UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT HUMAN MOVEMENT SUPPORT USING ANDROID TECHNOLOGY

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electronic Engineering Technology (Industrial Electronic) with Honours.

by

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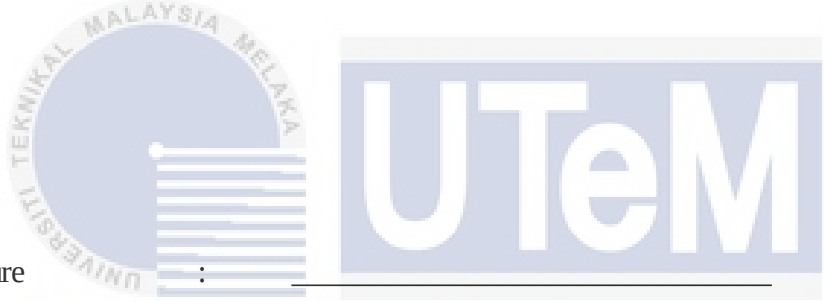

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirement for the degree of Bachelor of Electronic Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory committee is as follow :

.....

(Project Supervisor)

ABSTRAK

Setiap manusia mempunyai had dan keupayaan mereka sendiri terutamanya yang mempunyai kekurangan diri atau dalam perkataan lain kurang upaya. Ini akan mengehadkan kemampuan mereka bila bekerja yang boleh menyebabkan masalah jika mereka menghadapi halangan yang melebihi had mereka. Tujuan projek ini adalah untuk memudahkan kerja manusia atau melebihi keupayaan manusia terutama sekali dalam memuatkan atau mengangkat dengan menggunakan Teknologi Android. Dengan menggunakan Arduino sebagai mikro pengawal, ia akan bertindak sebagai satu medium antara peranti dan pengguna di mana penggunaan Bluetooth modul sebagai pemancar dan penerima. Micro pengawal akan menghantar signal untuk mengaktifkan pergerakan motor mengikut arahan diberi oleh pengguna. Ciri projek ini ialah ia boleh memuatkan beban sehingga 55 kg dan boleh dikawal sehingga 10 meter.

ABSTRACT

Every human have their own limits and capability especially those that have a natural limit or in other word disable. This would limit their ability when working which can lead to trouble if they were to encounter obstacle that are beyond their limit. The purpose of this project is to ease the human work or exceed beyond the human capability especially in loading or lifting by using Android Technology. With the use of Arduino as the microcontroller, it will act as a medium between the device and the user where the use of Bluetooth module as the transmitter and the receiver. The microcontroller will transmit command to activated the movement of the motor depending in how the user desired. The feature of this project is that it up to 55kg max and can be remote at a range of 10 meter.

DEDICATION

Alhamdulillah, praise to the Almighty ALLAH S.W.T.

This thesis is dedicated to

My beloved family,

My Friends,

and my lecturer

Thanks for their encouragement and support

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Bismillahirrahmaanirrahim,

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

HMS	-	Human Movement Support
MAC	-	Media Access Control
HCI	-	Host Controller Interface
EDR	-	Enhanced Data Rate
USB	-	Universal Serial Bus
AC	-	Alternating Current
DC	-	Direct Current
GND	-	Ground
RX	-	Receiver
TX	-	Transmitter
SPI	-	Serial Peripheral Interface
EDR	-	Enhanced Data Rate
IC	-	Integrated Circuit
PCB	-	Printed Circuit Board
IDE	-	Integrated Development Environment

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CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter will provide brief explanation about the project which will cover the background, problem statement, objective and scope of the project. This explanation will describe the idea and concept of the project and how it is applied in the real world situation.

1.2 Background

The purpose of this project is lift objects that are beyond the limitation of the persons capability. This can be example such as outdoor product, home application product and many more where some of them are very heavy and require the use of heavy duty vehicle and can lead to a burden in terms of time and money. Other than that is the burden that a disable person has to go through when they are doing any item lifting. Without the usual help of third person, the disable person would helpless and could not lift the item that they need to carry. Because of these problem, we have develop a project which would help to reduce the burden of these problem where it is call Human Movement Support (HMS).

Human Movement Support (HMS) is a device that can carry item remotely using mobile control which is either through smartphone or tablet or etc. The usage of this project will enable the person to transfer a heavy item with ease which lighten the burden of a heavy-duty lifting or disable person where this project will become much more helpful for them. This project will be primary focus on the use of Android operating system, which will be connected through the Arduino via Bluetooth module as medium signal.

Once this project is connected with the android application, it will control the device DC motor where the bluetooth module will act as a receiver and transmitter to the device and connect the module in the Arduino kit. The Arduino kit is the main body of the device which will response to the command of the user then react according to the command by moving the DC motor that is attach with the Arduino and allow the device to move arcordingly. The DC motor is located both left side and right side of the body which will enable the project to move forward and backward using both motor and left side and right side using only one of the motor. Also the project will have an additional component which four sensor that will mount in different direction to react when the project in counter obstacle when an object is nearby the project.

1.3 Problem Statement

1) **Carry a huge and heavy item with bare hand**

Depending on the type of field, the need of carrying huge and heavy item can be a burden to the person carrying it where a large amount of energy is needed to even lift the item and making the uncomfortable carry the item because of the stablitiy need to carry the item. With the aid of this device, the person will only lift the item to the device and then the device will carry the item using their mobile devices which will ease the burden of carry the item.

2) **Burden a disable person in carry and item**

Most disable person are either on wheelchair or have aid to support themselves for example in walking. Because of this, their need on carrying an object is trouble some where they require a helping hand to carry an item . By having this project, the disable person can independently carry the object using this project and controlling the device using mobile devices.

1.4 Objective

The objectives of this project are :

1. To study and understand about the basic concept of android application
2. To simulate and develop Arduino application in order to control the movement of DC motor.
3. To design and develop Human Support Movement in both hardware and software

1.5 Scope

This project is design to help ease the burden of carrying a huge and heavy object using the mobile devices to control the device. This project will be remotely control using Android Technology where Bluetooth will be connected as medium between the transmitter (mobile device) and the receiver (Bluetooth module). The receiver is then connected to the main body of the project which is the Arduino where it will control the DC motor of the project and allowing the project to move based on command it receive from the user. In addition, the project will add a few feature which is a sensor that allow the project to react when encounter object obstacle which enable the project to protect itself from self damage or notify the user that it has difficulties when a object or obstacle is nearby. But based on the scope of the project, the project itself is also limited within the following scope such as:

1. The range of the Bluetooth medium
2. The field situation to use the HSM
3. The type of magnetic motor to be use for the HSM
4. The design of the HSM

1.6 Thesis Outline

This implementation of Human Movement Support using Android Technology is arranged into following chapter :

Chapter 1

This chapter will provide brief explanation about the project which will cover the background, problem statement, objective and scope of the project. This explanation will describe the idea and concept of the project and how it is applied in the real world situation.

Chapter 2

Focuses on literature reviews of this project based on journals and other references.The method concept, and theory of component of hardware that used in this project is discussed in this chapter.

Chapter3:

Mainly focused on methodologies for the development of implementation of a Human movement Support. Details on the progress of the project are explained in this chapter .

Chapter4:

This chapter focus on the result and discussion that we obtain based on the methodology that we used. All information must be explained in detail in this chapter with the problem specification.The results were compared with the outlined .

Chapter 5:

Concludes overall about the project. Obtacle faces and future recommendation are also discussed in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will cover the background study about the project based on the knowledge and information required to design and develop the project. To develop this project, it is necessary to go through several research that is related to the idea of this project. The research that will focus on every hardware and software that will be used to develop this project. With the this, it will help in achieving the idea of the project based on what component is suitable to used. The source of these research has to be acceptable in the system format such as books, journals, articles and website that are licensed.

2.2 Software part

2.2.1 Android

Nowadays, Android is a powerful Operating system (OS) supporting a large number of applications in Smart phones. Aziz et al.(2015) state that Android technology is a solution that can provide a new approach to human interaction with machine or tools. These applications make life more easily and advanced for the users. Android is developed by the open handset Alliance led by google. Android comes with an Android market which is an online software store. It allows Android users to select and download applications developed by thirt party developers and use them. Figure 2.1 below shows the icon of android.

Figure 2.1 : Icon android

2.2.2 MIT App Inventor

There are few software that can create an application for android platform with diference type of code language such as Basic4Android and MIT App Inventor. The Basic4Android software used Visual basic language while the MIT used Block language. App Inventor is an incredible new system from Google that allows Android applications to be designed and programmed with a web page and Java interface. In this project, MIT App Inventor will be used to make the interface between the device and the android phone. This software has two section which is the Designer (Program the action of the application perform) and the Block Editor (The Program is take place or in other word the code program itself). The result of this is that it will display a simple graphical interface that can be easily read and understand when creating a basic, fully functional app. Figure 2.2 below shows the MIT App inventor icon.

Figure 2.2 : MIT App Inventor Icon

2.2.3 Arduino Software IDE

The Arduino Integrated Development Environment (IDE) as shown in figure 2.3 is Java Program that is derives from the Wiring projects and the IDE for the Processing programming language. Its contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and series of menus. It includes a code editor with features such as syntax highlighting, brace matching and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch". (Dey et al. 2015).

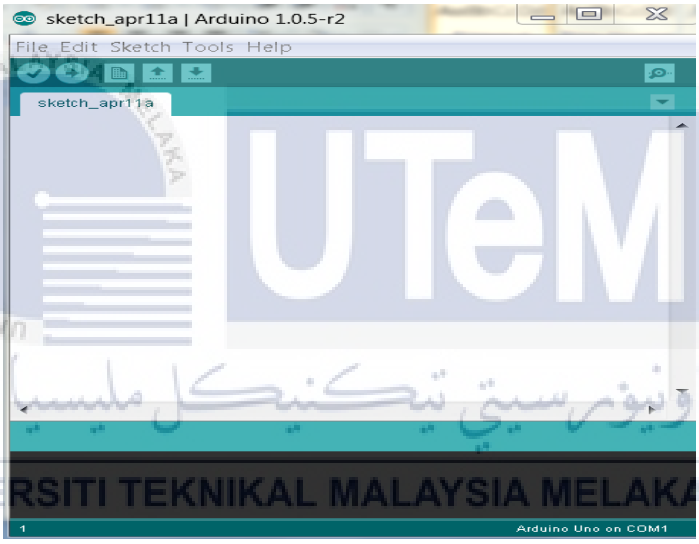


Figure 2.3 : Arduino software IDE

2.2.4 Proteus

Proteus as shown in figure 2.4 is a software design that allow the user to design and analyze the stimulation of a circuit. This software ease the progress of the circuit development because it can avoid any error that can cause any component replacement compare with using hardware analysis. This is because it will enable the user to analyze the circuit operation and measurement along with the intention on designing the desire circuit before moving on to constructing the hardware. With this, it will enable the user to

not only precise the hardware circuit contruction, but also experiment with the components that are available before choosing the suitable component for this project.

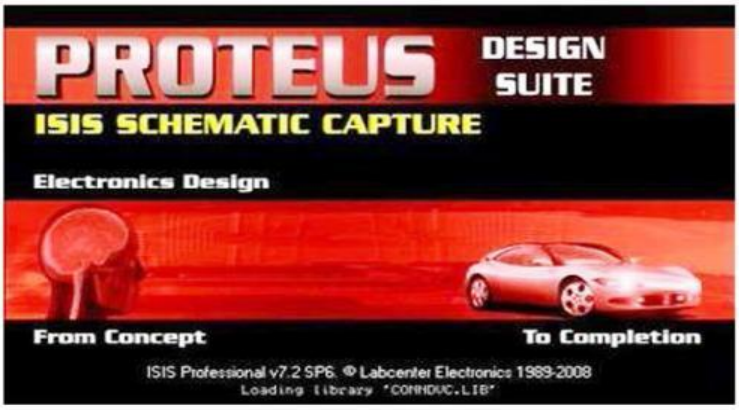


Figure 2.4: Proteus software

2.3 Hardware part

2.3.1 Bluetooth

Bluetooth is a low cost, low power, short- range radio technologies intended to replaced the cable connections between hand phones, PDA and other portable devices .Khurana (2015) stated that the circuit will less complex when the Bluetooth application eliminates usage of transmitter and receivers antenna of hardaware. Bluetooth is a wireless communications protocol running at 2.4 GHz, with client server architecture, suitable for forming personal area networks. Bluetooth is an extremely integral feature designed for low power devices. Bluetooth is the only appropriate communications protocol that has no fear of getting the frequency interferences because it uses the MAC adress (Media acess control adress) of the device. The usage of MAC adress that allows the Bluetooth for the connectivity between two devices. (Dey et al. 2015)

2.3.1.1 Bluetooth Architecture

The Bluetooth Architecture consists of seven layers that devided into both the implementation of software and hardware and separate by the Host Controller Interface (HCI) where the layer below HCI usually implemented in hardware and the layers above the HCI are usually implemented in software. Figure 2.5 shows the layers in Bluetooth and Table 2.1 gives a short description of each layer.

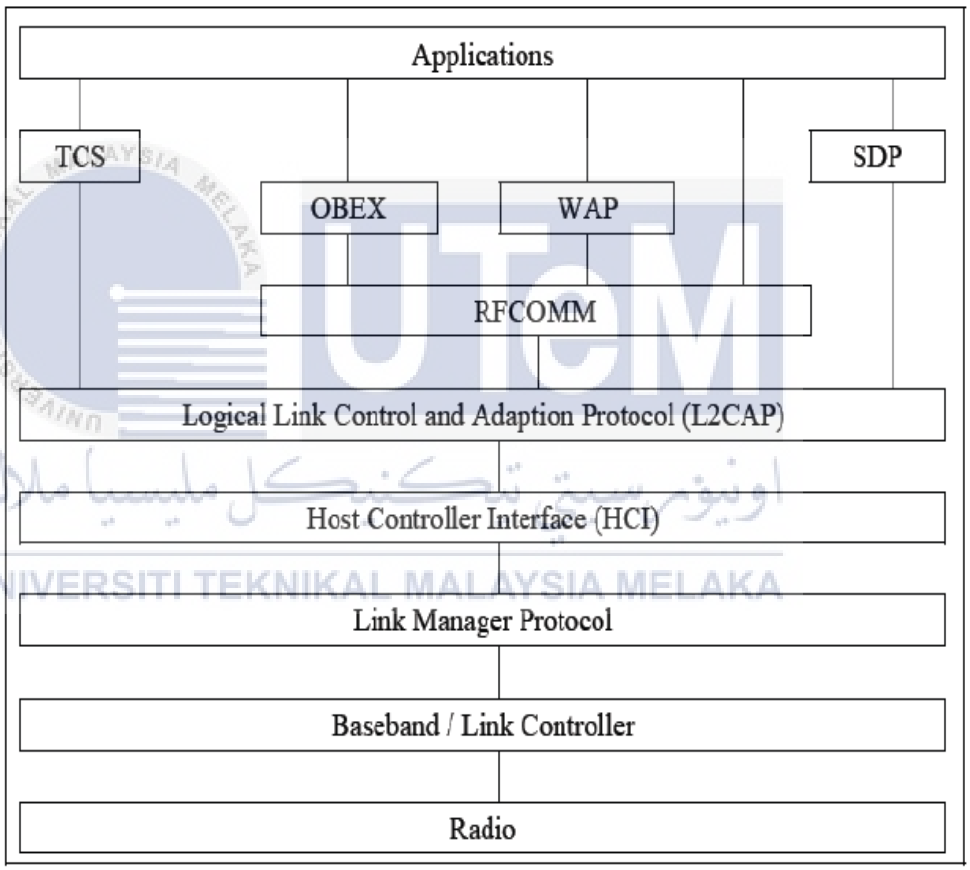


Figure 2.5 : Layers in a Bluetooth

Table 2.1: Description Layer of Bluetooth Protocol Stack

Layer	**Description**
Application	Bluetooth profile guide developers on how applications should use the protocol stack
SPP	Serial Port Profile
RFCOMM	Provide an RS-232 like serial interface
SDP	Used for service discovery on remote Bluetooth devices
L2CAP	Multiplexersdata from high layers and converts between different packet sizes
HCI	Handles communication between the host and the Bluetooth modules
LINK MANAGER	Controls and configures links to other devices
BASEBAND and RF	Controls physical links, frequency hopping and assembling packets
Radio	Modulates and demodulates data for transmission and reception on air

2.3.1.2 Power classes of Bluetooth

Table 2.2 below shows three power class of bluetooth. The difference between these three power class of bluetooth is their transmission power levels used. For power class 1, the maximum power is 100mW which is equavalent to 20dBm. It is cover over 100 meter in range. Besides, for power class 2, the maximum power is 2.5mW in which equavalent to 4dBm, can operate functionally for 10 meter in range. Then, the maximum power class 3 is 1mW which is 0dBm and cover 1 meter range. Most of gadget is compatible with Bluetooth devices of power class 2, followed by class 1, but class 3 is rarely found.

Table 2.2: Power Classes of Bluetooth

Power class	Maximum power	Range (m)
1	100mW(20dBm)	100
2	2.5mW (4dBm)	10
3	1mW (0dBm)	1

2.3.1.3 Bluetooth Modules

HC-05 module shown in figure 2.6 is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Pahuja and Kumar (2014) found that the main function of Bluetooth serial module is replacing the serial port line. Serial port Bluetooth module is fully qualified Bluetooth V2.0 +EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4 GHz radio transceiver and baseband. HC-05 module work on 3.0V low power operation and 3.0 to 4.2V I/O controls (Dey et al. 2015). In this project HC-05 is used as the medium to communicate

between the Arduino board and Android device. HC-05 is classified as a power class 2 which can transmit signal within the range of less than 10 meter at a maximum power of 2.5mW (4dBm). The reason using the HC-05 is that in is one of the most common power class use as it has a moderate power consumption and an acceptable distance range between the project and the user.

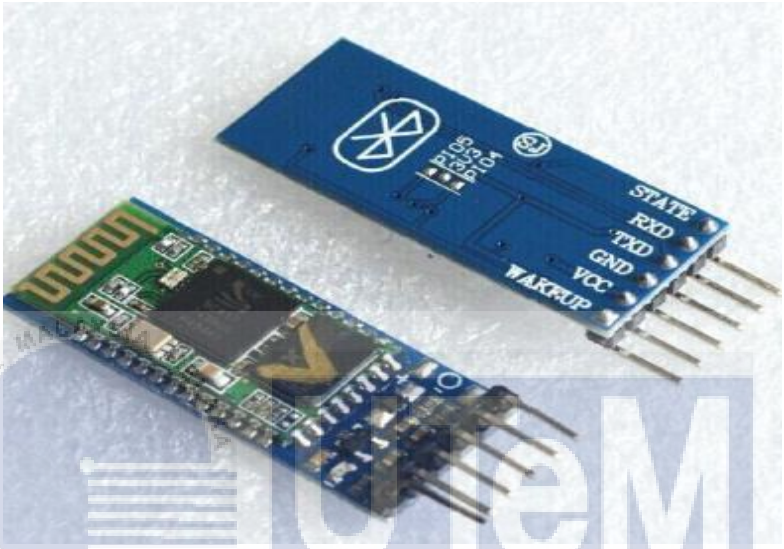


Figure 2.6 : HC-05 Bluetooth module

2.3.2 Arduino

Stated on MCROBERTS (2011), the Arduino is refer to as an open source for both software and hardware where all the codes, schematics, design and other feature of the Arduino are open to take use freely and do as the user please. Because of that, the Arduino becomes the most ideal component use for this project as it is flexible with its unlimited possibility when developing a program and it compatibility for connecting with external devices with its Microcontroller Board Design.

For this, the Arduino is divided into two major parts which is the hardware (Arduino Board) and software (Arduino IDE). For the hardware to connect other external component or devices, the Arduino board act as a main body and

also allow all components to function as a single device. Then, the Arduino software is also easy to understand for its open source. The popularity is ever increase to make people realize the potential of this open source project and ability to create any projects smoothly and easily with a relatively shallow learning curve. The arduino uno as shown in figure 2.7 below is a microcontroller board based on the ATmega328.

Figure 2.7 : Arduino uno board

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a poer jack, an ICSP header, and a reset button. It contains eveything needed to support the microcontroller (Aaron.2013). The technical specs as shown in table 2.3.

Table 2.3 Technical specs of arduino uno board

Subject	Specification
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

2.3.3 Sensor

A sensor is a device that able to detect and measure the environment change in its surrounding which is either physical object or temperature change. Fraden, J (2005) state that the purpose of a sensor is to respond to some kind of an input physical property (stimulus) and to convert it into an electrical signal that is compatible with electronic circuits.

2.3.3.1 Ultrasonic HC-SR04

The ultrasonic sensor is able to estimate objects in front of it using reflected sound. Similar to how bats communicate, the sensor uses ultrasonic wavelength to identify its surrounding where the wavelenght thats tranmitter will reflect when the wavelength is interfere by an object nearby. In ultrasonic sensor, the sensor will transmit a wavelength at a specific distance to identify if there are object surrounding the sensor.

For this project, Ultrasonic sensor that will be use is the Ultrasonic HC-SR04 provides 2cm-400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The table 2.5 shows the specification of the Ultrasonic HC-SR04 and the figure 2.8 shows the ultrasonic HC-SR04.

Table 2.4 : Specification of HC-SR04

Specification	
Working voltage	DC 5V
Working Current	15mA
Working frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10 uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

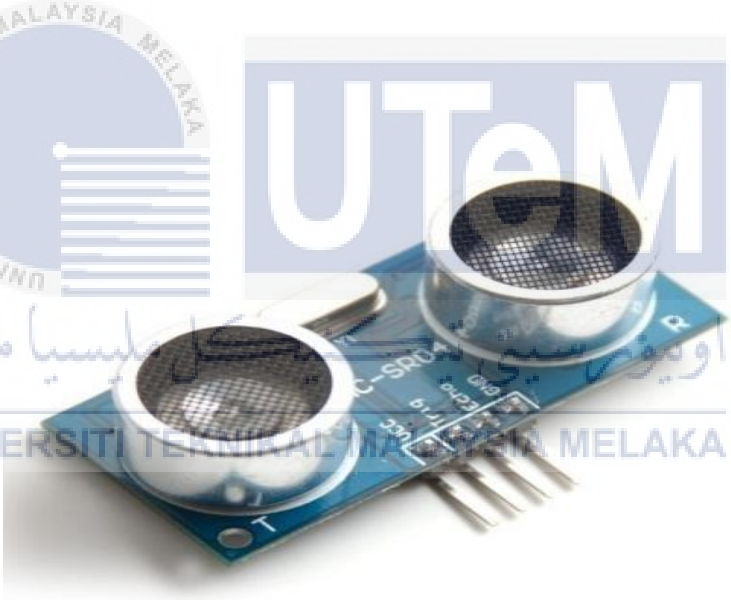


Figure 2.8 : Ultrasonic sensor

2.3.4 Electric Motor

Nowadays, usage of electrical motors will prevent the power of hundred of devices that used in daily lives which included the small application such as hands power tools, food blenders, mixer-grinders, and washing machines ,then large motor application especially automobiles, heavy lifting in industries and many more. (Dey et al. 2015)

An electric motor is an electric machine that converts energy into mechanical energy. Electric motor can be divided into three type which is direct current(DC), alternating current (AC) motors and universal motor. A DC motor is a simple electric motor that uses electricity and a magnetic field to produce torque, which turns the rotor and hence give mechanical work. DC motor requires at least one electromaget, where it switches the current flow as the motor turns, which change its polarity so that it would keep on running. DC motor divide in two types of DC motor that is DC brushed and DC brushless. In this project DC Brushless motor is the ideal motor that used for this project compared to Brushed motor. Table 2.5 shows the comparison between DC motor Brushed and Brushless motor and figure 2.9 below show a type of DC Brushless motor.

Table : 2.5 The comparison between DC motor Brushed and Brushless

Brushed motor	**Brushless Motor**
Generate directly through electrical supply to the motor	Generate electrical magnet on the motor housing
Require the use of carbon inside the actuator	Does not require the use of carbon in the actuator
Lower speed range	Higher speed range
Required maintenances	More economic

Figure 2.9 :DC Brushless motor

2.4 Comparison between Bluetooth and Wi-Fi

Wireless technology is a fast-growing technology that enables people to access networks and services without cables. Both of Bluetooth and Wi-Fi are wireless technology but the main difference are the design and used. The bluetooth is primarily used to connect devices without using cables while Wi-Fi provides high-speed acess to the internet. Table 2.6 below shows the comparison between Bluetooth and Wi-Fi technology.

Table 2.6 : Comparison between Bluetooth and Wi-Fi

	Bluetooth	Wi-Fi
Frequency band	2.4 GHz	2.4GHz, 5GHz
Noise adaptation	Link layer	Typical output power
Nominal range	10m	100m
Maximum signal rate	1 Mb/s	54 Mb/s
Channel efficiency	Constant	Decreasing with offered traffic
Typical current absorbed	1–35 mA	100–350 mA
Maximum number of devices in the Basic cell	8 active devices; 255 in park mode	Unlimited in ad hoc networks

The reason why Bluetooth is used for this project is because of it low cost where the component and device adapters are more cheaper than Wi-Fi component. Then Bluetooth device have lower power consumption which result in a more long lasting battery life compare to Wi-Fi that are not only high power consumption but also cause heat in the Wi-Fi chip which can affect the component around. Finally a Bluetooth technology is much more simple and flexible where it can be compatible with other network management device and consistant connection.

2.5 Related project research

2.5.1 Bluetooth based Robotic Car

Khurana (2015) Bluetooth based robotic car paper was presented that the robotic car can controlled by the Bluetooth application called bluecontrol which work in an android mobile and by this application one can send message to the robotic car to turn left, right or move forward or backward and to start and stop the range of wireless Bluetooth communication is 10 meters. The microcontroller 8051 is used for programming to control the motion of robotic car.

2.5.2 Solar- Powered Android-Based speed control of Dc motor Via secure Bluetooth

Khanna (2015) Solar-Powered Android based speed control of DC motor via Secure Bluetooth paper was issued that smart phone control experimental setup that can be acccesed via the Bluetooth. This setup consists of two basic primary elements communicating with each other. Bluetooth of smart phone which is connected to Arduino uno ATmega328P-Pu microcontroller, IC and Dc motor interfaced with L293D motor driver IC and a Bluetooth module HC-05. Android apps provide a seamless interface for control and monitoring. The smart phone sends/receives data to/from the microcontroller using the wireless technology via Bluetooth. The result shows

that DC motor can control from a range of Bluetooth device within the range of ten meters.

2.5.3 Smart control wheelchair Controller Design

Aziz et al.(2015) Smart Android wheelchair paper have reported that the system is designed to control a wheelchair by using android device. The objective of this project is to facilitate the movement of disable people or handicapped and also the senior people who are not able to move well. The result of this design will allow the special people to live a life with less dependence on others. Android tecnology is a key which may provide a new approach of human interaction with machine or tools. Thus their problem can be solved by using android tecnology to control the movement of a wheelchair. In this project, Basic 4 android device interface is designed to program the android device that will be able to control movement of wheel chair. This project integrated IOIO board and direct current motor to control to create the movement of wheelchair. This project gives an idea on how to combine all of the circuit board, DC motor scooter, and electronic components together in one whole system. As a future improvement, replacement DC motor scooter with a DC motor with geared is recommended.

Chapter 3

METHODOLOGY

3.1 Introduction

In this chapter, the working procedure was shown and explained in details. Other than that, all the researches, findings and approaches which are relevant to this project will be explained. Project methodology was created to make the time table for overall project flows and act as guideline from the beginning of the project until this project is completed. Besides, project methodology was also important as a guideline of activities to follow and obey. This methodology all has been followed to make sure that this project complete. Flow chart was to assist the flow of the work throughout this project from beginning to the end of this project

3.2 Flow of project methodology

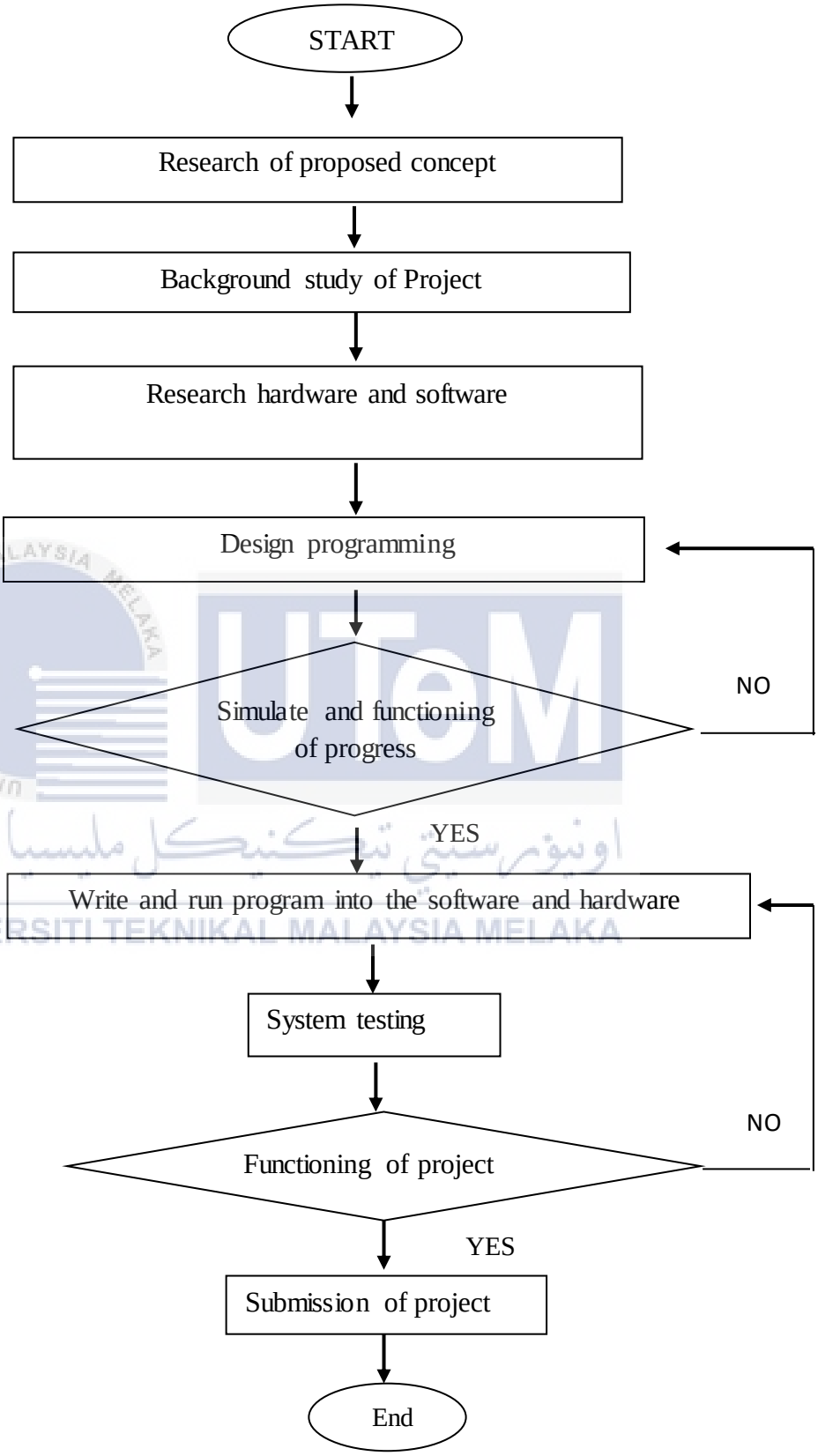


Figure 3.1 : Flow chart

3.2.1 Research of proposed concept

To decide and identify the project concept thats approciate with the studied field. To identify the project concept, jounals and articles are being collected and being analyzed, to discuss with supervisor. To find the most approciate project's concept, the project must cover up on current issues in many sectors or aspects, either economy, healthy or social development. Figure 3.2 below show the operation of HMS project.

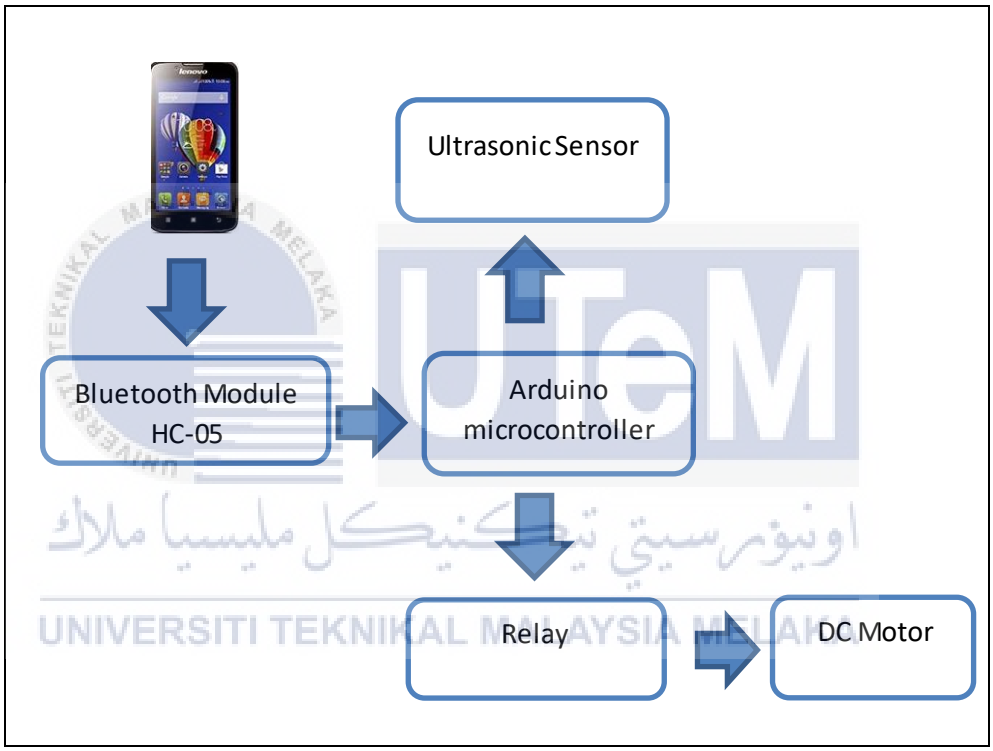


Figure 3.2: Block diagram of concept Project

The android smartphone is connected with the Arduino microcontroller via the Bluetooth module where the Bluetooth act as medium between the transmitter (smartphone) and the receiver (Bluetooth module). Then arduino will transmit the command to the motor to control direction of HMS. A relay is used between Arduino and DC Motor to control the switch operation and can handle the high power required to directly control an DC Motor. This project also used Ultrasonic sensor to detect obtacle.

3.2.2 Background study of Project

Background study represent the research that are relate with the concept of this project. This will give a clear idea on how to develop the project or improvise the related project based on using a more improve component or using a more efficient method.

3.2.3 Research hardware and software

To begin developing the project, a hardware and software used to develop this project. The hardware will be the component that will used to function according the concept of this project. While the software will be used to set the specification not the component and connecting all component into one device. The result research is needed to ensure that the right method and component is used. The research will be based on the has state in chapter 2 where it contain all the information needed to develop the project.

3.2.4 Design programming

To develop the project, a design of project program is required to ensure that the output has fulfilled the project concept. The program that will be used to develop this project are MIT App Inventor and Arduino IDE. MIT App Inventor used to make interface the device and the android Phone.

3.3 Project Planning

To complete this project sucessfully, the project planning is the most important task to ensure the project is completed on the schedule. If the deadline was ignored, there could be effects on the rest of the project. Therefore gantt chart is implement to record every project journey can be done efficiently and able to be completed according to time. Table 3.1 showed the Gantt chart for PSM1 and Table 3.2 showed the Gantt chart for PSM2.

Table 3.1 : Gant chart for PSM1

PROJECT PLANNING FOR PSM 1														
	FEBRUARY - MAY 2016													
PROJECT ACTIVITY	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PSM Briefing	BP BRIEFING							MID SEM BREAK						
Meeting and project discussion with supervisor														
Research on project														
Literature review														
Submit proposal														
Study for project progress														
Study onprogramming software														
Prepare for the report PSM I														
Submit report PSM I and present														

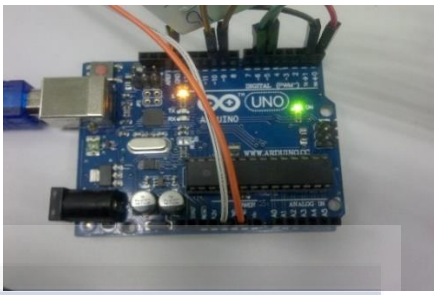
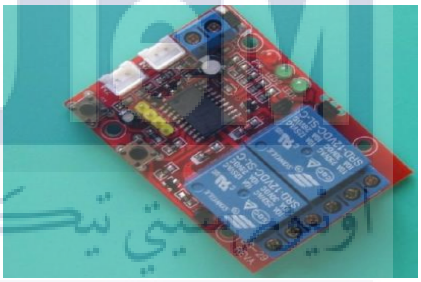
Table 3.2 : Gant chart for PSM2

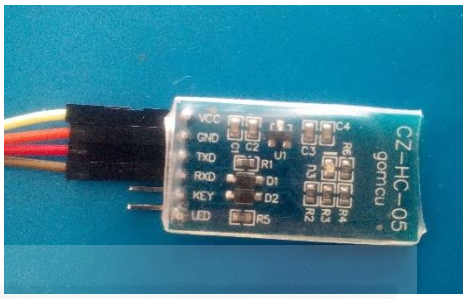
PROJECT PLANNING FOR PSM 2														
	SEPTEMBER - DICEMBER 2014													
PROJECT ACTIVITY	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Development and lab review on software								MID SEM BREAK						
Find equipment for hardware and focus on hardware part														
Hardware and software combination														
Test, run and troubleshooting circuit														
Whole project testing														
Rearrange information and supervisor verification														
Complete and submit draft report														
Submit report PSM II and present														

3.4 The main hardware selection

The following component in table 3.3 below represent the main component that influence of the project.

Table 3.3 : The main hardware selection

Component	Hardware
Arduino	
Relay module	
Electric DC motor	
Motor gear box	

Battery 6V (rechargeable)	
Bluetooth Module HC-05	
Ultrasonic sensor HC-SR04	

3.4.1 Electric DC Motor

This project used DL950 electric DC motor as shown in figure 3.3 with 6V voltage and 11000rpm . The normal voltage for this Dc motor is 6V but the operating range voltage was from 3V until 9V. While the current for no load was 0.26A and the maximum efficiency current was 1.4A.

Figure 3.3 : Electric DC motor

3.4.2 Motor Gear box

Because dc motor commonly run at high speed with relatively low torque, gear box is used to lower the speed rate of motor and increase the torque rate of motor. In figure 3.4 ,the gear box will be attach to a motor shaft to modify the motor capability.

Figure 3.4 : Motor Gear box

3.4.3 Relay module

Figure 3.5 shows the 2-channel relay module used in this project. Relay is an electrical switch that opens and closes under the operated of a electromagnet to control the gate.

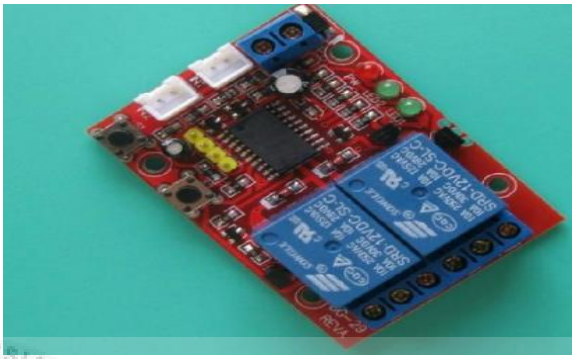


Figure 3.5 : Relay module

The table below shows the connection of the pin between relay and Arduino

Table 3.4 : Connection of pin between relay and Arduino

	Relay 1	Relay 2	Relay 3	Relay 4
NO	Power source positive	Power source negative	Power source positive	Power source negative
COM	Positive wire on motor	Negative wire on Motor	Negative wire on motor	Positive wire on motor
Relay VCC pin	Arduino 5V	Arduino 5V	Arduino 5V	Arduino 5V
Relay IN Pin	Arduino pin	Arduino pin	Arduino pin	Arduino pin

3.5 Software Implementation

This part consists of the create and design Android App using MIT Inventor and compiling the program to arduino. MIT App Inventor used to make interface the device and the android Phone. Figure 3.6 below shows the coding to develop the bluetooth program in one of the bluetooth medium which is for mobile phone or in other word bluetooth transmitter to control movement of HMS.

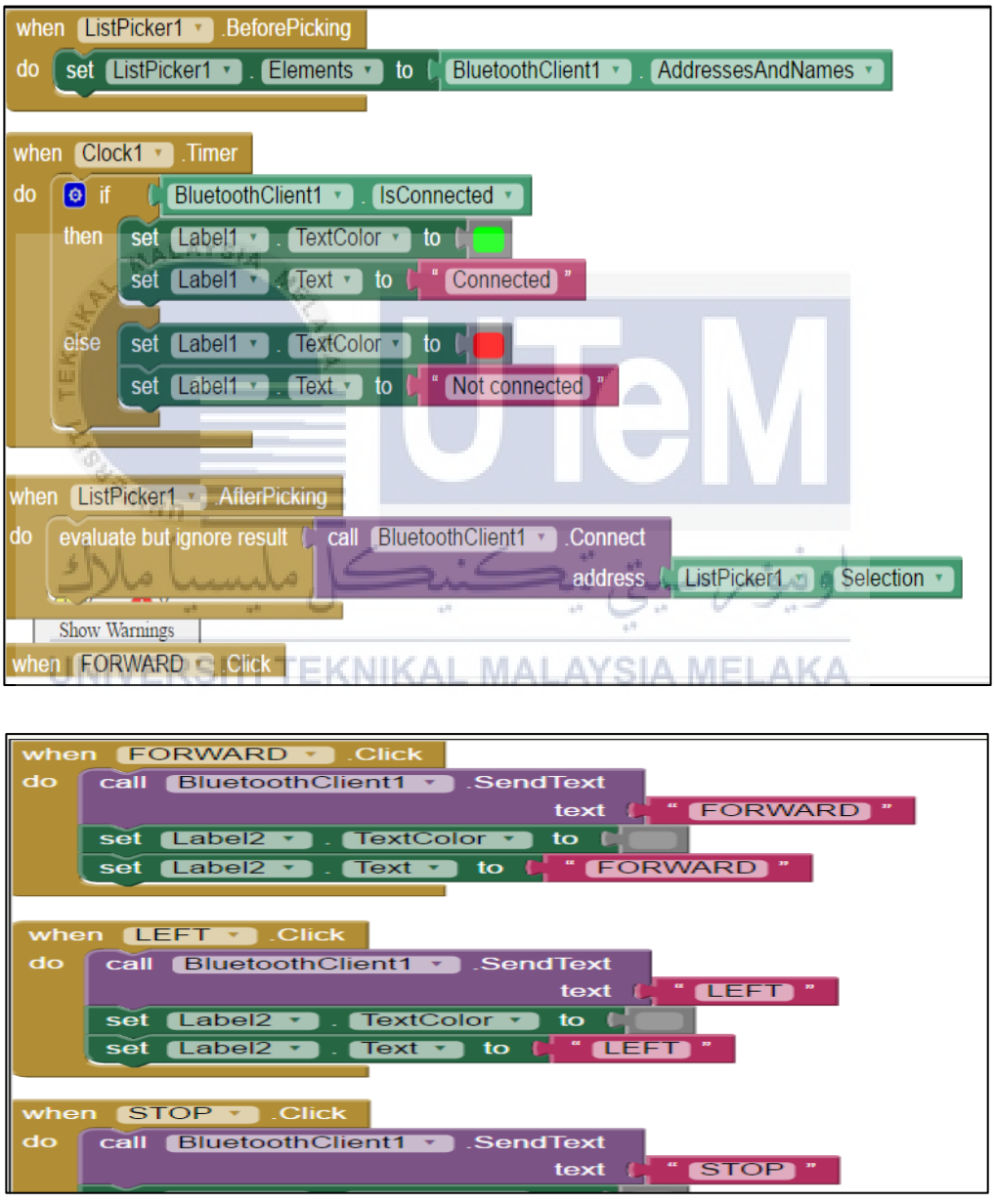


Figure 3.6 : Coding of remote control HMS

3.5.1 Remote control HMS

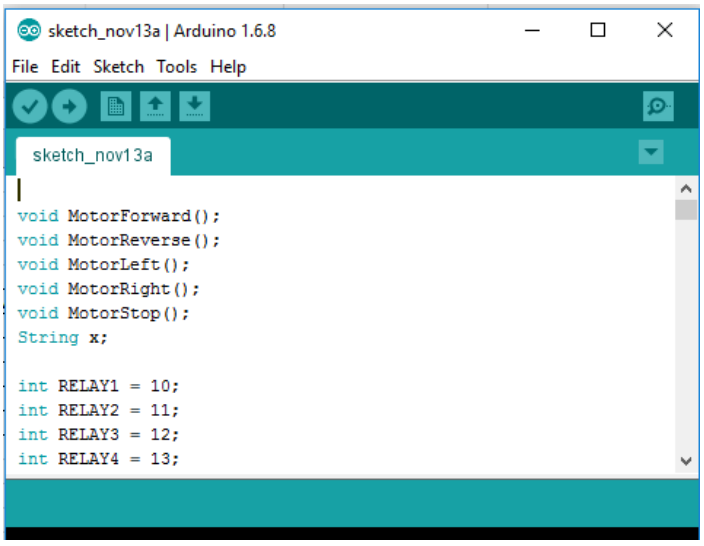
Figure 3.7 : Screenshot Remote control HMS

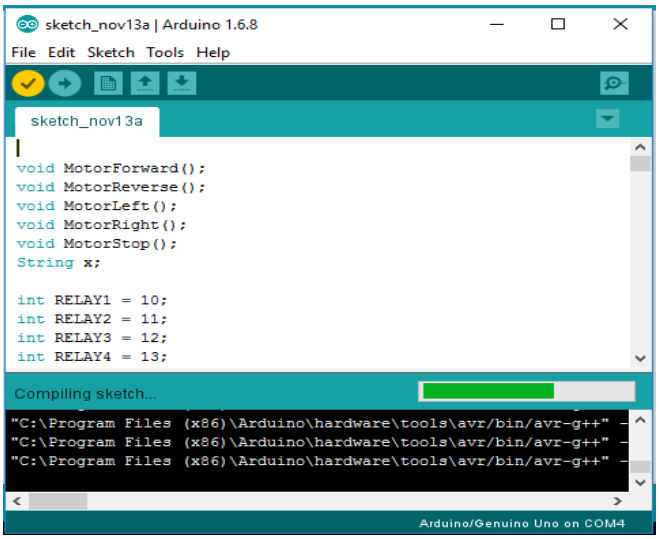
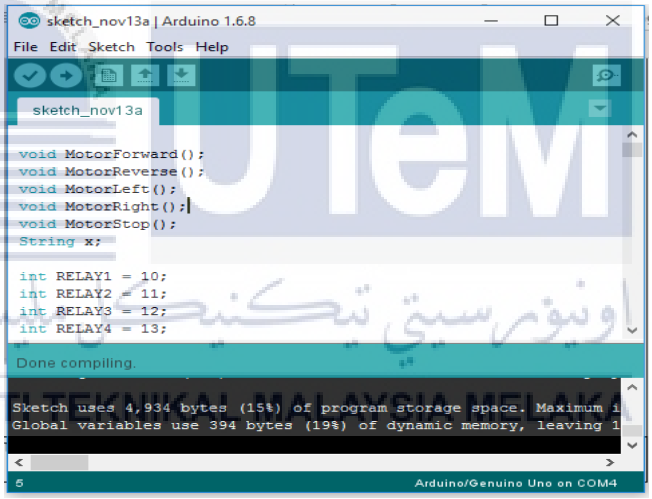
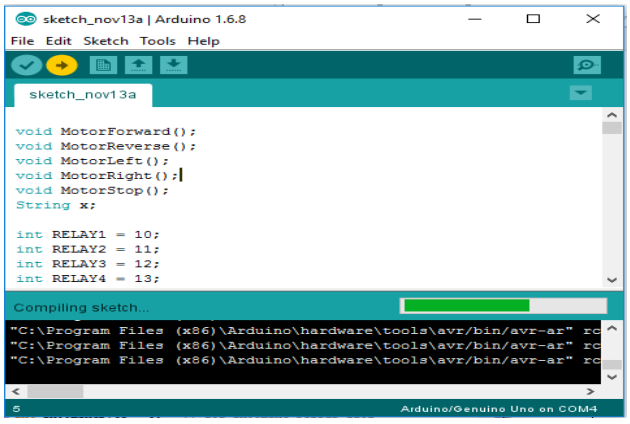
The program that has been program will be the application that control the HMS. Once the application is connected to Arduino, the status of the application will be in "connected" position and the application will represent the remote control of the HMS where it will control the direction of the HMS based on the arrow that is pressed from the application. Based on the figure 3.7 the direction that are available to control the HMS are forward (up), backward (down), left and right. This direction will control the motor based on the command that has sent from the software through the Arduino that has set its configuration. The application will also include a stop command which will stop the control of the motor making the HMS be in a stop position.

3.5.2 Compiling Program to Arduino

Table 3.5 below show the procedures for compiling and upload the program into Arduino Board. There are six steps to upload the program into Arduino by using Arduino IDE sketch.

Table 3.5 : Procedure for compiling and upload the program

Step	Figure description
1.	Open Arduino sketch 
2.	Write the program 

3.	Verify the program 
4.	Done compiling 
5.	Upload the program 

6.	Done Uploading 

3.6 Circuit Testing

Before going to analysis, each component must be ensure to function properly. So that the operation can be run according to flow chart. Each component required to be test to separately before combining another component

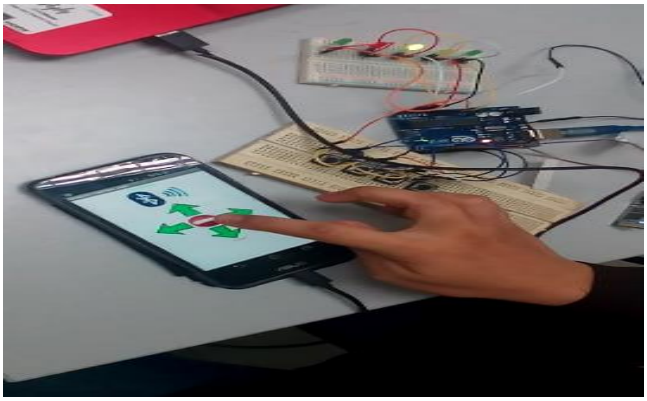


Figure 3.8 : MIT inventor App testing

Based on figure 3.8. four led represent motor used to interface between MIT Inventor App. This is to ensure that MIT has connection between mobile handphone and Bluetooth Module.

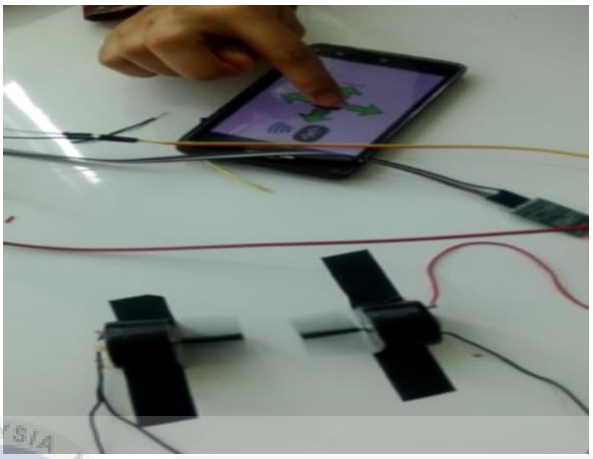


Figure 3.9 : Motor testing

Based on figure 3.9 two small motor (not actual motor) used to analyse configuration of motor connection and rotation. This is to understanding about the motor configuration.

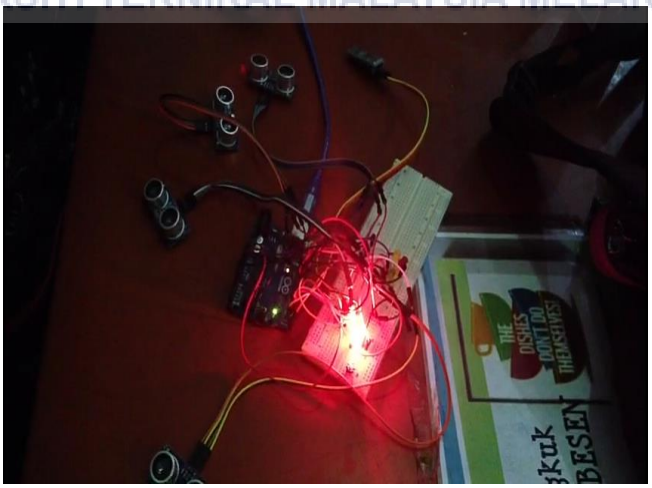


Figure 3.10 : Ultrasonic testing

The figure 3.10 shows the testing of Ultrasonic to ensure the component is function properly along with its range sensivity which is shown in figure 3.11 where a serial monitor is use to monitor the range sensivity of the sensor.

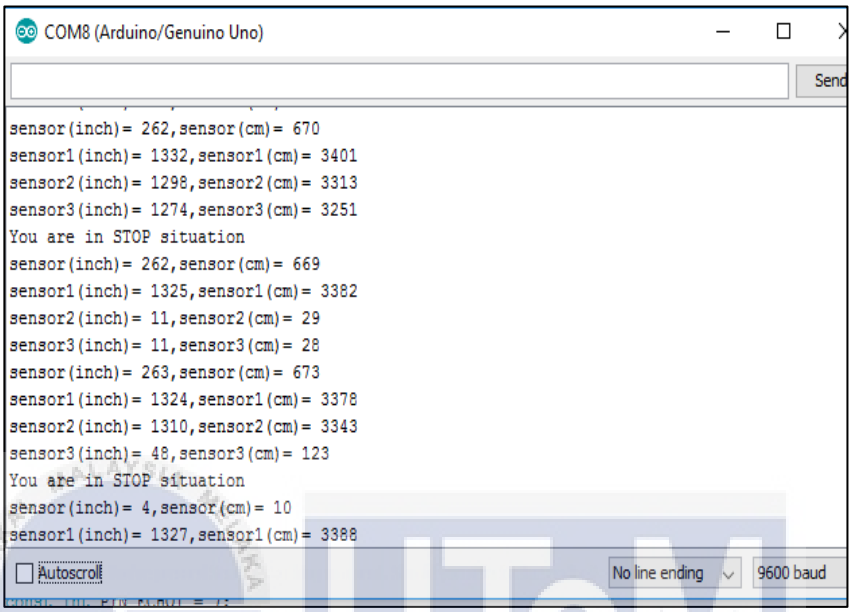


Figure 3.11 : Range sensitivity of Ultrasonic through serial monitor

3.6 Mechanical Implementation

This part will explain the combination of the component that will be wired and implement into the HMS. Figure below shows the device itself before the other component are wire together. The motor part of the device (DC motor, Gear Box and Tyre) has already be attach to the body of the HMS as this is a direct attach to the body.

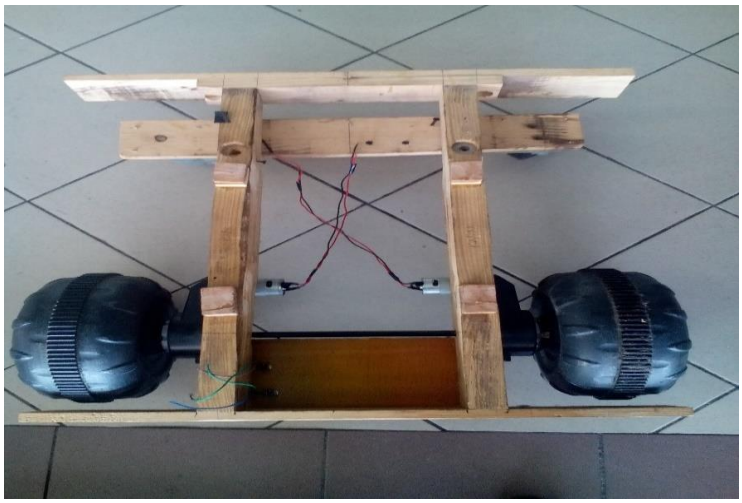


Figure 3.12 : Before wiring

First of is the implementation of the Arduino and Relay into the HMS. The table 3.12 below shows the connection of the pin between both Arduino and Relay along with the arrangement of the wired after it is wire together in figure 3.13.

Table 3.6 : Connection between relay and Arduino

Input relay	Pin Arduino
Input 1	Pin 10
Input 2	Pin 11
Input 3	Pin 12
Input 4	Pin 13

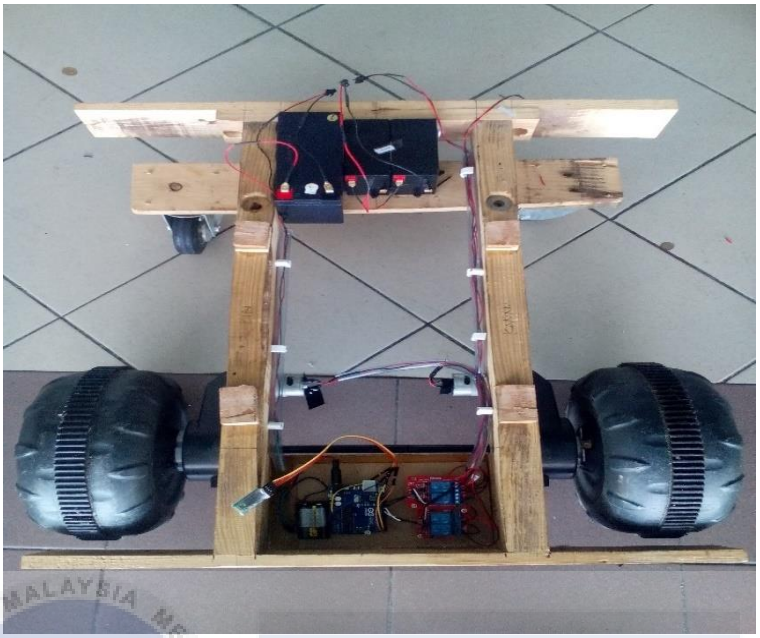


Figure 3.13 : After wiring and arrange

Figure 3.14 : Prototype of Human movement suppport

CHAPTER 4

RESULT AND DISCUSSION

This chapter provides result and discussion of the data gathering in conducting this project from beginning until it complete. Some testing and analysis are included as well as testing on the accuracy of the system. This chapter is very important to ensure the objective of this project is successful.

4.1 The movement of Motor

Table 4.1 : Truth table for the motor movement

MOTOR A		MOTOR B		DIRECTION OF MOVING
Relay 1	Relay 2	Relay3	Relay4	
0	1	0	1	Forward
1	0	1	0	Reverse
0	1	0	0	Left
0	0	0	1	Right
0	0	0	0	Stop
1	0	0	0	Reverse Left
0	0	1	0	Reverse right

From Table 4.3 shows the function of each relay to both motor based on the rotation of the motor . In the following table, the output represent in binary where 1 represent as ON State and 0 which represent the OFF State of the motor. This enable for an easy explanation on how the relay influence the movement HMS based on the motor and its rotation. This can be example when the project is moving forward the binary code

for the relay to operate are 0101 whereas if the project is moving backward the binary code for the relay to operate are 1010 and so forth.

4.2 Software development Result

The are two parts of testing and maintaining the system which are :

a) Interface between Bluetooth HC-05 and arduino
b) Interface between Bluetooth HC-05 and MIT inventor

4.2.1 Interface between Bluetooth HC-05 and Arduino

Below show the following connection represent the pin between Bluetooth HC-05 module and Arduino :

a) TX pin HC-05 with RX pin Arduino
b) RX pin HC-05 with TX pin Arduino
c) GND pin HC-05 with GND pin Arduino
d) VCC pin HC-05 with 5V pin Arduino

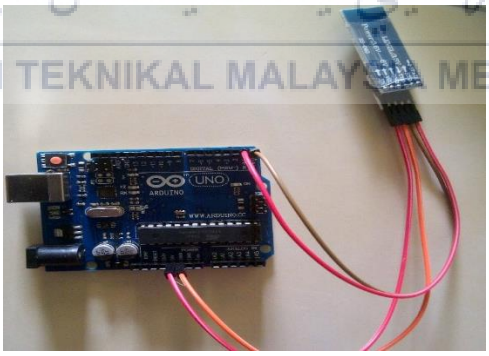
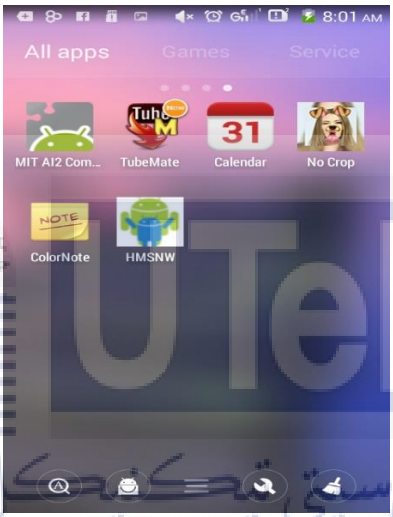


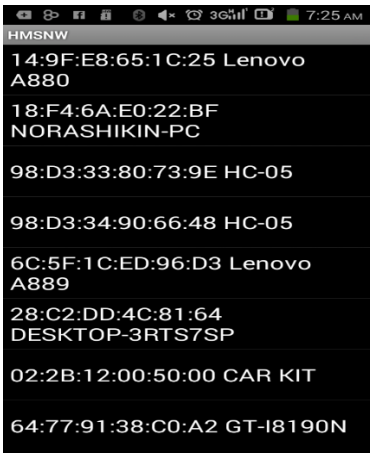
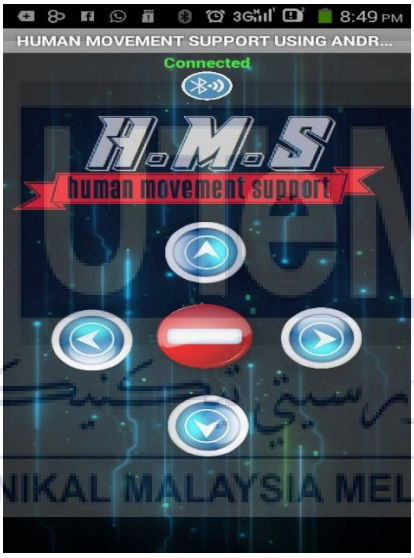
Figure 4.1 : Connection between Arduino and Bluetooth module

4.2.2 Interface between Bluetooth Hc-05 and MIT inventor App

Table 4.2 below show the procedure for connecting Bluetooth HC-05 with MIT inventor App.

Table 4.2 : Procedure for connecting Bluetooth with MIT Inventor App

Step	Figure description
1.	Open the HMS App 
2.	Turn on Bluetooth 

3.	Find Bluetooth Module HC-05 
4.	MIT Inventor is connected with Bluetooth HC-05 

4.3 Testing connection between Bluetooth module and Android phone

The connection between the Bluetooth module and Android phone is tested. This is ensures that the fixed distance for Bluetooth module can still connected with the Android phone. This experiment is divided by two part which is testing on the open space (no obstacle) and testing on the close space (with obtacle). From the result that recorded on table 4.3 the range of bluetooth for open space is less than 12 meter and for closet space is 2 meter.

Table 4.3 : Range of Bluetooth

Distance (m)	Bluetooth connection	
	Open	Close
2	Connected	Connected
4	Connected	Disconnected
6	Connected	Disconnected
8	Connected	Disconnected
10	Connected	Disconnected
12	Diconnected	Disconnected

4.4 Analysis of relationship between Weight and Time

Table 4.4 below show result of the analysis based of time affected to the weight as preference of analysis.

Table 4.4 : Relationship between time and weight

Weight (KG)	Time (s)
10	8.81
15	9.45
20	10.07
25	10.20
55	17.18

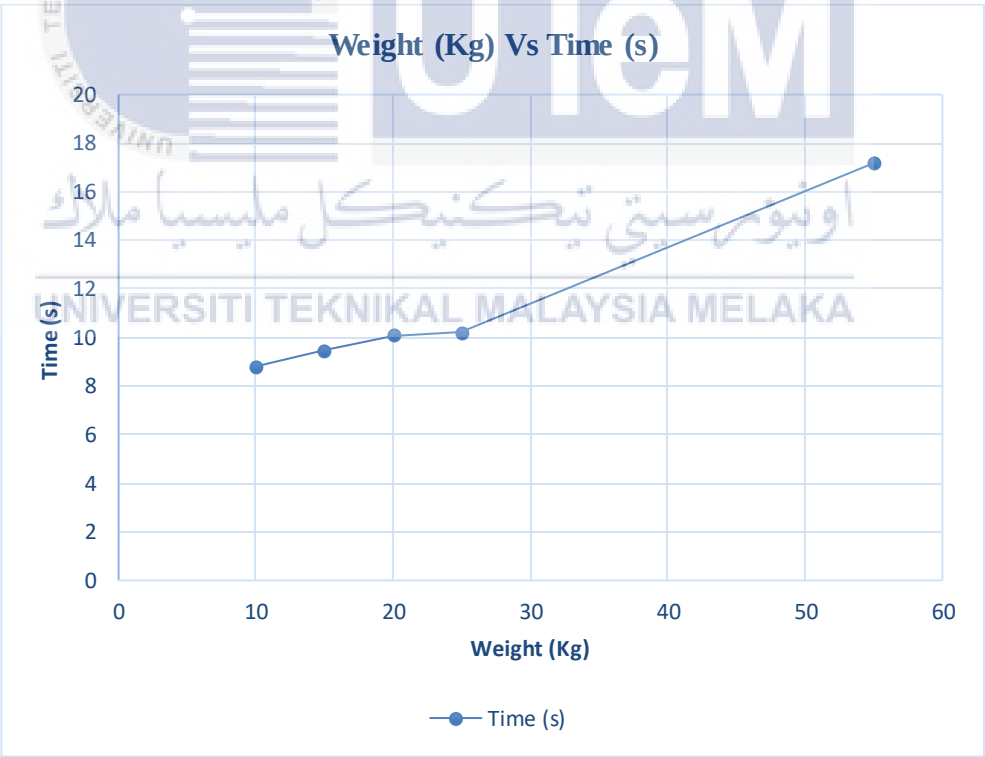


Figure 4.2 : Relationship between weight (Kg) and time (s)

The graph shows the relationship between weight (Kg) and time (s). By using a contant distance at six meter, project is analyze based on relationship between weight (Kg) and time (s). The variable factor that influence is the weight of the object where in the range between 10kg to 55 kg . From the result that analyze, when the weight increased the time taken for to device arrived at end point also increased.

Table 4.5 : Relationship between Weight (Kg) and Speed (ms)

Weight (Kg)	Speed (ms)
10	0.681
15	0.635
20	0.596
25	0.588
55	0.349

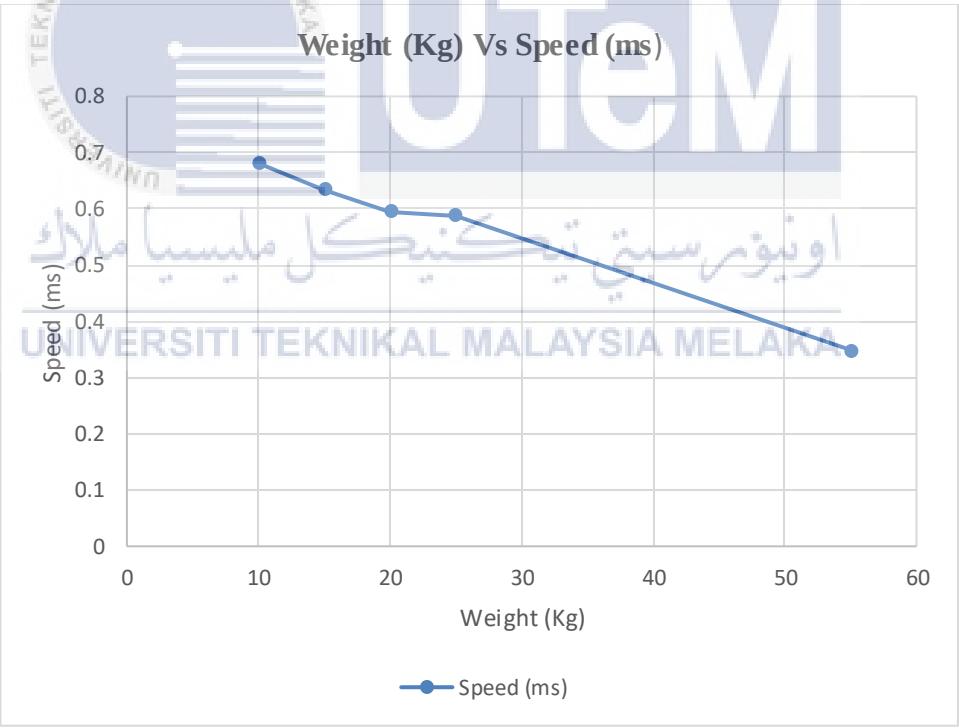


Figure 4.3 : Relationship between Weight (Kg) and Speed (ms)

The graph shows the relationship between weight (Kg) and speed (ms).
From previous data, the speed of project can be calibrated by following the equaction below :

$$\text{Speed} = \frac{Distance}{Time}$$

From the result that analyze the speed will decrease when weight (Kg) increased

4.5 Analysis of relationship between Weight (Kg) and Current (A)

Refer to the limitation of the current motor, the analyze will be measured based on the weight that can achieve or exceed the limitation of the current. Table below show result of the analysis based on variety of weight as preference of analysis.

Table 4.6 : Relationship between Weight (Kg) and Curent (A)

Weight (Kg)	Current (s)
10	0.25
15	0.64
20	1.1
25	1.6

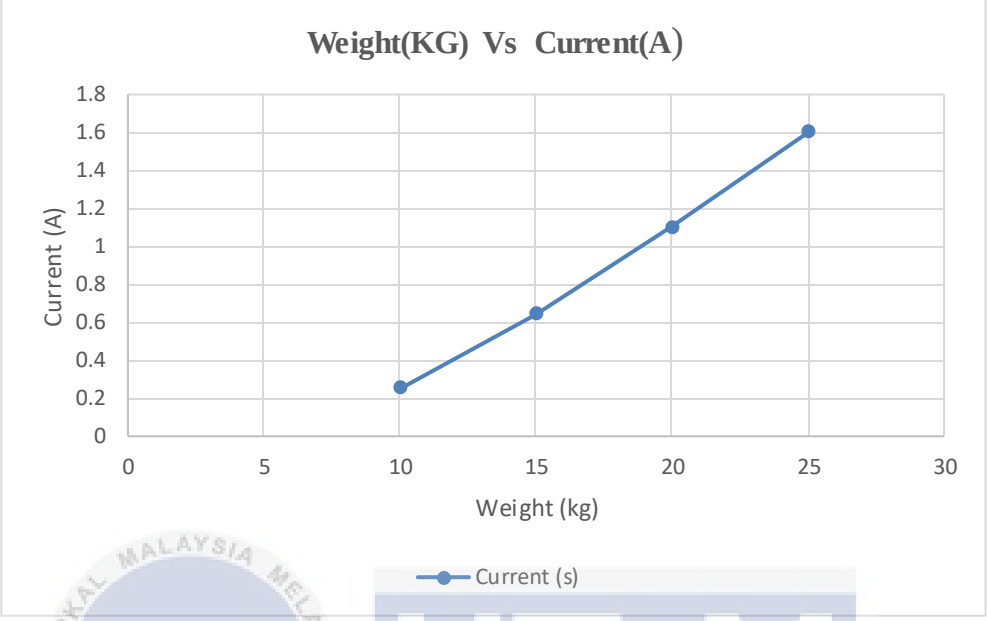


Figure 4.4 : Relationship between Weight (Kg) and Curent (A)

The graph shows the relationship between weight (Kg) and current (A). By using a constant distance at six meter, project is analyse based on relationship between weight (Kg) and current (A). When the weight increased the current also increased because of the weight increases the resistance of load. If the current exceed the limitation of the motor, it will effect the condition of the motor based on the margin diffrence between both factor.

4.6 Discussion

After going through several phase of design, development and testing finally the Human movement support using Android Technology (HMS) has been successfully constructed. All the objective of this project were achieved. The software implementation works well as expected. It has been proven that when user gives a command on Android application the device can move based on desired input. This device can move by four movement which is can moving forward , backward, left and right.

As mention before, this project is using Android application (MIT inventor) to control the direction of HMS. By using this application the device can be remotely control in reasonable distance. There are three interface needed to considered before user can control the HMS. The first interface are between Arduino and Android. Arduino IDE sketch was used in compiling and uploading program to Arduino. The second interface are between Android and MIT inventor. The MIT inventor was used to create a new application which consists of 5 button and also serial program for Bluetooth application. While the third interface is between Bluetooth and Android. Bluetooth pairing was needed for communicating Arduino and Bluetooth.

Besides that, Bluetooth module is used as medium to communicate between Arduino board and Android phone. Every Bluetooth module has specific range depend on the class of Bluetooth. For this project, the class that been choose is class 2. Based on analysis finding the maximum range of Bluetooth for open space is 10 meter and the range for closet space is 2 meter.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This chapter will cover about the conclusion that can be made after the entire project is finished. Besides, this chapter also will discuss about recommendation and further improvement that can be made in order to make the system to be more efficient.

5.1 Conclusion

As conclusion, the objective of this project have been achieved sucessfully where as this project be able to achieve the construction of Human Movement support using Android Technology (HMS). With this project the user can control the movement of HMS by interacting between the user mobile phone and Bluetooth module at Maximum range of 10 meter theoricaly. Other than that, HMS has been analyze based on real world situation and obtain data infomation from the limitation of the HMS. The capability of HMS is recorded based on preference chosen for the analysis which is at distance of six meter and range of weight from 10 Kg to 55 Kg.

This project is proven to be useful for carrying aid or disable person in carrying heavy item without any burden or effort. Finally, all the information in this project can be used for future research works and can inspire our young generation engineers to design excellence innovation that meets the market needs and public interest.

5.2 Recommendation

Although the project manage to be run successfully, improvement can be added to the project for any further study or experiment to enable the project to cover up any flaws that may encounter to the projects current state. To some recommendation, this project can be modified into a more better system such as the controller for example; the controller can be upgraded by removing the use of the controller to control the project. Instead, by using tracking sensor which allow the project to move without the aid of remote control. With the aid of the ultrasonic sensor that's already added to the project, the project will become a more independent project where not only it can follow the user anywhere but also able to avoid any obstacle that may encounter.

Beside the component, the design can also be improve where this project itself has a lot of flaws on the design itself. This can be example in the design of the wheel implementation where the while will stuck once in a while. This can be recommend for further study on the implementation design where it can be operate more smoothly. Other than that is the body of the project itself which could be design into a more sturdy and practical depending on the situation use. This also include on the material that is used of this project such as the body of the project which can be replace to a material that is both light weight and sturdy such as a carbon fiber for example.

And finally is the component system of the project where the system can be from the strength of the motor to the capacity of the power consumption of the system. For motor, the power of the motor can be enhance to enable the project to be more flexible when carrying an item or a person. For power consumption, where it can minimize the power consumption by reducing the component use for project or use a less power use component. At the end of this recommendation, improvement can always be added as technology continues to improve and device have become more and more easily access.

5.3 Project potential

Based on the following result that have obtain through the analysis, the HMS is conveient tool to help people either normal people or disable people to carry their item. To normal people, it provide a safety procedure as it does not effect the human body when carry the object that are especially heavy. While for disable people, it can either carry their item or themselve with ease as it can be remote within range of the controller.

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APPENDIX A

(ARDUINO SOURCE CODE)

```
void MotorForward();
void MotorReverse();
void MotorLeft();
void MotorRight();
void MotorStop();

int command;;
const int PIN_TRIG2 = A2;
const int PIN_TRIG3 = A0;;
const int PIN_ECHO2 = A3;
const int PIN_ECHO3 = A1;
long microsecondsToInches(long microseconds);
long microsecondsToCentimeters(long microseconds) ;
String x;

int RELAY1 = 10;
int RELAY2 = 11;
int RELAY3 = 12;
int RELAY4 = 13;

void setup()
{
 Serial.begin (9600);
 pinMode(PIN_TRIG1, OUTPUT);
 pinMode(PIN_TRIG2, OUTPUT);
 pinMode(PIN_ECHO1, INPUT);
 pinMode(PIN_ECHO2, INPUT)
 pinMode(RELAY1, OUTPUT);
 pinMode(RELAY2, OUTPUT);
 pinMode(RELAY3, OUTPUT);
 pinMode(RELAY4, OUTPUT);
```

```
}
void loop()
 {
  long
distance,inches,cm,distance1,inches1,cm1,distance2,inches2,cm2,distance3,inches
3,cm3;//
//////////////////ULTRASONIC 1////////////////////////////////
  pinMode(PIN_TRIG, OUTPUT);
  digitalWrite(PIN_TRIG, LOW); //give high to pin trig
  delayMicroseconds(2); //delay for 2ms
  digitalWrite(PIN_TRIG, HIGH);
  delayMicroseconds(5); //delay for 5ms
  digitalWrite(PIN_TRIG, LOW); //give high to pin trig
  pinMode(PIN_ECHO, INPUT);
  distance = pulseIn(PIN_ECHO, HIGH); //read data from pin echo
  inches = microsecondsToInches(distance); //function call
  cm =microsecondsToCentimeters(distance);
//////////////////////ULTRASONIC 2////////////////////////////////
  pinMode(PIN_TRIG1, OUTPUT);
  digitalWrite(PIN_TRIG1, LOW); //give high to pin trig
  delayMicroseconds(2); //delay for 2ms
  digitalWrite(PIN_TRIG1, HIGH);
  delayMicroseconds(5); //delay for 5ms
  digitalWrite(PIN_TRIG1, LOW); //give high to pin trig
  pinMode(PIN_ECHO1, INPUT);
  distance1 = pulseIn(PIN_ECHO1, HIGH); //read data from pin echo
  inches1 = microsecondsToInches(distance1); //function call
  cm1 =microsecondsToCentimeters(distance1);


{
   delay(10);
   char c = Serial.read();
   x += c;
```

```
  }

delay(500);

  if ( ( cm<=60||cm3<=60)  ) //0.3 x1023
  {
    digitalWrite(LED1,  LOW);
    digitalWrite(LED2,  LOW);

    MotorStop();
    Serial.println("You  are in STOP situation");
    ////////////////////////////////////////
  {
    if  (x == "FORWARD")
    {
    MotorForward();
    Serial.println("You  are in FORWARD situation");
   // delay(3000);
    MotorStop();
    Serial.println("You  are in STOP situation");
    exit;
    }
    if  (x == "REVERSE")
    {
    MotorReverse();
    Serial.println("You  are in REVERSE  situation");
   // delay(3000);
    MotorStop();
    Serial.println("You  are in STOP situation");
    exit;
    }
  }
  }
```

```
/* else if ( (cm <= 59 || cm1 <= 59) )  //0.4 x 1023
 {
  digitalWrite(LED1,  LOW);
  digitalWrite(LED2,  LOW);

  MotorStop();
  Serial.println("You  are in STOP situation");

 } */
 else
 {
  digitalWrite(LED1,  HIGH);
  digitalWrite(LED2,  HIGH);

 if (x.length()  > 0)
 {
  if (x == "FORWARD")
  {
  MotorForward();
  Serial.println("You  are in FORWARD situation");

  }

  Serial.println(x);
  if (x == "REVERSE")
  {
  MotorReverse();
  Serial.println("You  are in REVERSE  situation");

  }

  Serial.println(x);
```

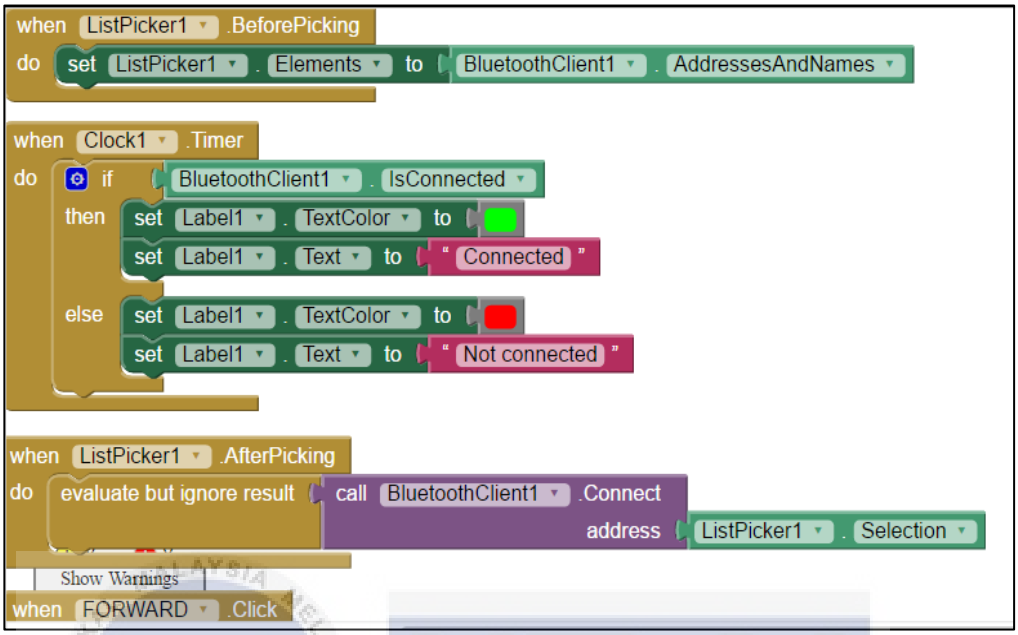
```
  if (x == "STOP")
  {
  MotorStop();
  Serial.println("You  are in STOP situation");


  }


  Serial.println(x);
  if (x == "LEFT")
  {
  MotorLeft();
  Serial.println("You  are in LEFT situation");


  }



  Serial.println(x);
  if (x == "RIGHT")
  {
  MotorRight();
  Serial.println("You  are in RIGHT situation");
  }


  x = "";
}
}
Serial.print("sensor(inch)=  ");
Serial.print(inches);
Serial.print(",");
Serial.print("sensor(cm)=  ");
Serial.print(cm);
Serial.println();
/*
```

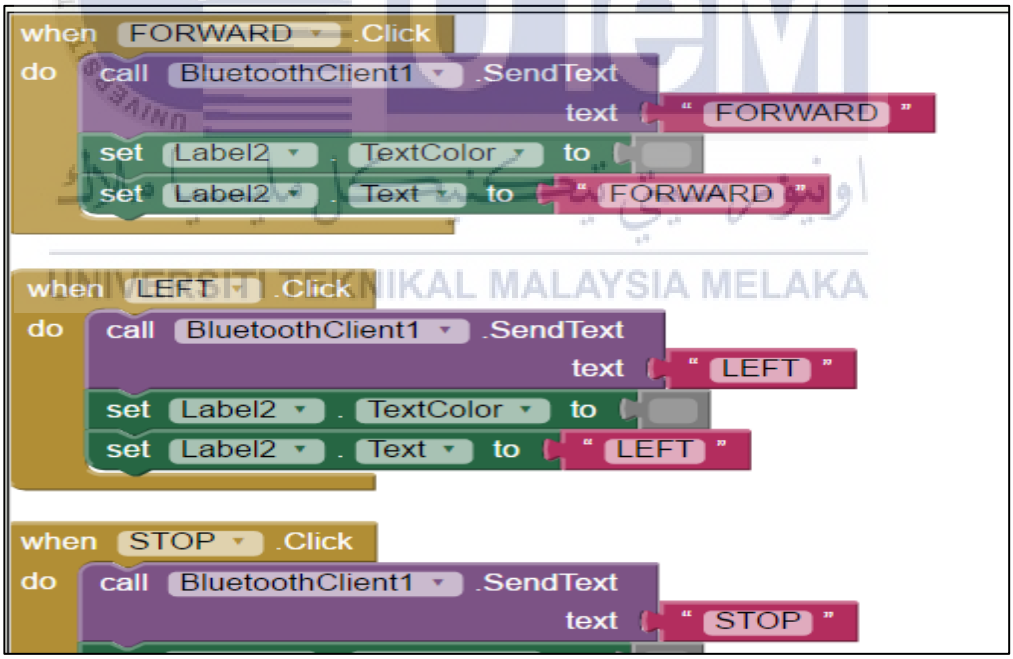
```
  Serial.print("sensor1(inch1)=  ");
  Serial.print(inches1);
  Serial.print(",");
  Serial.print("sensor1(cm1)=  ");
  Serial.print(cm1);
  Serial.println();


}
  long microsecondsToInches(long microseconds)  //function definition
  {
  return microseconds  / 74 / 2;
  } //microsecondsToInches

  long microsecondsToCentimeters(long microseconds)
  {
  return microseconds  / 29 / 2;
  }
void MotorForward()
{
    digitalWrite  (RELAY1,  LOW);
    digitalWrite  (RELAY2,  HIGH);
    digitalWrite  (RELAY3,  LOW);
    digitalWrite  (RELAY4,  HIGH);
}

void MotorReverse()
{
    digitalWrite  (RELAY1,  HIGH);
    digitalWrite  (RELAY2,  LOW);
    digitalWrite  (RELAY3,  HIGH);
    digitalWrite  (RELAY4,  LOW);
}
```

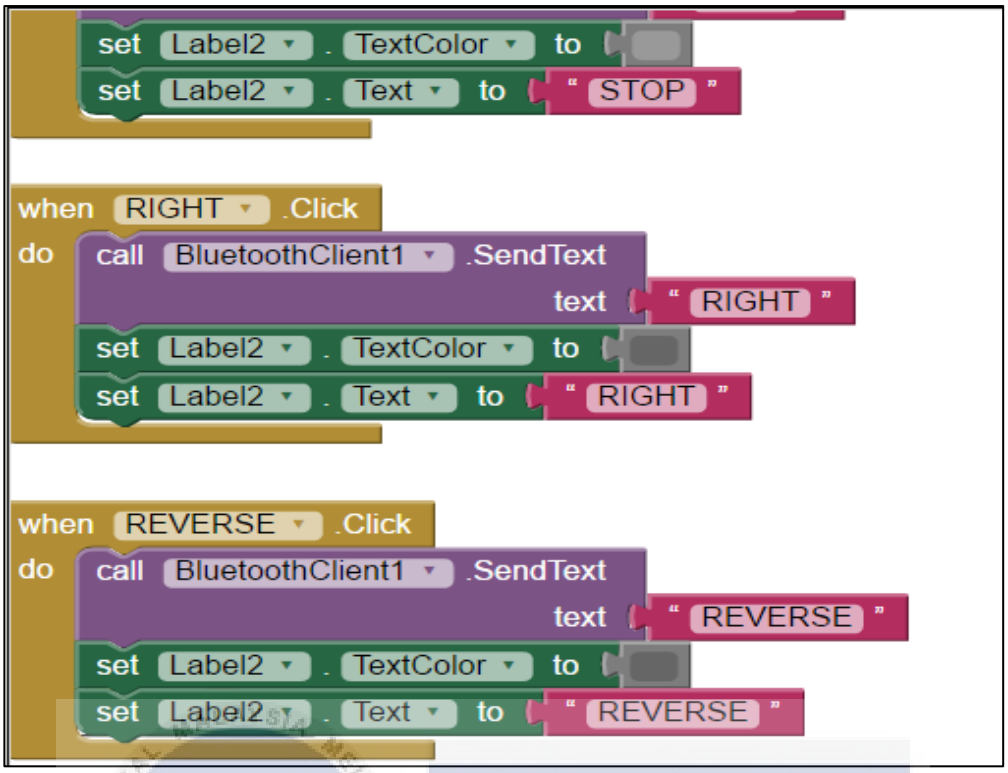
```
void MotorLeft()
{
    digitalWrite (RELAY1, LOW);
    digitalWrite (RELAY2, HIGH);
    digitalWrite (RELAY3, LOW);
    digitalWrite (RELAY4, LOW);
}

void MotorRight()
{
    digitalWrite (RELAY1, LOW);
    digitalWrite (RELAY2, LOW);
    digitalWrite (RELAY3, LOW);
    digitalWrite (RELAY4, HIGH);
}

void MotorStop()
{
    digitalWrite (RELAY1, LOW);
    digitalWrite (RELAY2, LOW);
    digitalWrite (RELAY3, LOW);
    digitalWrite (RELAY4, LOW);
}
```

APPENDIX B

(MIT Inventor SOURCE CODE)

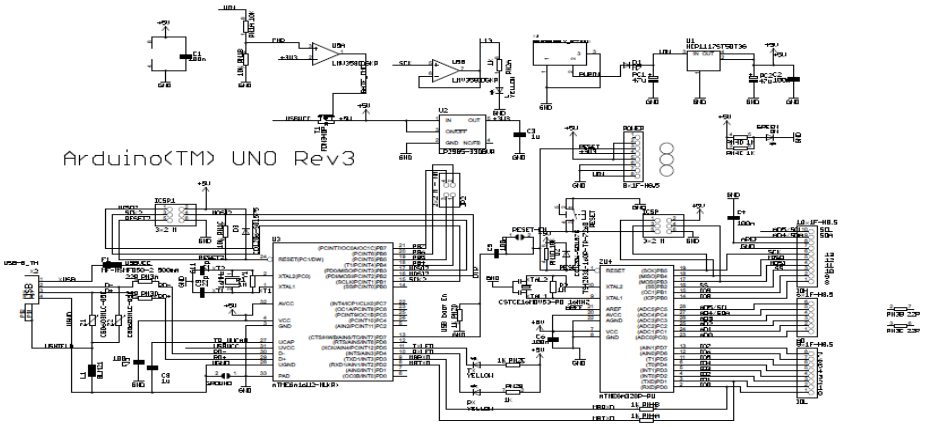






APPENDIX C

(Arduino Datasheet)



Arduino Uno

APPENDIX D

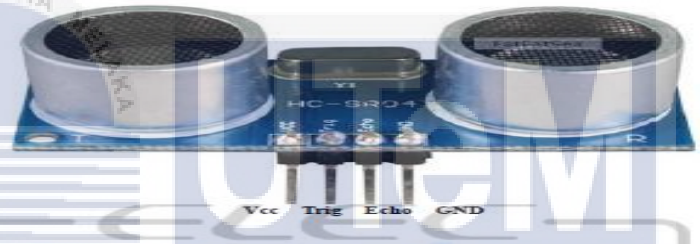
(Ultrasonic HC-SR04 Datasheet)

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

Electric Parameter

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**



Timing diagram

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

APPENDIX E

(Relay module Datasheet)