/L of Alcohol in air at 33%RH and 20 ℃
Rs: sensor resistance at 0.4mg/L of Alcohol at different temperatures and humidities.

SENSITVITY ADJUSTMENT

Resistance value of MQ-3 is difference to various kinds and various concentration gases. So,When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 0.4mg/L (approximately 200ppm) of Alcohol concentration in air and use value of Load resistancethat(R_L) about 200 KΩ(100KΩ to 470 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

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APPENDIX F Coding for Full System

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 20, 4);

#define normal 180  // Define max value that we consider sober
#define Drunk 200    // Define min value that we consider drunk
#define MQ3 A0
#define relay 10
#define buttonPin 3

bool sensorEnabled = true;
bool motorStopped = false;

void setup() {
  Serial.begin(9600);
  delay(100);

  lcd.init();
  lcd.backlight();
  lcd.begin(16, 2); // Initializing LCD
  lcd.setCursor(0, 0);
  lcd.print("Alcohol");
  lcd.setCursor(0, 1);
  lcd.print("Detection");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Detecting...");
  lcd.setCursor(7, 0);
  lcd.print("");

  delay(1000);

  pinMode(relay, OUTPUT);
  pinMode(buttonPin, INPUT_PULLUP); // Button pin as input with pull-up resistor
}
```

```
void loop() {
  getLcdDisplay();

  int sensorValue = analogRead(MQ3);

  if (digitalRead(buttonPin) == LOW) {
    // Button pressed, toggle the sensor status
    sensorEnabled = !sensorEnabled;
    delay(500); // Debouncing delay
  }

  if (!sensorEnabled || (sensorValue < normal)) {
    motorStopped = false; // Run the motor
  } else if (sensorValue >= Drunk && sensorEnabled) {
    if (digitalRead(buttonPin) == HIGH) {
      motorStopped = true; // Stop the motor
    } else {
      motorStopped = false; // Run the motor
    }
  }

  if (motorStopped) {
    digitalWrite(relay, HIGH); // Stop the motor
  } else {
    digitalWrite(relay, LOW); // Run the motor
  }
}
```

```
void getLcdDisplay() {
  float sensorValue = analogRead(MQ3);
  float sensorvalue2 = sensorValue;

  Serial.print("Sensor Value: ");
  Serial.println(sensorvalue2);
  lcd.setCursor(0, 7);
  lcd.print("ppm");

  if (!sensorEnabled || (sensorvalue2 < normal)) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print(sensorvalue2);
    lcd.setCursor(0, 1);
    lcd.print("Drive safely     ");
    Serial.println("  |  Status: Drive safely");
    motorStopped = false;
    delay(1000);
  } else if (sensorvalue2 >= Drunk && sensorEnabled) {
    if (digitalRead(buttonPin) == LOW) {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print(sensorvalue2);
      lcd.setCursor(0, 1);
      lcd.print("Motor running again");
      Serial.println("  |  Status: Motor running again");
      motorStopped = false;
      delay(1000);
    } else {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print(sensorvalue2);
      lcd.setCursor(0, 1);
      lcd.print("Drunk! Motor stop ");
      Serial.println("  |  Status: Drunk! Motor stop");
      motorStopped = true;
      delay(1000);
    }
  }
}
```