

CAR SECURITY ALERT SYSTEM

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Bachelor Degree of
Electronic Engineering (Telecommunication)

Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
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ABSTRACT

Cars and vehicles have been incorporated into culture as one of the most resourceful, easiest and accessible means of transportation available. But besides being a suitable and common means, it is equally an incredibly dangerous mode of transport. Thousands of people die in vehicle accidents each year, whether it is accident with another vehicle or with a motionless object. A method of early accident exposure and evasion can control several accidents that may be associated to factors such as loss of control, careless driving, tired/intoxicated drivers, and not paying concentration to the road. As the current market does not present a normal safety feature in any car, the use of sensory tools to sense potentially hazardous objects a definite distance away and either alert the driver or shove to a safer path has not been released. In this research paper a new technique is introduced for safety against accidents. Ultrasonic sensors are used to sense the of objects or can in front. By implementing a possible improvement in safety/sanctuary systems in vehicles, the vehicle and sensor would be able to operate normally until the sensor detects possible risk of obstacle or car in front. In our project, the sensor does not give output or signal until the car comes less than 50cm of an object, at which timer sends information of hurdle to driver. The sensor only indicates the presence of an object; it is up to the user or driver to tackle the hurdle.

ABSTRAK

Kereta merupakan keperluan yang utama dalam kehidupan seharian manusia. Jumlah pengguna kereta meningkat dari hari ke hari dan ini mendorong kepada peningkatan statistik kemalangan jalan raya. Ratusan pengguna kereta terkorban akibat kemalangan jalan raya setiap tahun, dan jumlah ini meningkat setiap tahun. Kemalangan yang berlaku sama ada kemalangan yang melibatkan kenderaan lain ataupun kemalangan tanpa melibatkan kenderaan lain. Langkah pencegahan awal bagi mengatasi masalah yang dihadapi pemandu sehingga berlakunya kemalangan jalan raya boleh yang mungkin disebabkan oleh faktor teknikal mahupun kelalaian pemandu. Faktor teknikal seperti masalah yang dihadapi daripada kereta itu sendiri menyumbang kepada peningkatan peratusan kemalangan jalan raya. Selain itu, faktor kelailaian manusia merupakan penyumbang terbesar peningkatan peratusan kemalangan seperti memandu dalam keadaan mengantuk, mabuk, cuai, letih, dan kurang tumpuan semasa memandu. Sebagai memenuhi pasaran dan keperluan semasa, ciri sistem keselamatan menggunakan sensor ultrasonic tidak banyak digunakan pada kereta. Dalam kertas kajian yang dilakukan ini, satu teknik terbaru diperkenalkan untuk mengatasi masalah yang disebabkan oleh faktor manusia. "Car Security Alert System" menggunakan pengesan jarak ultrasonik bagi mengesan objek di hadapan. Dengan menggunakan buzzer dan LED sebagai system notifikasi, setiap jarak yang dikesan akan mempengaruhi system notifikasi. Sebagai contoh, buzzer akan menghasilkan bunyi yang lebih kuat apabila jarak yang dikesan semakin dekat. Dalam projek yang dilaksanakan, sensor ultrasonik tidak akan mengaktifkan sistem notifikasi ataupun output sehingga sensor ultrasonik mengesan jarak kereta dengan halangan kurang daripada 50cm.

Keyword

1. Arduino Uno
2. HC SR04
3. Proteus Design Suite
4. Range Finder
5. Arduino Software

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BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : CAR SECURITY ALERT SYSTEM

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Specially dedicated to my beloved parent:

Mohamad Ramdzan Bin Pelet

Haslina Bte Ab.Rahman

To my Supervisor:

Mdm. Siti Rosmaniza Bte Ab-Rashid

*Also to all my fellow friends who have encouraged
and inspired me. Thanks for all the support and
guidance*

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ABSTRACT

Cars and vehicles have been incorporated into culture as one of the most resourceful, easiest and accessible means of transportation available. But besides being a suitable and common means, it is equally an incredibly dangerous mode of transport. Thousands of people die in vehicle accidents each year, whether it is accident with another vehicle or with a motionless object. A method of early accident exposure and evasion can control several accidents that may be associated to factors such as loss of control, careless driving, tired/intoxicated drivers, and not paying concentration to the road. As the current market does not present a normal safety feature in any car, the use of sensory tools to sense potentially hazardous objects a definite distance away and either alert the driver or shove to a safer path has not been released. In this research paper a new technique is introduced for safety against accidents. Ultrasonic sensors are used to sense the of objects or can in front. By implementing a possible improvement in safety/sanctuary systems in vehicles, the vehicle and sensor would be able to operate normally until the sensor detects possible risk of obstacle or car in front. In our project, the sensor does not give output or signal until the car comes less than 50cm of an object, at which timer sends information of hurdle to driver. The sensor only indicates the presence of an object; it is up to the user or driver to tackle the hurdle.

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Chapter I

Introduction

Car Security Alert System is a system that is designed with used of ultrasonic to detect range to ensure the car was driven in a safe distance. The system alerts the driver when they reach unsafe distance. The Light Emitting Diode (LED) was used as notifications to show three different level of distance which are green colour for safe distance, blue colour for beware, and red colour for dangerous distance. Besides that, the buzzer also used as alert component by produce tone pin. The display function is to show the status of distance and also show the distance of car from hurdle.

Project Background

Nowadays, all products in the market have their own disadvantage or weakness. The designed product start with the basic thing before the creator adds some element as the enhancement from the current product. All this matter is to follow the flow of technology improvement that expanded every day. Therefore, this project has the same purpose, but with enhancements to give an advantage to the user or consumers. Problems that occur from an existing product will be improved and the problem is identified from a few factors like functionality, reliability, and security.

Driving is a routine activity for most people and they use their car to move from one place to another place. Numbers of vehicle were increasing day by day and make a risk of accident increase. The numbers of accident are so high and it occurs every time and anywhere and leads to a worst damage, serious injury and probably causing death. Based on the table above, the statistic show from 1995 until 2012 had increasing of road accident due to increasing of vehicles. [7]

Year	Population	Vehicles Registered	Vehicle Involved	Road Length	Road Accidents	Road Casualties	Road Deaths	Vehicle Ownership (Person per vehicle)
1995	20,096,700	6,802,375	275,430	62,221	162,491	52,152	5,712	3.0
1996	21,169,000	7,686,684	325,915	64,511	189,109	53,475	6,304	2.8
1997	21,665,600	8,550,469	373,526	66,108	215,632	56,574	6,302	2.5
1998	22,179,500	9,141,357	366,932	66,741	211,037	55,704	5,740	2.4
1999	22,711,900	9,929,951	390,674	67,069	223,166	52,937	5,794	2.3
2000	23,263,600	10,598,804	441,386	68,770	250,429	50,200	6,035	2.2
2001	23,795,300	11,302,545	483,351	74,217	265,175	50,473	5,849	2.1
2002	24,526,500	12,068,144	507,995	74,641	279,711	49,552	5,891	2.0
2003	25,048,300	12,819,248	555,634	79,667	298,653	52,741	6,286	2.0
2004	25,580,000	13,828,889	596,533	71,814	326,815	54,091	6,228	1.8
2005	26,130,000	15,026,660	581,136	71,814	328,264	47,012	6,200	1.7
2006	26,640,000	15,790,732	635,024	72,781	341,252	35,425	6,287	1.7
2007	27,170,000	16,813,943	668,173	73,032	363,319	33,999	6,282	1.6
2008	27,730,000	17,971,901	671,078	73,419	373,071	32,274	6,527	1.5
2009	28,310,000	19,016,782	705,623	100,002	397,330	31,417	6,745	1.5
2010	28,910,000	20,188,565	760,433	111,378	414,421	28,269	6,872	1.4
2011	29,000,000	21,401,269	817,151	127,517	449,040	25,570	6,877	1.4
2012	29,300,000	22,702,221	777,817	127,517	462,423	24,439	6,917	1.3

Table 1.1

This Car Security Alert System is design to develop a new system that can notify driver if the car reaches the dangerous distance. Using ultrasonic as a ranging sensor, its function based on ultrasonic wave. After transmit by transmitter, the wave is reflected back when obstacle detected and receive by receiver. The main target for this project is notification from buzzer and LED give an alert to driver when the car reach distance less than the predetermined distance set in the system, while LCD will display the status of distance and range or distance of car with the next car

1.1 Objective

The main objective of this project is to design an alert system that function to alert the driver if car reach certain distance that declared as dangerous distance.

1.2 Problem Statement

Sometime, driver not giving full attention on their driving and this careless can cause an accident to happen. This bad habit can cause serious problem or accidents which involve not only the driver, but also involve other people. As the solution for that problem, the Car Security Alert System was created. Everybody knows the accident were not a planned, but this system can be used to prevent the accident because when the driver got an alert, they can save a life of their family and if the accident occurs, it can reduce impact from the accident.

1.3 Scope Of Project

For hardware development, this project will use an Arduino UNO R3, Radio Car model, Ultrasonic sensor HC-SR04, Buzzer, LED, and 16x2 LCD display. The ultrasonic sensor has an advantage such that its used a wave where the nature of wave is spreading the wave everywhere. This will benefit the project because ultrasonic wave doesn't limit towards one direction only. The Arduino hardware platform already has the power and reset circuitry setup as well as circuitry to

program and communicate with the microcontroller over USB. In addition, the I/O pins of the microcontroller are typically ready to feed out sockets/headers for easy access.

For software development, the programming for Arduino is using Arduino Coding Software and for circuit design, this project is using „ISIS“ software. In the software, the circuit created can be simulated and the parameter can be adjusted. This ultrasonic sensor using in this project can detect range from 2cm up to 400cm (13ft). Arduino provides a number of libraries that makes an easy steps in programmed the microcontroller. More useful of Arduino are things such as being able to set I/O pins to PWM at a certain duty cycle using a single command or doing Serial communication.

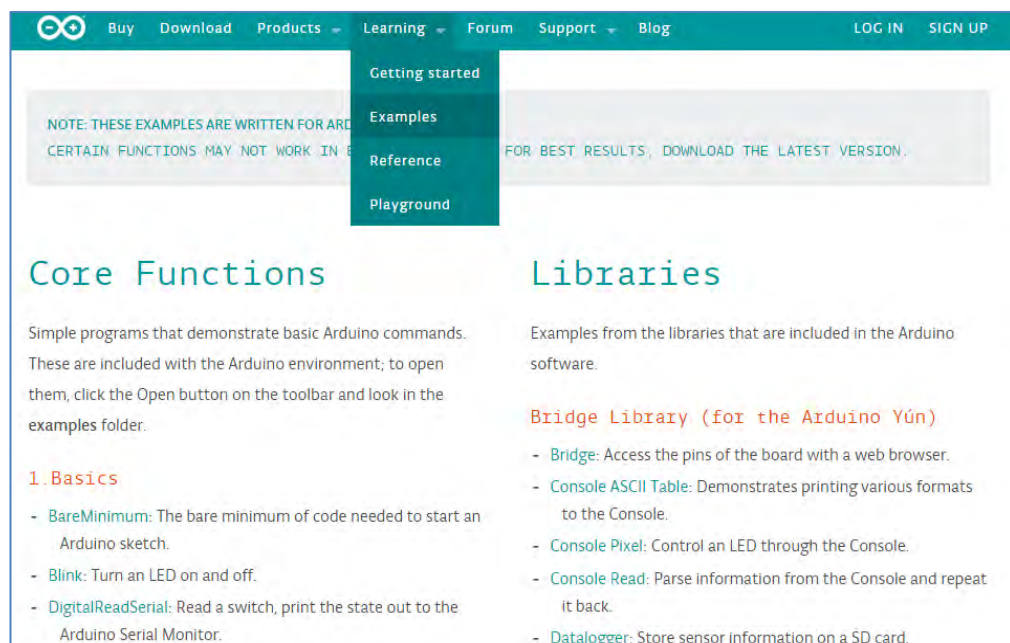


Figure 1.1: Arduino Libraries

1.4 Project Methodology

There are three main parts to complete this project

- System to detect the range
 - The component involve is ultrasonic sensor that function to detect the range between two cars.

- System that function as an alert
 - The component use in this system is buzzer and LED. Buzzer produce „beep“ sound and LED indicate the level of range.
- System to display
 - Using LCD to display the range that detect by ultrasonic. If more than 50cm, the LCD display show “SAFE DISTANCE”, 20cm until 11cm , the display show “BEWARE!!” and less than 10cm, LCD display “BRAKE!!”. Else, LCD display show the distance in centimetre.

1.5 Report Structure

This report covered 5 chapters. The first chapter is about the introduction of project. In this chapter, it contains the Project Background, Problem Statement, Scope of Project, and Project Methodology. In Chapter II, it discuss about Literature Review, for example it discuss about the Project Overview, the previous project, and also about the software and hardware used to achieve goal for this project. For Chapter III, it explained the Methodology and discussed about the flow of the project. The hardware and software implementation discussed on Chapter IV while Chapter V covered the conclusion of the project and suggestion to improve the project in future.

Chapter II

Literature Review

2.1 Chapter overview

This chapter will discuss about the previous project and journal related to this project. These journal and report have been analysed to improve the effectiveness and quality of this project. In the previous project, it recommends some methods or strategy that could be done to improve the project. At the same time, ideas that can be implemented in Car Security Alert System was developed. Therefore, literature reviews process can start from the beginning of project until the end of project. By viewing the previous work, an effective plan on how this project was created and the system and application that can be implemented in order to complete this project. Review from internet and book are very effective to make this project successful.

2.2 Previous Project

2.2.1 Distance Measuring (Hurdle Detection System) for Safe Environment in Vehicle through Ultrasonic Sensor Rays. [3]

Distance Measuring (Hurdle detection System) for Safe Environment in Vehicles through Ultrasonic Rays show the development to secure the movement of car or security of driver and vehicle against different hurdles. These projects use four units of ultrasonic sensors which is located at the left side, right side, back side and front side. This is important to achieve the objective because in this journal they want to provide safe environment on car surrounding. Each sensor has one transmitter and one receiver. The transmitter of each sensor will continuously transmit the signals. When these signals will collide with any object and will be reflected back, the receiver of sensor will catch these reflected signals and forward them to the computer on port 889 of parallel port. To find out the object on the side of car, the signal is send to processing unit through parallel ports. Each side or receiver has its own address which is unique. Through this uniqueness or address the proposed method finds out the side of object (Hurdle). In ultrasonic sensor the power is directly proportional to range of ultrasonic sensor. The weakness of this project is there have no alert system as a safety reason because the main objective of this project is to detect the coming of hurdle around a car. For an enhancement from this project, Car Security Alert System has built an alert system to alert the driver when the hurdle is coming.

2.2.2 Car Anti-Collision and Intercommunication System using Communication Protocol [1]

“Car Anti-Collision and Intercommunication System using Communication Protocol” have designing a system to avoid a direct collision between two cars. The car will be equipped with an ultrasonic sensor which will continuously track for any obstacles from the front side. If the obstacle was detected then the microcontroller will continuously compare the distance given by the ultrasonic sensor. If the next car is at a safe distance then the CAR will keep going at the same speed. If the distance

keeps reducing, indicating that the front car is coming closer to the current CAR then the microcontroller will start applying brakes until the distance is within safe parameters. This process will continue in a loop until the car stop moving. In this way we can ensure that a safe distance is always maintained between the two cars and thus Accident can be avoided. The three IR sensors are interfaced which are connected to the three sides of the car to detect any proximity to the car. The IR sensor will give a pulse to the microcontroller. The microcontroller will turn on the buzzer which will alert the driver in time to avoid the accident. This project was performed by using ARM7 processor. The weakness of this project is the driver is not allowed to increase speed manually if the security systems detect an obstacle. So, it give risk to driver if want to overtake the front car because the system not allowed car to increase the speed.



Figure 2.1: Communicating between cars

2.2.3 Ultrasonic anti crashing system for automobiles [2]

“Ultrasonic anti crashing system for automobiles” make a same concept of project. By using LV-MaxSonar-EZ1, create a system that can slow down the motor when LV-MazSonar-EZI detects a dangerous distance. The LV-MaxSonar- EZ1 provides very short to long-range detection and ranging, in an incredibly small package. The LV-MaxSonar-EZ1 detects objects from 0-inches to 254- inches (6.45-meters) and provides sonar range information from 6-inches out to 254-inches with 1-inch resolution. The interface output formats included are pulse width output, analog voltage output, and serial digital output. The concept of this sensor is same as HC-SR04 that using in Car Security Alert System. The system shows in this journal

is using PWM to slow down the motor. This feature varying duty cycle of digital wave and gives its corresponding analogue value to one of the pins controlling the motors. This pin decides the speed of the motor, thus a regulation in speed is achieved. This system also use buzzer to alert driver. Weakness of this project is there have no LCD display to show the distance and have no LED to notify the level of distance. Besides that, controlling the speed will affect the acceleration during overtake the car in front and it will bring the car in high risk because of this system. So, for the enhancement, the LCD display and LED was added to the system.

2.3 Hardware

2.3.1 Liquid Crystal Display

To read the output indicator, Liquid Crystal Display (LCD) was used. For a show-up measurement or range of readings, LCD display panel is better choice because it may show the features other than the measurement readings. LCD component is specifically designed to use with microcontrollers such as Arduino, which means that it cannot be activated by standard IC circuits. It is used to display a different message on a small liquid crystal display. It can display a message in two lines with 16 characters each. It displays all the letters of the alphabet, Greek letters, punctuation, mathematical symbols. Other useful features include automatic message shift (left and right), cursor appearance, LED rear lights and etc. There are a total of 16 pin on the display include the pin for brightness adjustment. The VO pin is connect to potentiometer for brightness adjustment. Besides that, it can connect to GND if don't want to connect it with potentiometer. [4]

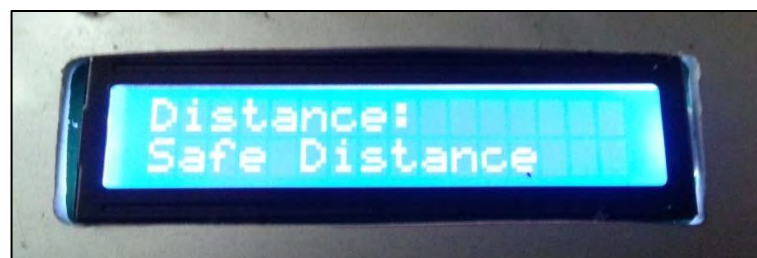


Figure 2.2: 16x2 line LCD Display

2.3.2 Arduino

Arduino is an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs[8]. For this project, Arduino used the ultrasonic sensor as the input and for the output, LED, LCD display, and buzzer was used. There are many type of Arduino such as Arduino UNO R3, Arduino Mini, Arduino Mega, and Arduino nano etc. For Car Security Alert System, the Arduino Uno R3 was used due to easier to get in the market. Arduino projects can be stand-alone, or they can communicate with software running on computer. The analog output pins are located on the bottom-right six-pin female connector labelled as “ANALOG IN 0-5”. The digital-only pins are located on the top labeled “DIGITAL 0-13”. For this project, the all the digital pin was used except the Tx, Rx, and GND pin. [5]

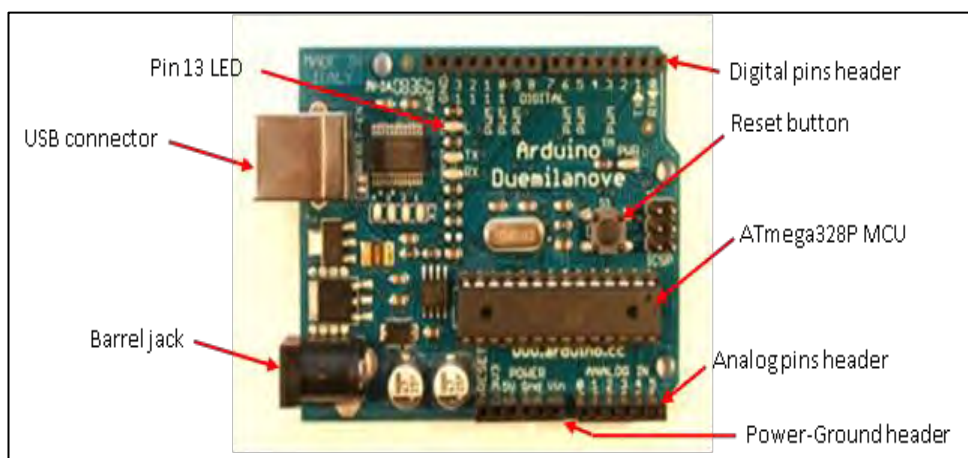


Figure 2.3 : Arduino Structure

Figure above show the structure of Arduino Uno R3. As the source, there have two ports that can be used as the source that is using the USB connector and also Barrel Jack. The USB connector need supply of 5V and for Barrel Jack is the alternative way if want to use the battery. The recommended battery is 7V until 12V. Besides that, the adapter can be used on the Jack but the voltage must not higher than 12V. The power ground header must be connect with the ground and Vcc of circuit.

If not, the circuit will not run properly. On the board is also a single reset button that causes the program to restart when pressed, and two more LEDs that flash as data is passed back-and-forth over the USB connection.

The board is most often powered from the USB connector on the upper-left side during software development. The USB connection is the programming link over which programs compiled on the computer are transferred to the MCU. This connection also may be used to exchange data between the board and the computer. The Arduino board comes with a single LED, often called the Pin 13 LED because it is electrically connected to Digital Pin 13. This LED is the board's only built-in indicator accessible to programs.

2.3.2.1 Advantage of Arduino [8]

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms such as PIC. For example is Arduino Uno R3 that used in this project that only costing around RM70.

Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows. For this project, Arduino is run with the Window 7 Ultimate.

Simple, clear programming environment - The Arduino programming environment is easy to use for beginners, and the coding is quite easy to understand. Besides that, the library of Arduino also provides the coding complete with the schematic circuit to ease the user. In the web of Arduino, the manufacturer provide the step by step setting for first time user such as how to setting the port, and how to verify the coding.

Open source - The Arduino software is published as open source tools. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board.

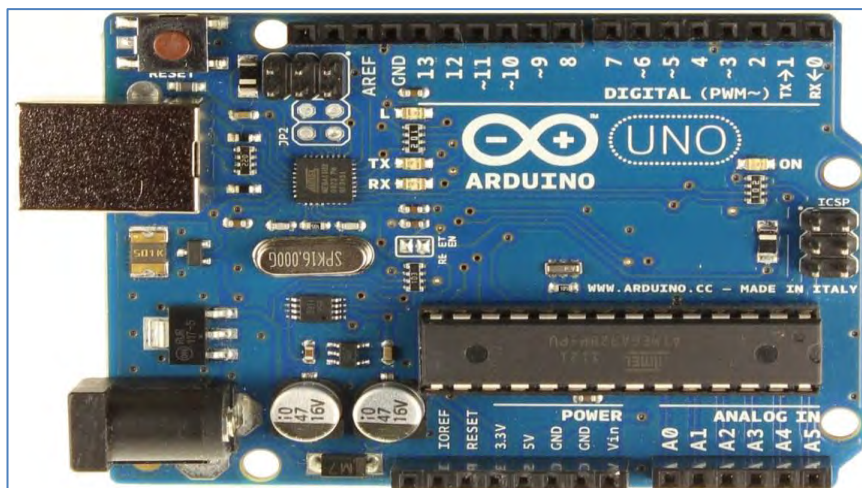


Figure 2.4: Arduino UNO R3

2.3.2.2 Comparison of Arduino type

	Arduino Uno R3	Arduino Mega	Arduino Nano
Processor	ATmega328	ATmega2560	ATmega168
Operating Voltage/ Input Voltage	5 V/7-12 V	5 V/7-12 V	5 V/7-9 V
CPU Speed	16MHz	16MHz	16MHz
Digital IO/PWM	14/6	54/15	14/6
Analogue In/Out	6/0	16/0	8/0

Table 2.1

2.3.3 Ultrasonic sensor

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy to use package. From 2 cm to 400 cm or 1 feet to 13 feet. Its operation is not affected by sunlight or black material like Sharp

rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module [9].

The features of HC-SR04:

- Power Supply: +5V DC
- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance : 2cm – 400 cm/1" - 13ft
- Resolution : 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm

Product specification and limitation:

Parameter	Min	Typ.	Max	Unit
Operating Voltage	4.50	5.0	5.5	V
Quisent Current	1.5	2	2.5	mA
Working Current	10	15	20	mA
Ultrasonic Freq	-	40	-	kHz

Table 2.2 [9]

To start measurement, Trig of SR04 must receive a pulse of high (5V) for at least 10us, this will initiate the sensor will transmit out 8 cycle of ultrasonic burst at 40kHz and wait for the reflected ultrasonic burst. When the sensor detected ultrasonic from receiver, it will set the Echo pin to high (5V) and delay for a period (width) which proportion to distance. To obtain the distance, measure the width (Ton) of Echo pin. [9]

Time = Width of Echo pulse, in uS (micro second)

- Distance in centimetres = Time / 58
- Distance in inches = Time / 148
- Utilize the speed of sound, which is 340m/s

In this project, the time is divide with 58 in the Arduino coding because the distance measure in centimetre.

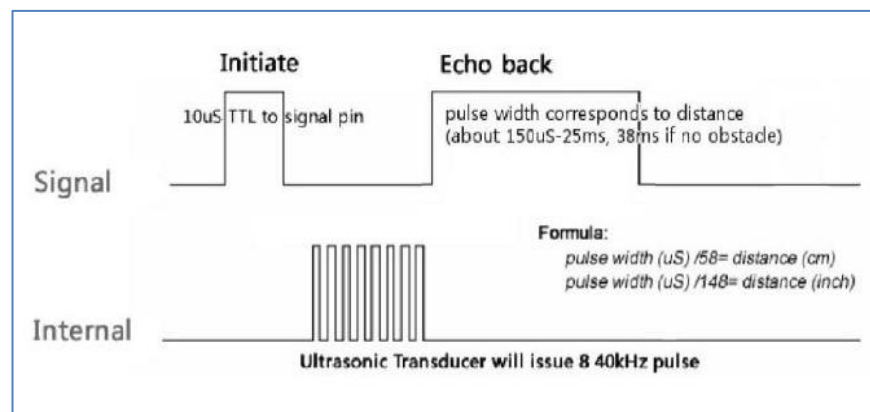


Figure 2.5 : Cycle of wave



Figure 2.6: Product Layout of HC-SR04

2.3.3.1 Comparison of distance sensor in market

	HC SR04	RB MAB 31	Max Sonar WR	Max Sonar EZ3
Distance Measure	2cm – 400cm	3cm – 4m	Up 10m	Up to 5m
Operating Voltage	3.3V – 5V	3.3V – 5V	3.3V – 5V	3.3V – 5V
Price (depend on market)	RM 70	RM95	RM130	RM90

Table 2.3

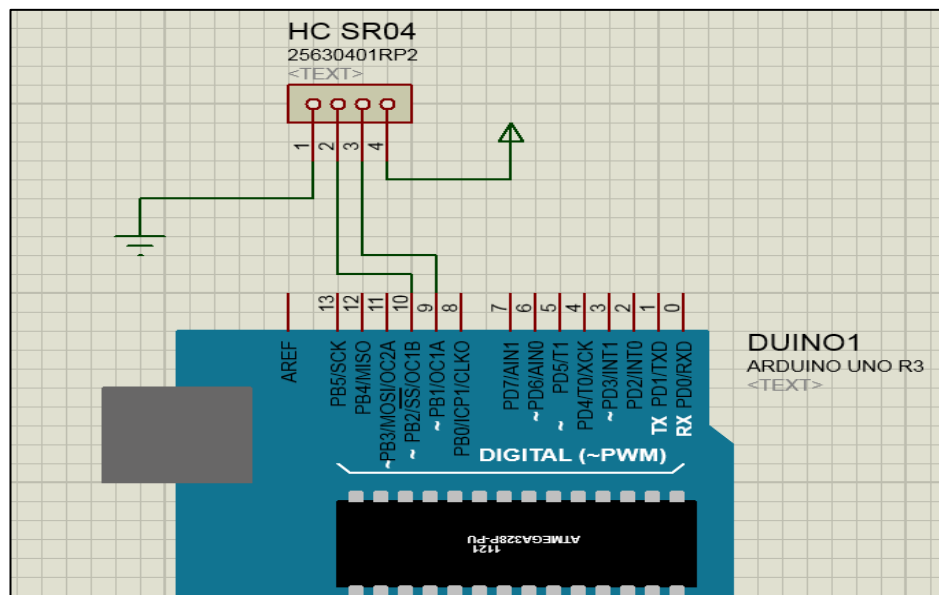


Figure 2.7: Connection of ultrasonic sensor

Figure above show the connection of HC SR04 to Arduino. The Echo and Trigger pin of the sensor is connect to the pin 9 and pin 10 of the Arduino respectively.

2.3.4 Buzzer

A buzzer defines as a mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic or piezoelectric audio signalling device. It produce tone depend on the oscillating of the electronic circuit. Besides that, it also can operate by using other audio signal source [10]

2.3.4.1 Types of Buzzers

There have several types of buzzers in market that suitable for this project. The buzzer can be divide due to it categorized. For example the buzzer can be categorize by Type, Sound Level, Frequency, Rated Voltage, and Dimension. The several types of buzzer available in market such as Electro-Acoustic, Electromagnetic, Electromechanic, Magnetic and Piezo.

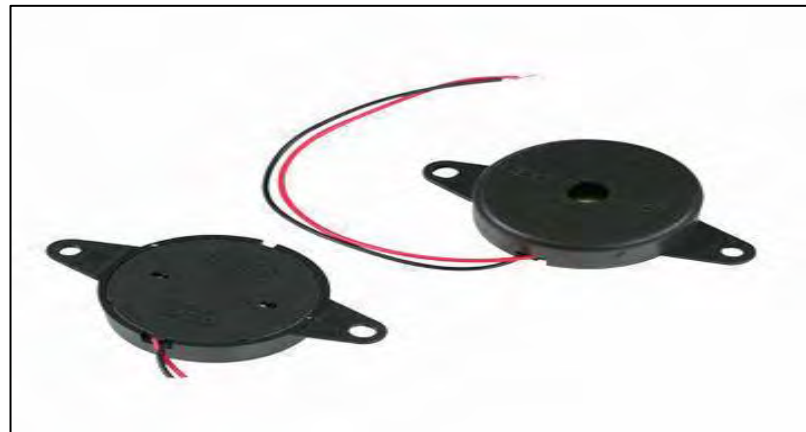


Figure 2.8: Buzzer

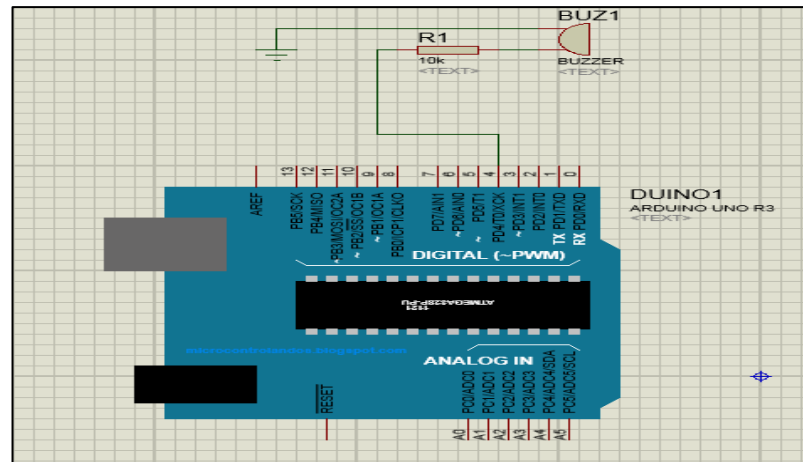


Figure 2.9: Connection of buzzer

Figure above show the connection of buzzer on the ISIS software. The positive terminal of buzzer is connect with 220 Ω resistor and the negative terminal of buzzer is connect to pin 4 of Arduino.

2.3.5 74HC595 IC

74HCT595 are 8-stage serial shift registers with a storage register and three state outputs. The registers have separate clocks. This IC use in this project as the shifter for LED. Data is shifted on the positive-going transitions of the shift register clock input (SHCP). The data in each register is transferred to the storage register on a positive-going transition of the storage register clock input. If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register. [11]

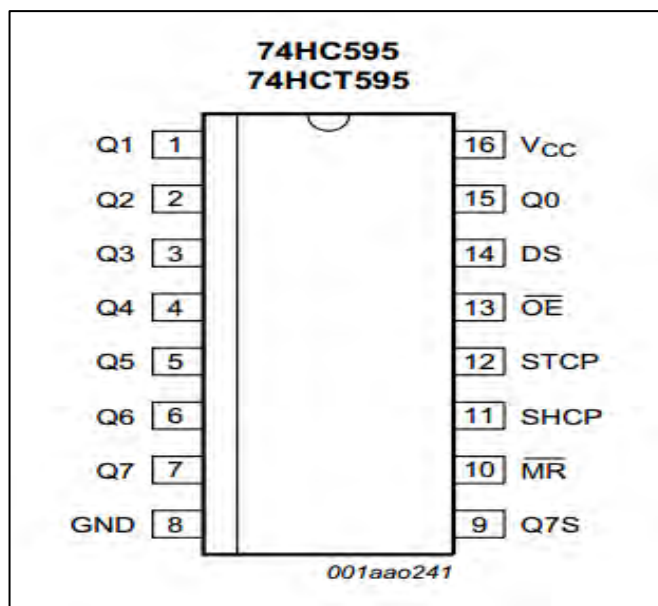


Figure 2.10: Pin Configuration

Symbol	Pin	Description
Q1	1	Parallel data output 1
Q2	2	Parallel data output 2
Q3	3	Parallel data output 3
Q4	4	Parallel data output 4
Q5	5	Parallel data output 5
Q6	6	Parallel data output 6
Q7	7	Parallel data output 7
GND	8	Ground (0V)
Q7S	9	Serial data output
MR	10	Master reset (Active LOW)
SHCP	11	Shift register clock input
STCP	12	Storage register clock input

OE	13	Output enable input (Active LOW)
DS	14	Serial data input
Q0	15	Parallel data output 0
Vcc	16	Supply voltage

Table 2.4: Pin Description of 74HC595n

2.4 Software

2.4.1 Proteus Design Suite

The Proteus Design Suite comprises a fully integrated EDA package with modules for schematic capture (ISIS) (Intelligent Schematic Input System), circuit simulation (PROSPICE), PCB layout (ARES) and embedded co-simulation (VSM). The simulation functions take place entirely within the schematic editor whilst ISIS and ARES share a common and easy to use. It provides total control of drawing appearance in terms of line width, fill styles, colour and fonts. After the Arduino programming completed design, Proteus Professional 8 will used to simulate the programming. After circuit is completed draw in, the next step is to programming the microcontroller. ISIS software was used to create the circuit before its transfer to the ARES for PCB footprint. The components need to pick from the library and place manually. After complete construct the circuit, ARES software was used to transfer the circuit into footprint.

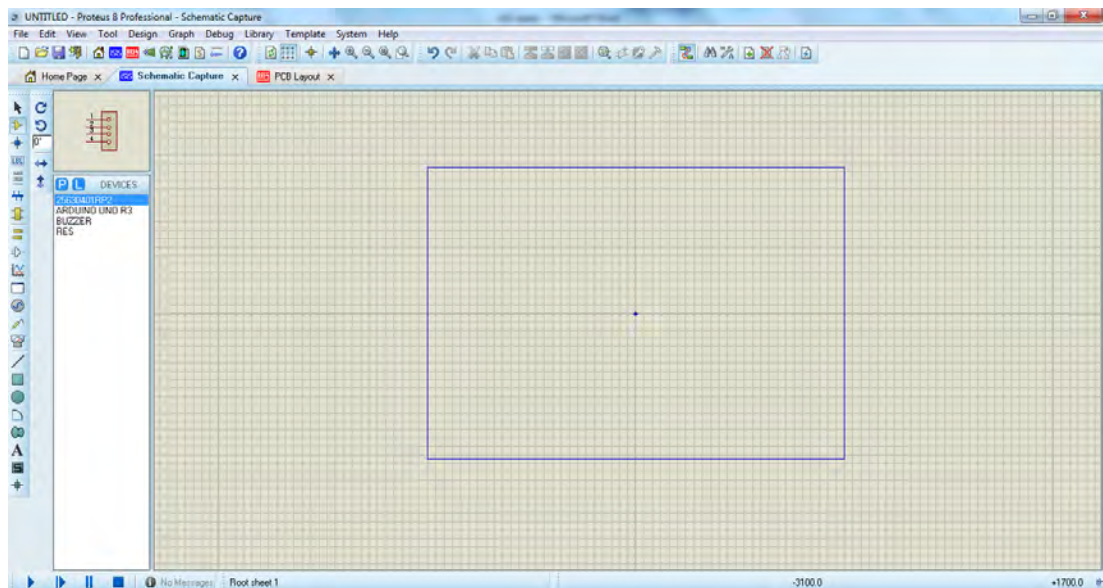


Figure 2.11: ISIS interface

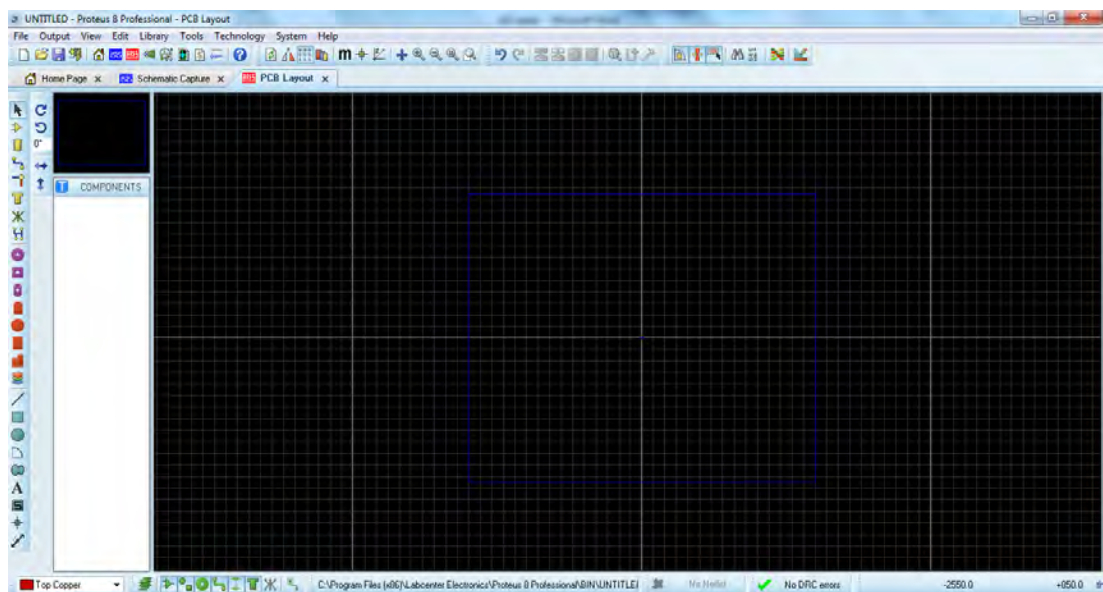


Figure 2.12: ARES interface

Other general features of Proteus 8 include:

- ✓ Runs on Windows XP onwards.
- ✓ Automatic wire routing and dot placement/removal.
- ✓ Powerful tools for selecting objects and assigning their properties.

- ✓ Total support for buses including component pins, inter-sheet terminals, module ports and wires.
- ✓ Fully configurable Bill of Materials reporting.
- ✓ Live netlisting to the ARES Layout module and additional netlist outputs to suit other PCB layout tools.



Figure 2.13: Proteus Design Suite

2.4.2 Arduino Coding software

Arduino coding software function to give a command by writing code in the Arduino programming language and using the Arduino development environment. Arduino coding software provide library to ease the user to learn about the Arduino coding. The list of code makes it easy to connect to a sensor, display, module, etc. For example, the built-in Liquid Crystal library makes it easy to talk to character LCD displays. There are hundreds of additional libraries available on the Internet for download. The built-in libraries and some of these additional libraries are listed in the reference. To use the additional libraries, the file of library need to install first.

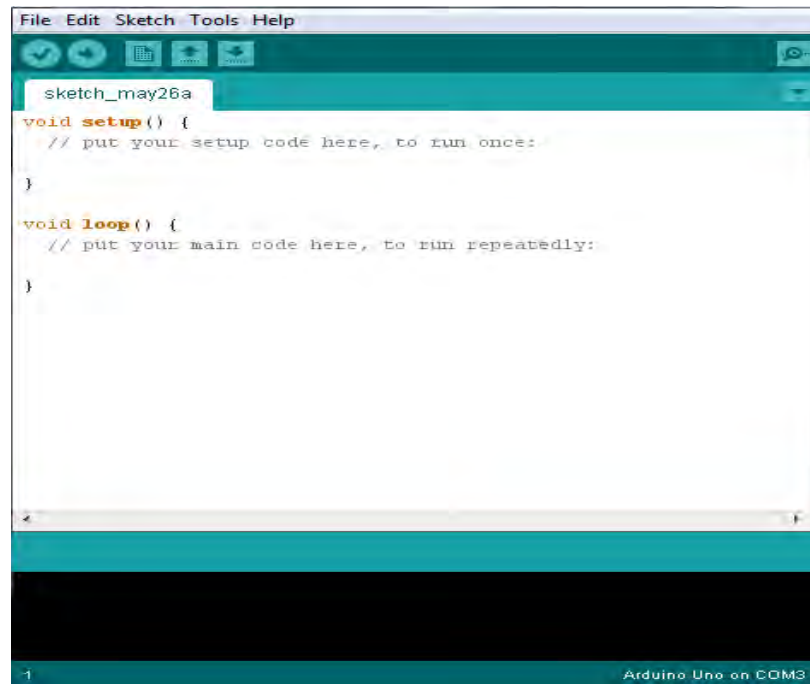


Figure 2.14: Interface of Arduino software

Chapter III

Methodology

3.1 Introduction

This chapter explains about the project methodology for Car Security Alert System through analysing on conceptual design, development, and implementation of ultrasonic sensor HC SR04 as the input for the system while the output is the LCD display, LED, and buzzer as the alert system.

This chapter describe how this project will be carried out to achieve the objective of project. The element of methodology includes the planning of study, flowchart of research, and analysis technique.

3.2 Project Planning

Project planning is important to make sure the project can be done within the duration. Project planning which is implemented at the initial stage of project. The Gantt chart present every step done in the project and make sure the project done as the expectation time needed.

3.3 Project Flowchart

The flowchart of project illustrated as the figure below. The project divided into two main parts which is hardware and software implementation. It continuous with the development of circuit and coding for Arduino. Debug and testing is done to detect if there have an error from the both side, hardware and software. Hardware and software was integrated together as the final step of project.

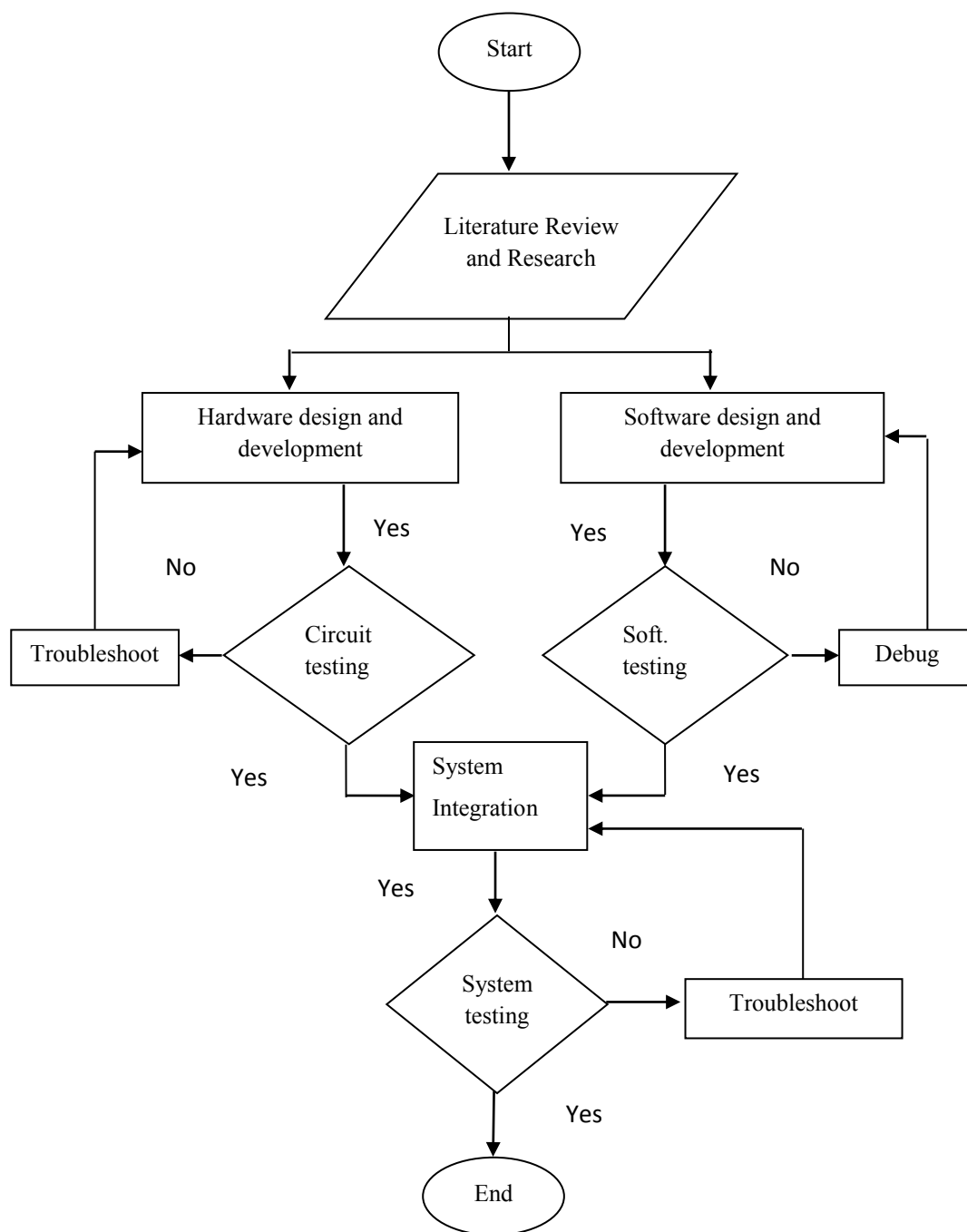


Figure 3.1

3.4 Project Implementation

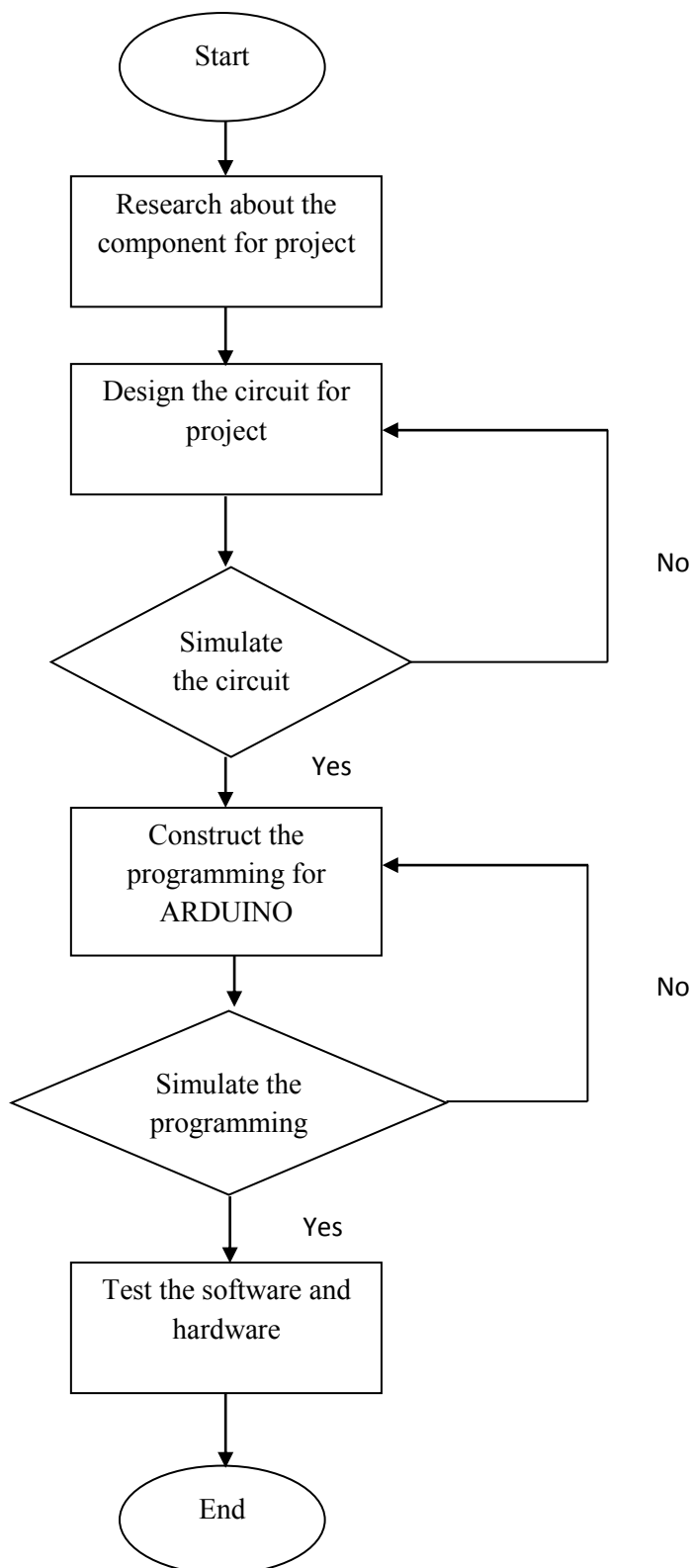


Figure 3.2: Project Implementation

Figure 3.2 show the flow of project implementation start from the research until software and hardware development. The first step in this project implementation is by do a research about the quotation of the project. It was done by reading the journal. From there, it shows the idea how to develop the project. The second step is design the circuit for project. In this phase, the entire component used was listed. The input, controller and output was determined and constructed in protoboard by refer to the schematic of the circuit. After completely designed the circuit, the simulation run on circuit. In this phase, there was two stage for simulation. The first one is computerised simulation and second one is on-board simulation. It has done by connect the circuit with power source. The next step is construct programming for Arduino. Once it successfully verified, load the program into Arduino and run the circuit that connected to Arduino.

3.4.1 Circuit Development

The circuit development start from determine the component need for circuit development process. This job can be done by do a research and study about previous project. After component list was determined, the next process is circuit construction by using ISIS software. By using this software, the simulation of circuit can be done and the circuit can be transfer to ARES for PCB footprint purpose.

3.4.1.1 List of Component

Item	Quantity
Arduino UNO R3	1
Positive PCB	1
LCD display	1
Buzzer	1
LED	7
RC car model	1

Table 3.1

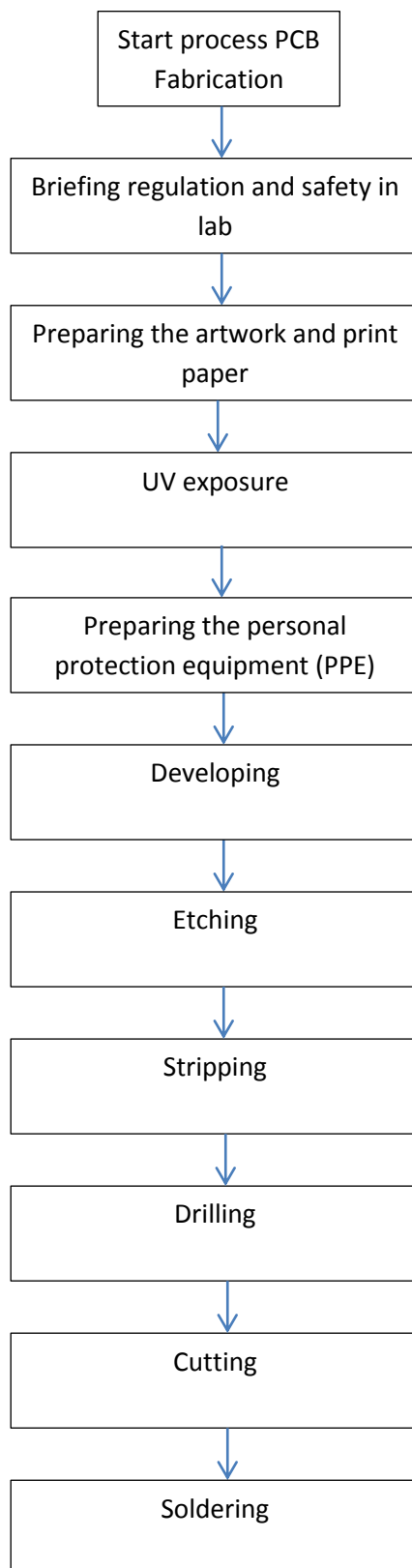
3.4.1.2 Etching Process

Figure 3.3

In order to obtain a suitable PCB layout for fabrication process, the circuit simulated using Proteus requires some modification. This is because some of the components that were used in the simulation using Proteus cannot be implemented while constructing the PCB Layout as it's not available. As an example, animated LED is used while conducting the Proteus simulation as it aids in showing the functionality of the circuit. On the other hand, for constructing the PCB layout, the specific component turns out to be unavailable. Therefore, to attain a suitable PCB footprint a connector is implemented instead of LED.

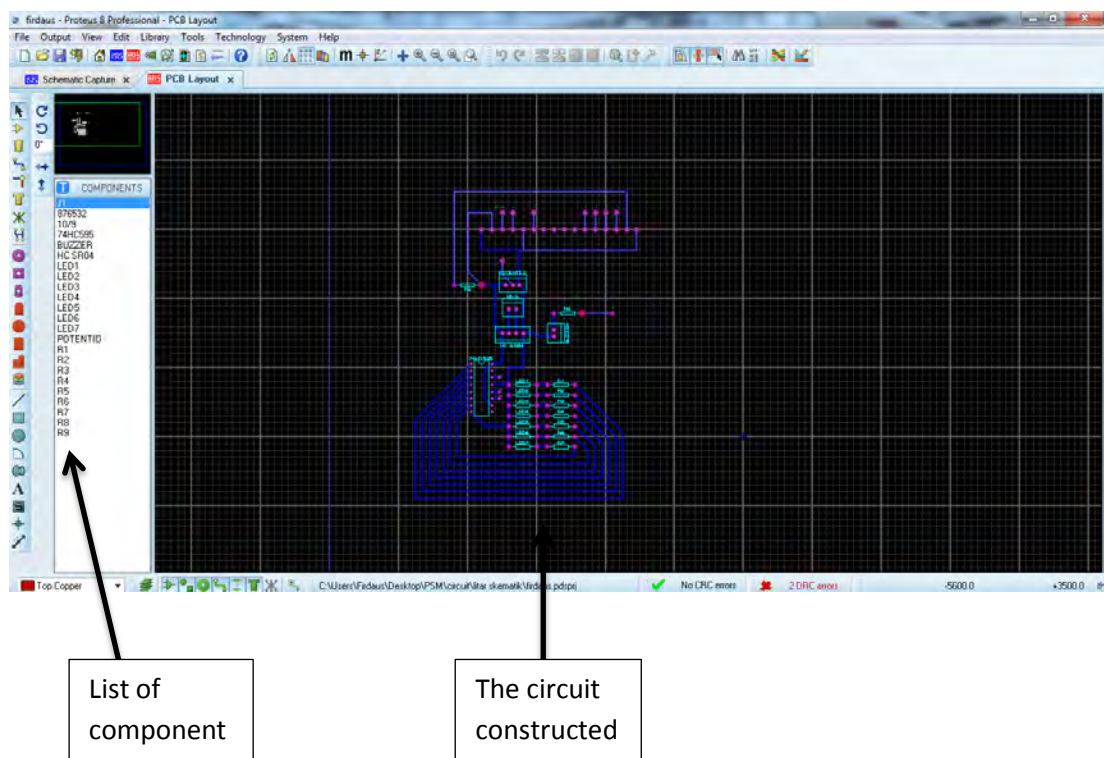


Figure 3.4

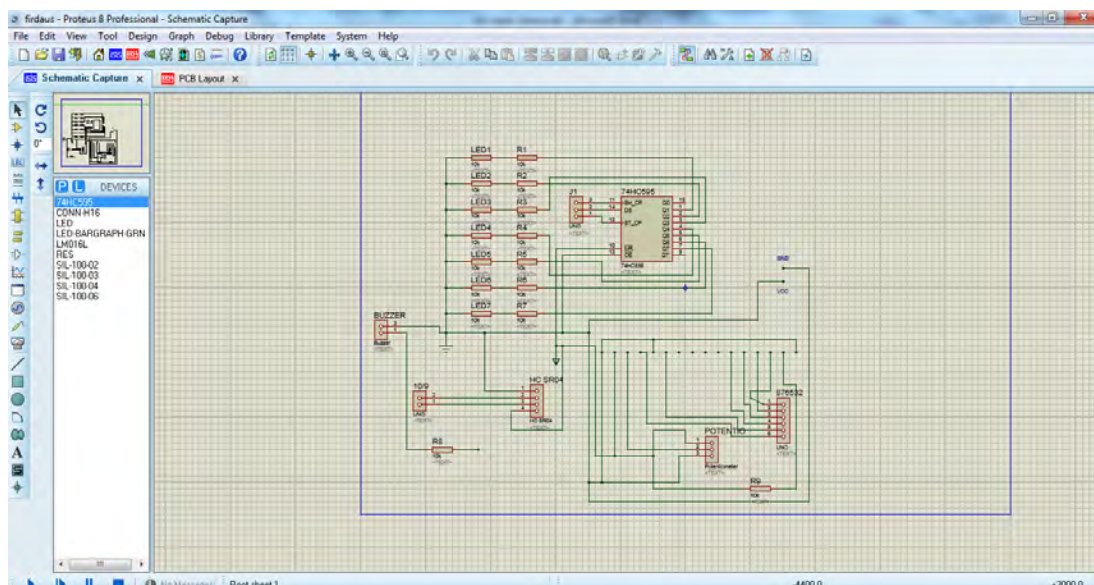


Figure 3.5

ISIS provides the development environment for PROTEUS VSM, the revolutionary interactive system level simulator. This product combines mixed mode circuit simulation, micro-processor models and interactive component models to allow the simulation of complete micro-controller based designs. ISIS provides the means to enter the design in the first place, the architecture for real time interactive simulation and a system for managing the source and object code associated with each project. In addition, a number of graph objects can be placed on the schematic to enable conventional time, frequency and swept variable simulation to be performed. [11]

During etching process, all safety precaution must be taken to avoid hazard. Personal Protection Equipment must be worn during conducted the etching process. It is because during etching process, human are exposed to chemical reactance. The equipment required such as:

- Respirator
- Apron
- Chemical Google
- Nitrile Boot
- Nitrile Glove



Figure 3.6

For fabrication process involved many step and one of the step is printed PCB layout on transparent plastic that compatible with UV process. After the circuit printed on transparent paper, it was attached to UV PCB board.

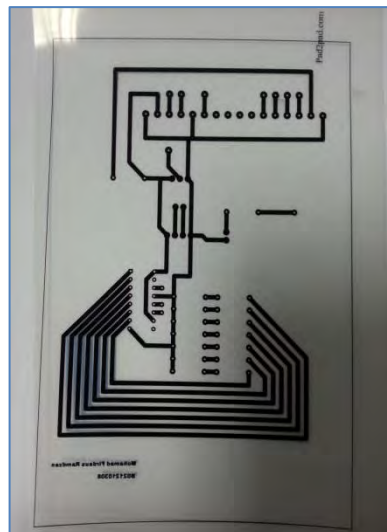


Figure 3.7: Printed Circuit



Figure 3.8: UV PCB Board

The UV PCB Board has a layer of protection and it must remove in the dark room condition. The printed PCB layout was rubbed together with the PCB Board and then the board was put on the UV machine. This machine will vacuum the board to make sure the printed PCB layout stick properly with PCB Board without air bubbles.



Figure 3.9: Protection layer remove in dark room



Figure 3.10: PCB board in the UV machine

The machine was set to 10 second for UV process. Close the lid and wait until end of 10 second before the PCB going to the next process.



Figure 3.11: UV process

After complete the UV process, remove the transparent paper on the PCB. Next process is developing. This process was used developer liquid to develop the board and this process takes around 10 to 15 second. The board was soak in the developer liquid and make sure there have no over develop because it will reduce the thickness of copper. This will break the route on etching process.

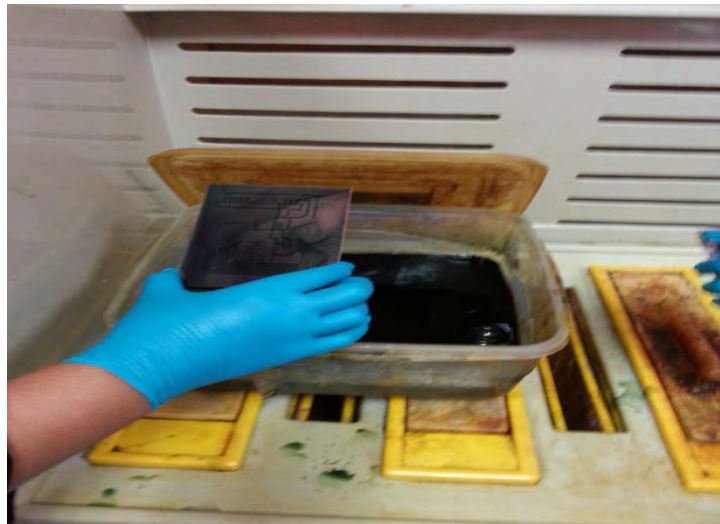


Figure 3.12: Developing Process

After done developing process, the board need to rinse with the water.



Figure 3.13: The board after developing



Figure 3.14: Etching machine

The etching process must be done for three or four times. This is because the copper still cover the board after the first etching process. For this project, the board has done four times etching process before the board are clean from the unwanted copper.

After that, the board will go to stripping process. an etched circuit still covered in the photo resist. This layer can be removed with the resist strip applicator. Put the board inside the board holder in the tank containing the resist stripper. The photo resist should be stripped off approximately 1 minute. Once the photo resist has been stripped from the circuit board holder and the board are then wash with water.



Figure 3.15: Immersed Board

The next process is drying process. For this process, there have specific method to dry the board. This process can be done by using cotton to dry the board or using the dryer provided in the lab.



Figure 3.16: Dryer Machine

After the board dry, it ready to go to the next process that is drilling process. Precaution step must be taken during this process such as wearing the google and earplug.

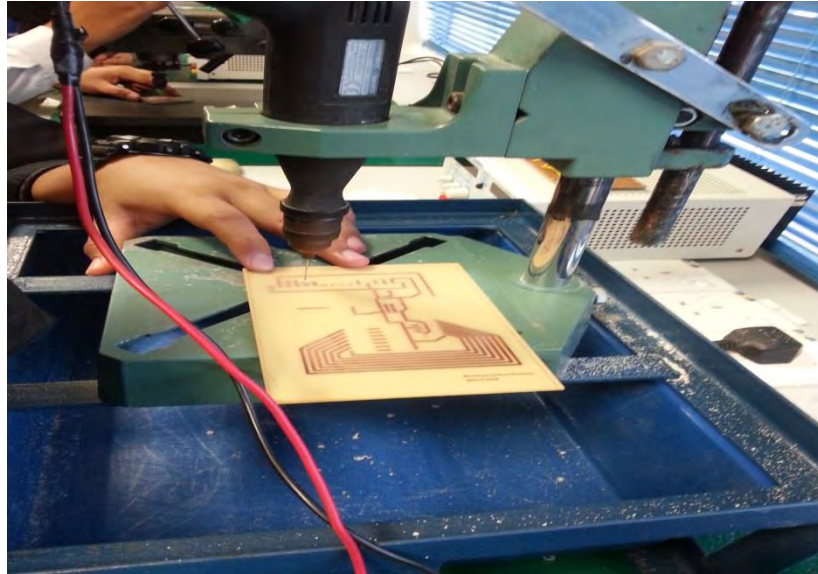


Figure 3.17: Drilling Process

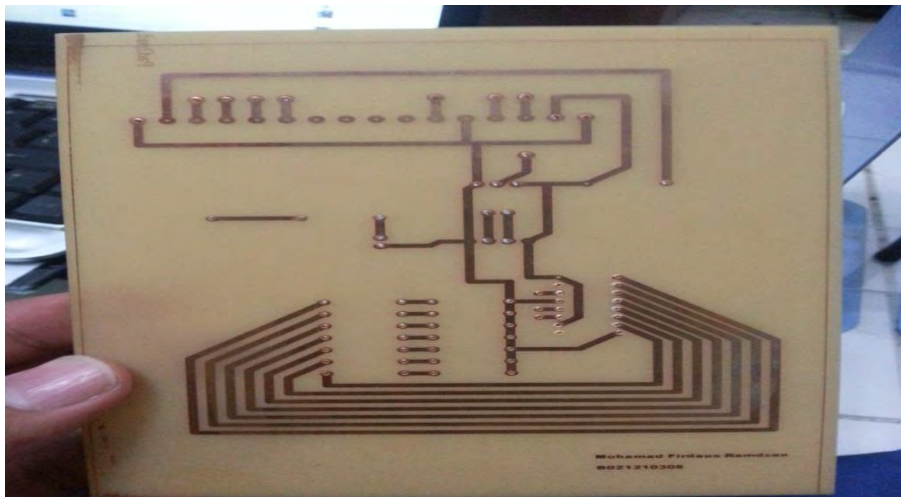


Figure 3.18: board after drilling process

After the drill process, the board are ready to be solder with the component. Place the entire component properly on the top of board and then solder the leg of component.

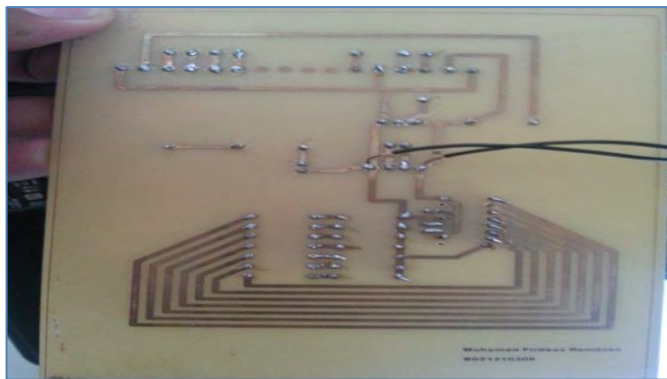


Figure 3.19: Complete soldered board

3.5 Project Chart

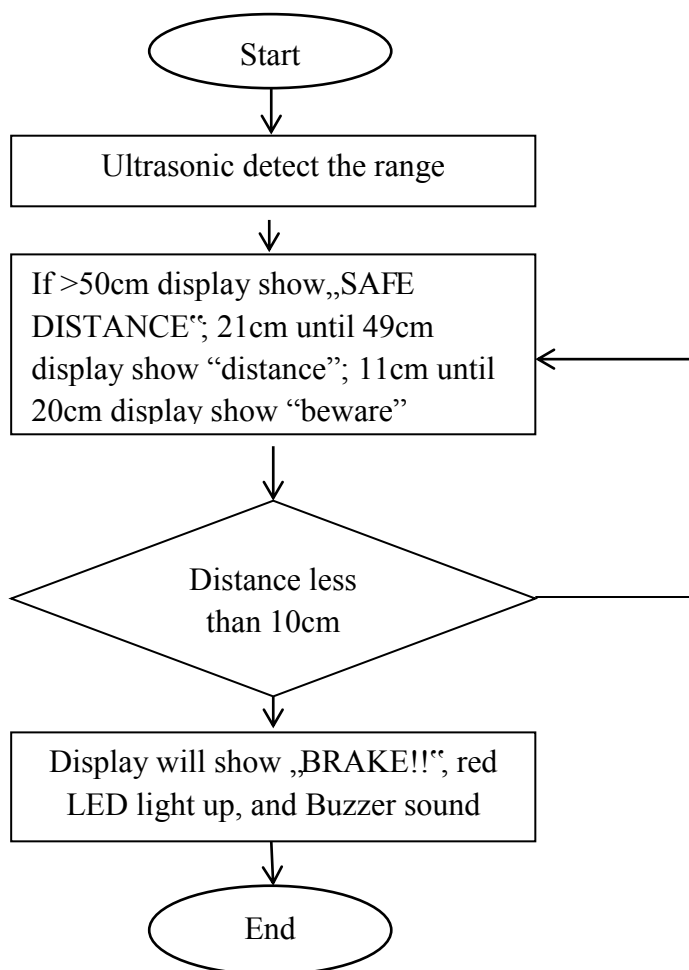


Figure 3.20

The chart above is about the sequence of the project running. Started from the HC-SR04 detect the distance, and then it send the data to Arduino. This process is continuous until the sensor detects the range less than 50cm. HC-SR04 use pulse and echo to detect the range. By using this feature, trigger or transmitter spread the wave in 30° angle and once the wave collide with something, the wave is reflect back to echo or receiver. For the output, if the sensor detect the distance more than 50cm, the display show “SAFE DISTANCE”. If the distance from 21cm to 49cm, the display show the distance in centimetre and if the sensor detect the range between 11cm to 20cm, the display show “BEWARE!!” and the last one is sensor detect the range is less than 10cm, then the display show “BRAKE!!”. For LED, its start to light up once the distance reaches at 40cm. The first level indicates by green colour, second level indicates by blue colour and the third level indicates by red colour. The tonepin for buzzer produce the louder sound every time the LED turns to the next level.

3.5.1 Block Diagram

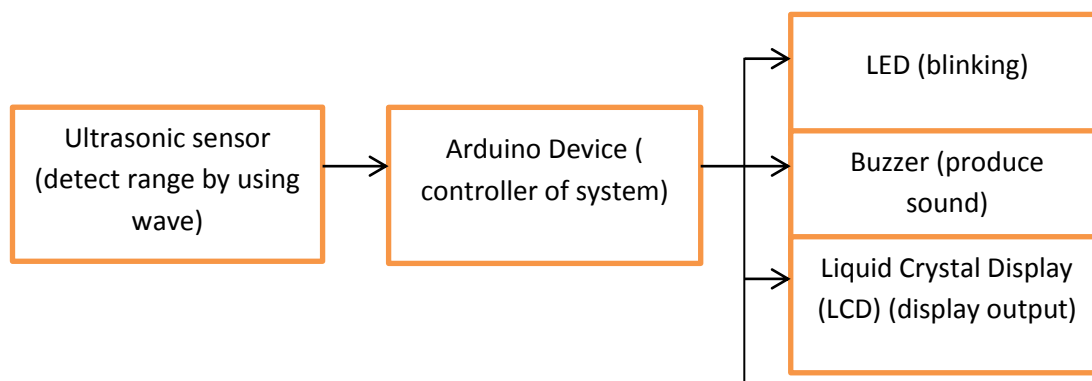


Figure 3.21

Figure 3.21 shows the block diagram for Car Security Alert System. The ultrasonic sensor is the input where it sent the distance data to Arduino. Arduino take an action as the brain of this system and control all components in this system. For the output, there are three outputs for the system. The first output is LED, second is Buzzer, and the third one is LCD. LED will light up when the ultrasonic detect range

less than 40cm and buzzer will alert the driver by produce the different tone depend on the level of LED. The LCD function to show the distance and status of distance.

Chapter IV

Result and Discussion

4.1 Overview

In this chapter, it discussed about the result obtained after the project was completed. It discussed about the step upon completing the project start from development of circuit, fabrication process, and hardware development. The performance evaluation of this project also discussed in this chapter, followed by analysis of project outputs. The experimental and testing phase was shown in this chapter, including the functionality of the project.

4.2 Testing and Output Result

From the previous chapter, the software and hardware implementation were already discussed. Project methodology, method, and comparison of each journal have been made for enhancement purpose. The ISIS software gives results from the aspect of layout design and fabrication.

4.2.1 Hardware and Prototype of Car Security Alert System

Figure 4.1 shows prototype of the project. The car was equipped with the ultrasonic sensor on the front side and for the output, the LCD display, LED, and Buzzer was placed on the back of the car. The circuit and Arduino were placed in the car while the battery that was functioned to operate the circuit was placed under the car. Some modifications have been done before the circuit and Arduino can fit in the car.



Figure 4.1

The systems used in the car are user friendly which the LED has a Multi-Stage / Level of LED that's very easy to understand. There are seven LEDs which first stage represent by Green colour, second stage represents by Blue colour and the third stage represent by Red colour. For sequential of led, the first led will light up when the car reach 40cm from hurdle following by second led which light up when

the car reach 35cm from hurdle and the next led will light up every 5cm movement of car from hurdle.

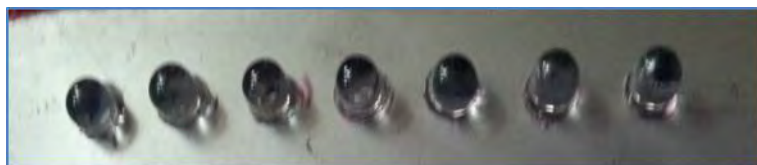


Figure: 4.2

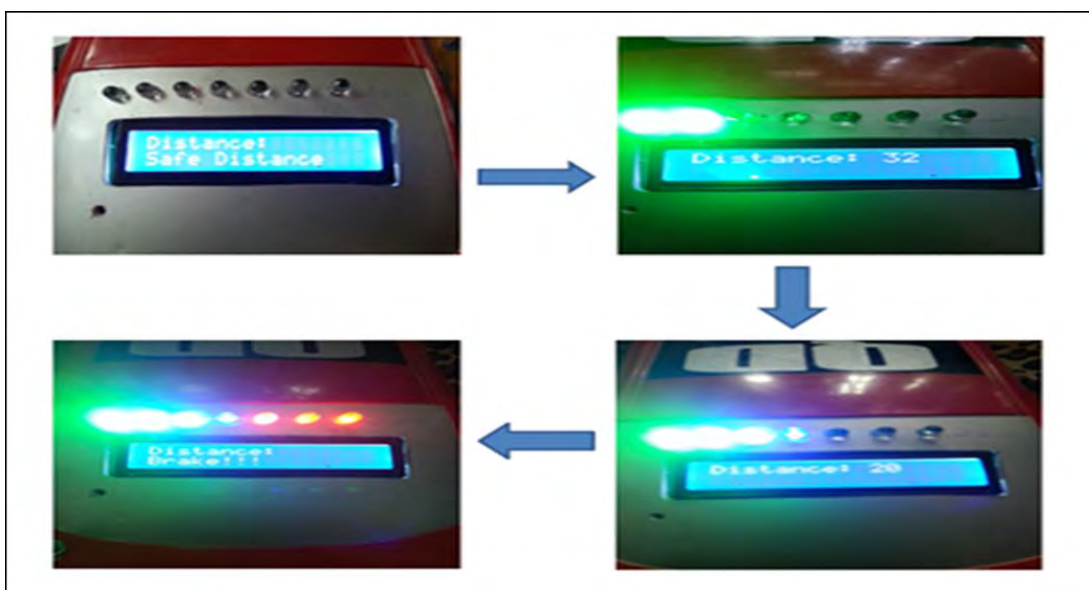


Figure: 4.3

The second output used in the Car Security Alert System is a buzzer. The buzzer operates in a different tone for each level of distance where the closer the distance, the louder the buzzer tone. The buzzer produced different tone due to coding for tone pin on the Arduino. The coding for buzzer was showed in the subchapter 4.3.



Figure: 4.4

Figure 4.4 shows the location of the buzzer on the prototype. The positive terminal of buzzer was connected to 220 Ω resistor and the negative terminal of buzzer was connected to pin no 4 of the Arduino. The resistor function is to avoid the damaged due to the high flow of current.

The third output as the alert system is 16x2 display. 16x2 represents the sixteen character of horizontal of display and two characters for vertical of display. For LCD display, there has a VO pin connected to potentiometer as the brightness adjuster. For display, there have 3 conditions which more than 50cm, the display will show "Safe Distance", 20cm to 11cm will show as "Beware" on the display and the last condition is less than 10cm and the display will show "Brake!!"

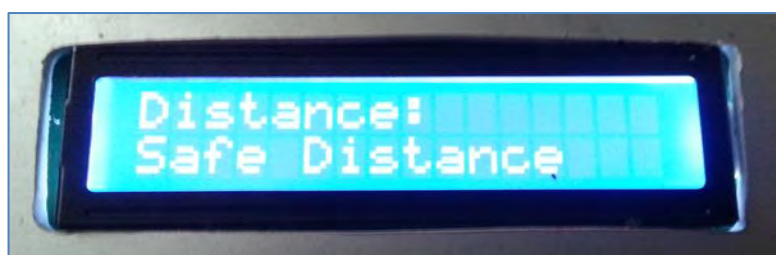


Figure: 4.5

4.2.2 Experimental

For experimental phase, the projects go through a process which is simulated by using software and On Board testing.

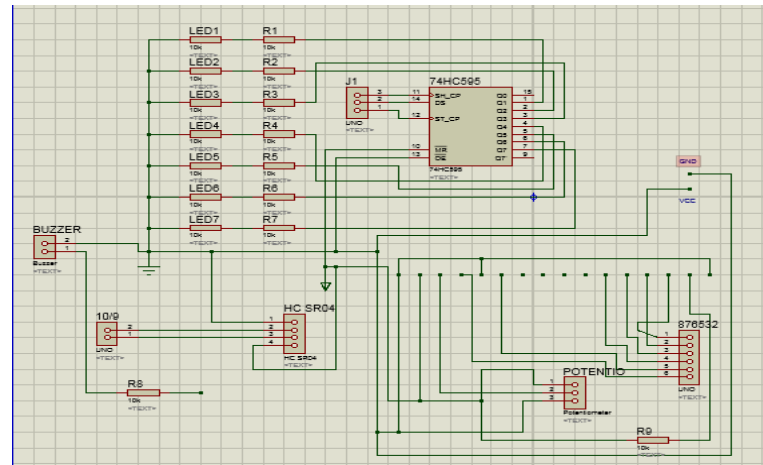


Figure 4.6: Simulation on ISIS

In Figure 4.6, it shows the simulation on ISIS. The circuit was constructed and debug. Using the ISIS software, it can detect if there is any wrong connection and it can't simulate unless the wrong connection was repaired. The circuit simulate to verify the functionality of the coding. Eventually, we are able to see if the output display on the LCD screen.

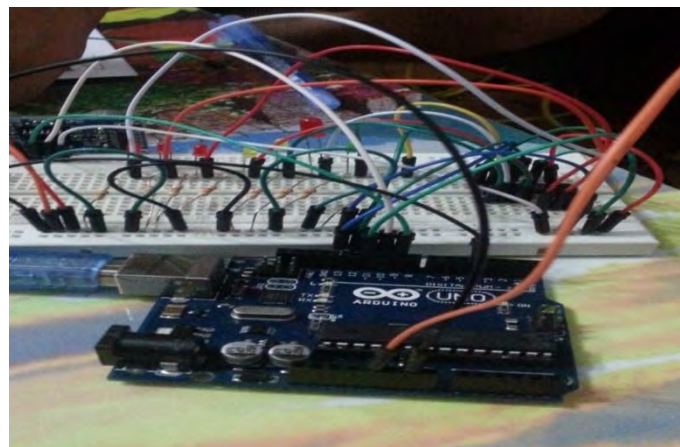


Figure 4.7: On Board Testing

Figure 4.7 shows the complete circuit constructed on board. All the VCC and GND are connected to the main controller (Arduino). For Arduino, it contains 14 digital output pin. For secure connection, all precaution steps were taken before the Arduino connected with source. Fail to do so, caused the Arduino and component will be broken. The IC 74HC595N was used as shift register for LED and as the result, the LED shifted due to distance measured by the ultrasonic. Three colour of LED was used to indicate the level of distance. The green colour for “safe distance”, yellow colour indicates for “beware” and red colour means “danger”. Each LED connected with 220ohm resistor to avoid the overflow current through the LED.

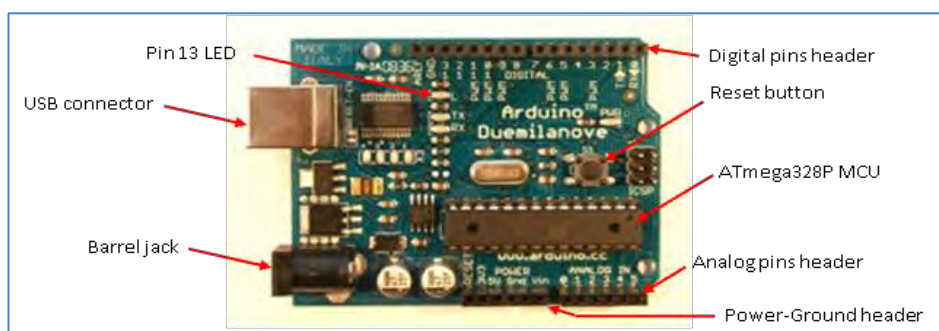


Figure 4.8: Arduino Structure

4.2.3 Circuit Design

In order to obtain a suitable PCB layout for fabrication process, the circuit simulated using Proteus requires some modification. This is because some of the components that were used in the simulation using Proteus cannot be implemented while constructing the PCB Layout as it's not available. As an example, animated LED is used while conducting the Proteus simulation as it aids in showing the functionality of the circuit. On the other hand, for constructing the PCB layout, the specific component turns out to be unavailable. Therefore, to attain a suitable PCB foot print a connector is implemented instead of LED. Figure 4.9 demonstrates the modified circuit used for designing PCB Layout.

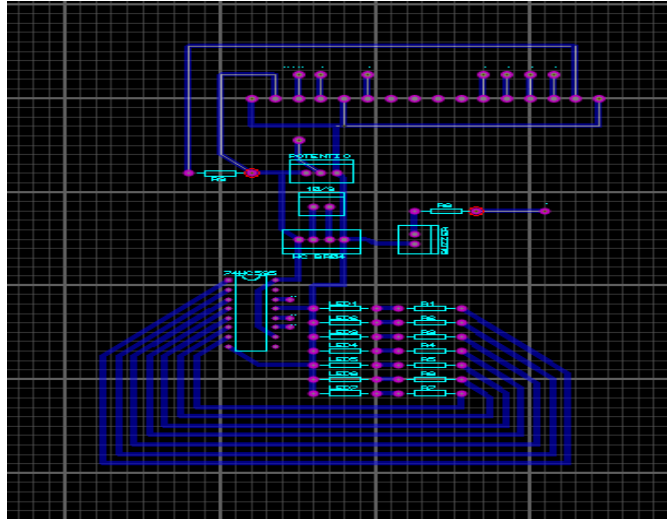


Figure 4.9: Circuit constructed on ARES

The pin connected to Arduino just put as marked point. After the modification is successfully, the PCB layout was designed using software Proteus 8.0 (ARES). Figure 4.9 shows the footprint for each component. The component must be rearranged by manual method to avoid clash route. For this project, the route size is T60 and the marked point set to C70-30. For this process, avoid using small route and small marker point because it will affect the route during the etching process. The small marker will get in trouble during drilling process because the marker is too small and drill will damage the copper on the marker. For Arduino connection, the pin was replaced with header to get the suitable footprint.

4.2.4 Etching and Circuit

After done the circuit design, the PCB going to next process called as Etching process. This process resulted the board with the route and marked. The size of route and marked point was set during the developing the circuit using ISIS. After complete the etching process, the marked point was drilled to fit the component on the board.



Figure 4.10: Complete Drilled Board

The component was placed on the board and soldered. The connection must be checked first to make sure there have no short circuit before the circuit running. This precaution step is important to avoid the faulty component.

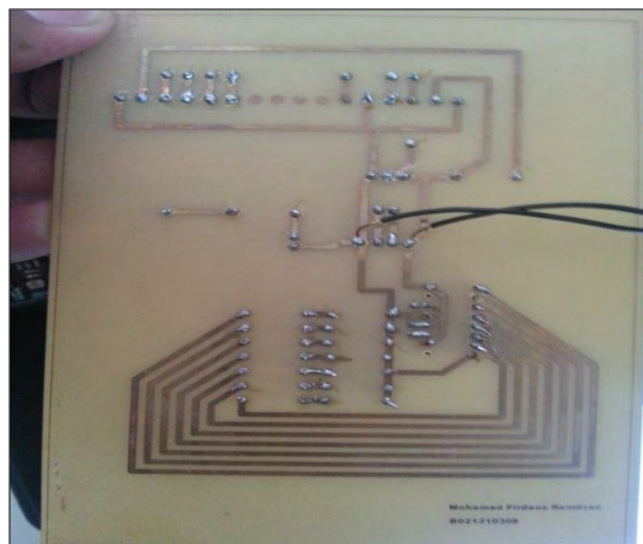


Figure 4.11: Complete Soldered Board

Figure 4.11 show the complete soldered board. The black jumper behind the board is to recover the missing route and need to put jumper manually. Every single route must be check using multimeter to avoid the touched route.

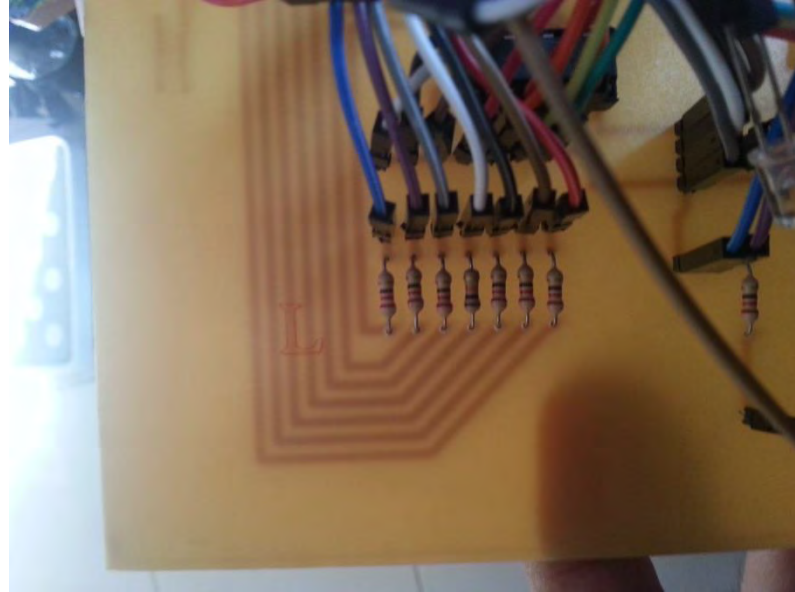


Figure 4.12: Component placed on PCB

4.3 Arduino Coding

Arduino 1.6.0 is software used to develop the coding for the project. The software is compatible with many type of Arduino such as Arduino UNO, Arduino Mega, Arduino Mini and many more. In this project, the coding developed resulted the perfectly running system. The project running with sequence as well and the outputs for the system function using the coding developed.

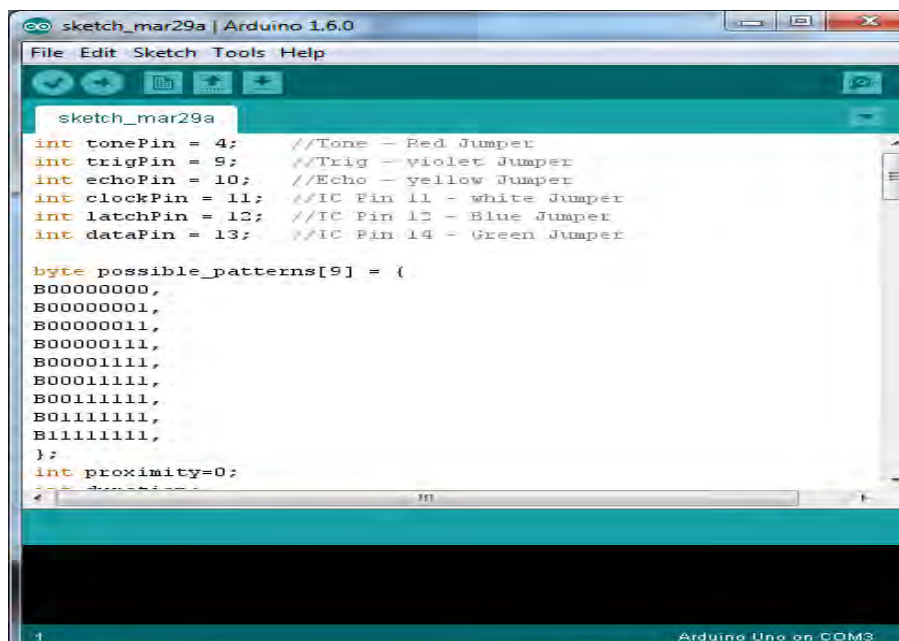


Figure 4.13: Arduino 1.6.0 interface

The Arduino board must be connect to the USB port before the coding can be upload to the Arduino. The port used can be determined on control panel of desktop and to run the Arduino, the port can be selected by clicking at „Tools → Port“. After complete develop the coding, verify it by click the „verify“ button. If no error, proceed by uploaded the coding.

```

if (distance <= 10) //Display Brake
{
  Serial.println("Brake");

  lcd.setCursor(10, 0);
  lcd.print("      ");

  lcd.setCursor(0, 1);
  lcd.print("      ");

  lcd.setCursor(0, 1);
  lcd.print("Brake!!!");
}
else if (distance >= 45) //Safe Distance
{
  Serial.print(distance);
  Serial.println(" cm");

  lcd.setCursor(10, 0);
  lcd.print("      ");

  lcd.setCursor(0, 1);
  lcd.print("Safe Distance");
}
else

```

Figure 4.14: Coding for Display

The figure 4.14 show the coding for Display and declaration on each command has been made to more understanding about the coding. As show in the figure, the display show “Brake” if the distance less than 10cm. The command wrote as „if (distance <= 10)“. If distance more than 50cm, the Display show “Safe Distance” and the command wrote as „else if (distance >= 50)“. The „else/if“ command was used to allows greater control over the flow of code than the basic if statement, by allowing multiple tests to be grouped together. For example, an analogue input could be tested and one action taken if the input was less than 45, and another action taken if the input was 45 or greater.

```

if (proximity <= 0)
{
  proximity=0;
}
else if (proximity >= 3 && proximity <= 4)
{
  tone(tonePin, 1000, 200);
}
else if (proximity >= 5 && proximity <= 6)
{
  tone(tonePin, 5000, 300);
}
else if (proximity >= 7 && proximity <= 8)
{
  tone(tonePin, 200000, 300);
}
shiftOut(dataPin, clockPin, MSBFIRST, possible_patterns[proximity]);
digitalWrite(latchPin, HIGH);

delay(500);
noTone(tonePin);
}

```

Figure 4.15: Coding for Buzzer

```

pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(clockPin, OUTPUT);
pinMode(latchPin, OUTPUT);
pinMode(dataPin, OUTPUT);
pinMode(tonePin, OUTPUT);

lcd.begin(16, 2);
}

void loop() {
  digitalWrite(latchPin, LOW);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(1000);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 58.2;
}

```

Figure 4.16: Coding for ultrasonic sensor

Trig of SR04 received a pulse of high (5V) for at least 10us, this initiated the sensor to transmit out 8 cycle of ultrasonic burst at 40 kHz and wait for the reflected ultrasonic burst. When the sensor detected ultrasonic from receiver, it will set the Echo pin to high (5V) and delay for a period (width) which proportion to distance. To get the distance in cm, the time was divided with 58.

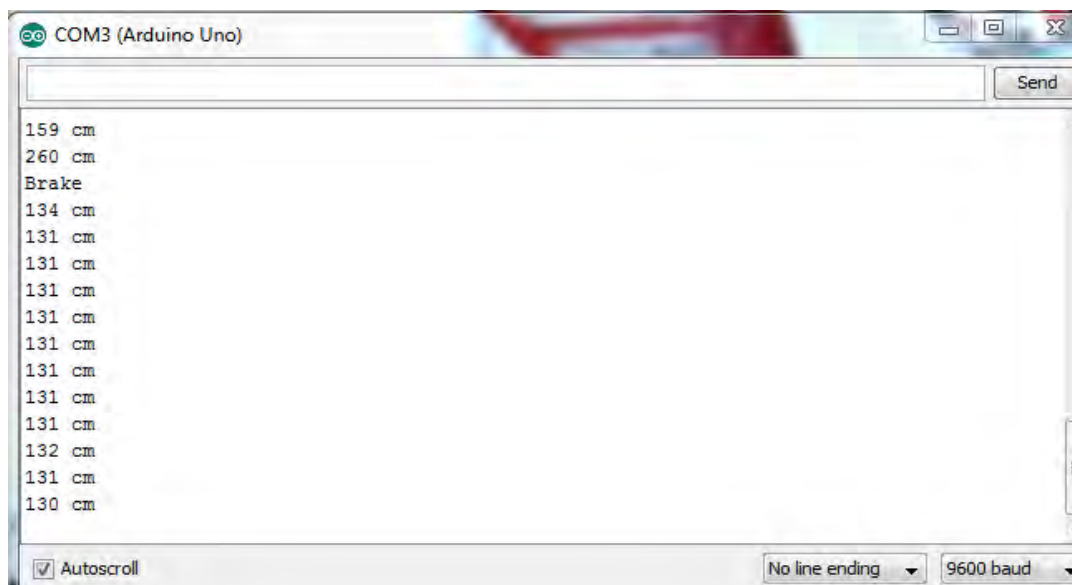


Figure 4.17

Figure above show the analogue value of ultrasonic sensor and this value can be seen in the serial monitor of Arduino Coding software. By using this features, the distance measured can be seen and always scroll to show the current distance.

4.4 Cost for whole project

Item	Price per unit (RM)	Unit	Total (RM)
LCD Display	8.00	1	8.00
Arduino UNO R3	43.00	1	43.00
Male Jumper	8.00	1	8.00
Female Jumper	8.00	1	8.00
220Ω resistor	0.30	9	2.70
Buzzer	1.80	1	1.80
Led	0.10	7	0.70
Positive PCB	15	1	15
Total			87.20

Table 4.1: Cost for Whole Project

4.5 Discussion

After testing has been made rigorously and all components function properly, it is clear that "Car Security Alert System" achieve the objective. However a few challenges have been countered while developing this project.

The first challenges are developing process of prototype. The structure of RC car body is hard and need to use drill to place the output component. This is important because the prototype part need to develop with nice and tidy to make it more interested. The bigger PCB used also give some trouble while fitting into the RC car body structure. The RC car body need to modify by cutting some part until the PCB board and Arduino are fitted into the RC car.

Second challenge is the coding development. As the beginner in Arduino coding, it become a bit problem while develop the coding because there is have an error every time the coding verified. But that matter was overcome by doing a study

about the Arduino coding provided in the library of Arduino. Even the coding was provided, it need to modify as to fulfil the requirement of the system.

The third challenge is related to the circuit development and fabrication. Student need to understand the process of circuit development. As discussed on chapter 4, the circuit of project was developed by using ISIS software and then transferred to ARES to create the footprint. But, not all the components have own footprint and need to replace with the header connector to get the footprint. The route of circuit need to create by manually and creator must be avoided from shot route. The etching process is the next stage of circuit development. During this process, there have some problems that affect the quality of circuit. The printed circuit on transparent paper must use the black ink to avoid the circuit route breaking during the etching process.

Chapter V

Conclusion

5.1 Introduction

This chapter discuss about the conclusion from the project and also the recommendation for future enhancement as innovation purpose. Upon completion of this project, a user friendly, fully functional low cost alert system, and distance measurement using ultrasonic sensor was achieved the target and successfully developed.

5.2 Conclusion

As the conclusion, the project objective “To design an alert system for the driver at certain distance of hit” has been achieved. As the project designed, the buzzer and LED’s were functioned to give an alert to driver when they were reached the distance which declared as distance of hit. Besides that, the display also functioned as the notification which show the distance status and also show the distance in centimetre. The Arduino UNO as a microcontroller to control all components and the Arduino software was used as the coding development software in ways to complete the “Car Security Alert System” project. As the conclusion, this project is a successful because all objective managed to be achieved at the end of the research and "Car Security Alert System" has successfully been developed.

5.3 Recommendation

Several improvement and innovation can be added to the current project to enhance its functionality. The first improvement can be made is by adding the vibrator to make the driver more alert. This feature can be install on the driver’s seat and the driver will get an alert by vibration if the car reach dangerous distance.



Figure 5.1: Vibrator Seat

Another improvement that can be made on this project is „speed switch“ for the system. The current problem in Car Security Alert System is the alert system always operates and this makes trouble when the car in traffic jammed. The buzzer and LED will always operate and this will make the driver feeling uncomforted with the system. In order to overcome this problem, the speed switch can be implement in this project. This system’s function is switch on the alert system when the speeds reach 30KM/H and below the stated speed, the alert system will automatically switch off. With this improvement, the system would provide a more effective outcome to this project.



Figure 5.2: Speed Switch

Reference

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Appendix A

```

int tonePin = 4; //Tone Buzzer
int trigPin = 9; //Trig HC SR04
int echoPin = 10; //Echo HC SR04
int clockPin = 11; //IC Pin 11
int latchPin = 12; //IC Pin 12
int dataPin = 13; //IC Pin 14
byte possible_patterns[9] = {
B00000000,
B00000001,
B00000011,
B00000111,
B00001111,
B00011111,
B00111111,
B01111111,
B11111111,
};
int proximity=0;
int duration;
int distance;
// include the library code:
#include <LiquidCrystal.h>
LiquidCrystal lcd(2, 3, 5, 6, 7, 8);
void setup() {
//Serial Port
Serial.begin (9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(clockPin, OUTPUT);
pinMode(latchPin, OUTPUT);
pinMode(dataPin, OUTPUT);

```

```

pinMode(tonePin, OUTPUT);
lcd.begin(16, 2);
}
void loop() {
digitalWrite(latchPin, LOW);
digitalWrite(trigPin, HIGH);
delayMicroseconds(1000);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 58.2;
lcd.setCursor(0, 0);
lcd.print("Distance: ");
  if (distance <= 10) //Display Brake
  {
    Serial.println("Brake");
    lcd.setCursor(10, 0);
    lcd.print("  ");
    lcd.setCursor(0, 1);
    lcd.print("          ");
    lcd.setCursor(0, 1);
    lcd.print("BRAKE!!!");
  }
  else if(distance >= 50) //Safe Distance
  {
    Serial.print(distance);
    Serial.println(" cm");
    lcd.setCursor(10, 0);
    lcd.print("  ");
    lcd.setCursor(0, 1);
    lcd.print("Safe Distance");
  }
  else if (distance >= 11 && distance <= 20)
  {
    Serial.print(distance);

```

```

Serial.println(" cm");
lcd.setCursor(10, 0);
lcd.print("      ");
lcd.setCursor(0, 1);
lcd.print("BEWARE!!!");
}
else
{
Serial.print(distance);
Serial.println(" cm");
lcd.setCursor(10, 0);
lcd.print("  ");
lcd.setCursor(10, 0);
lcd.print(distance);

lcd.setCursor(0, 1);
lcd.print("      ");
}
proximity=map(distance, 0, 45, 8, 0);
//Serial.println(proximity);
if (proximity <= 0)
{
proximity=0;
}
else if (proximity >= 3 && proximity <= 4)
{
tone(tonePin, 1000, 200);
}
else if (proximity >= 5 && proximity <= 6)
{
tone(tonePin,5000, 300);
}
else if (proximity >= 7 && proximity <= 8)
{

```

```
tone(tonePin, 200000, 300);  
}  
shiftOut(dataPin, clockPin, MSBFIRST, possible_patterns[proximity]);  
digitalWrite(latchPin, HIGH);  
delay(600);  
noTone(tonePin);  
}
```


Appendix B

74HC595; 74HCT595

8-bit serial-in, serial or parallel-out shift register with output latches; 3-state

Rev. 7 — 26 January 2015

Product data sheet

1. General description

The 74HC595; 74HCT595 are high-speed Si-gate CMOS devices and are pin compatible with Low-power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard No. 7A.

The 74HC595; 74HCT595 are 8-stage serial shift registers with a storage register and 3-state outputs. The registers have separate clocks.

Data is shifted on the positive-going transitions of the shift register clock input (SHCP). The data in each register is transferred to the storage register on a positive-going transition of the storage register clock input (STCP). If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register.

The shift register has a serial input (DS) and a serial standard output (Q7S) for cascading. It is also provided with asynchronous reset (active LOW) for all 8 shift register stages. The storage register has 8 parallel 3-state bus driver outputs. Data in the storage register appears at the output whenever the output enable input (OE) is LOW.

2. Features and benefits

- 8-bit serial input
- 8-bit serial or parallel output
- Storage register with 3-state outputs
- Shift register with direct clear
- 100 MHz (typical) shift out frequency
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

- Serial-to-parallel data conversion
- Remote control holding register

NXP Semiconductors

74HC595; 74HCT595

8-bit serial-in, serial or parallel-out shift register with output latches; 3-state

6. Pinning information

6.1 Pinning

001aac241

001aac242

Fig 5. Pin configuration DIP16, SO16

Fig 6. Pin configuration SSOP16, TSSOP16

001aac243

Transparent top view

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 7. Pin configuration for DHVQFN16

Appendix C

