`

Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF SMART HOME AUTOMATION USING ARDUINO

EDDIE LIM HOCK LENG

Bachelor of Electronics Engineering Technology with Honours

2021

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DEVELOPMENT OF SMART HOME AUTOMATION USING ARDUINO

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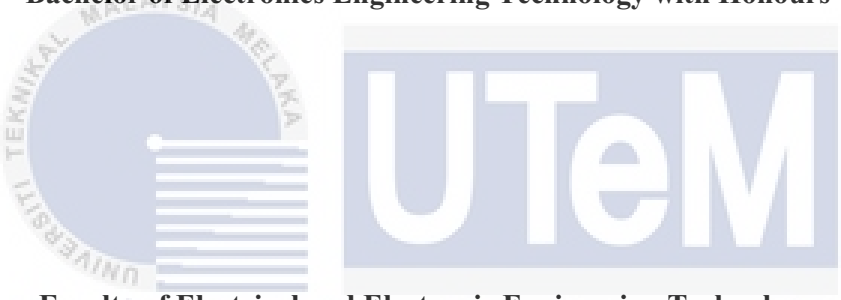
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

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DECLARATION

I declare that this project report entitled "DEVELOPMENT OF SMART HOME AUTOMATION USING ARDUINO " is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Student Name : EDDIE LIM HOCK LENG

Date : 10/1/2022

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APPROVAL

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

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Supervisor Name : DR.HASLINAH BINTI MOHD NASIR

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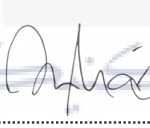
Signature : 

Co-Supervisor Name (if any) : MR NOOR MOHD ARIFF BIN BRAHIN

Date : 22/2/22

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DEDICATION

The thesis is entirely dedicated to my beloved parents, LIM CHENG SIEW and PONG AI RIN who always there with me and instilled in me the virtues of perseverance and relentlessly encouraged me to strive for excellent in completing this report.

To my siblings, COREEN LIM AI LIN and ERIC LIM HOCK LI that always generates and giving idea for me to complete this report, I would like to say thank you for always support and help me with their full of love that make me feel motivated and always in high spirits to finish my report.

To my awesome supervisor DR.HASLINAH BINTI MOHD NASIR, thank you for the guidance and encouragement for me to make sure my report and project is done well and always keep reminds me to complete my task and always motivate me with some brilliant idea.

`

ABSTRACT

In this era of modernization, the process of improving and upgrading the living standard of the house have been increased in such as smart home automation. However, most of the smart home require internet connection where in Malaysia network connectivity is one of the common issues. Besides, elderly person powerless to reach high or lower places due to her back problems and Elderly person had to enlist the help of other people to open the fan and lamp switch. Thus, this project is proposed to develop home automation using Arduino through Bluetooth connection. The system used Arduino Uno as microcontroller and Arduino HC05 Bluetooth Module as a platform between smart phone application and the device. This project is successfully functional where the user can control the fan and lamp by using their smartphone. In addition, the pir sensor was installed and the door lock was remotely controlled through the smart phone for anti-theft features. By pressing button at smartphone, lamp, fan, and gate can be controlled easily. In conclusion, this project presented a home automation integrated with Bluetooth connection that will be beneficial in daily life especially to the elders.

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ABSTRAK

Dalam era pemodenan ini, proses penambahbaikan dan peningkatan taraf hidup rumah telah dipertingkatkan seperti automasi rumah pintar. Walau bagaimanapun, kebanyakan rumah pintar memerlukan sambungan internet di mana di Malaysia sambungan rangkaian adalah salah satu isu biasa. Selain itu, warga emas tidak berdaya untuk mencapai tempat tinggi atau lebih rendah kerana masalah belakangnya dan warga emas terpaksa meminta bantuan orang lain untuk membuka suis kipas dan suis lampu.Oleh itu, projek ini dicadangkan untuk membangunkan automasi rumah menggunakan arduino melalui sambungan bluetooth. Sistem ini menggunakan Arduino Uno sebagai mikropengawal dan Modul Bluetooth Arduino HC05 sebagai platform antara aplikasi telefon pintar dan peranti. Projek ini berjaya berfungsi di mana pengguna boleh mengawal kipas dan lampu dengan menggunakan telefon pintar mereka. Selain itu, sensor pir telah dipasang dan kunci pintu dikawal dari jauh melalui telefon pintar untuk ciri anti-kecurian. Dengan menekan butang pada telefon pintar, lampu, kipas dan pintu pagar boleh dikawal dengan mudah. Kesimpulannya, projek ini mempersembahkan automasi rumah yang disepadukan dengan sambungan Bluetooth yang akan memberi manfaat dalam kehidupan seharian terutamanya kepada warga emas.

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ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor DR. HASLINAH BINTI MOHD NASIR for her precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support which enables me to accomplish the project. Not forgetting my fellow colleagues, for the willingness of sharing his thoughts and ideas regarding the project.

My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study

Finally, I would like to thank all the staffs at the FTKEE lab, fellow colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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CHAPTER 1

INTRODUCTION

1.1 Background

In this era of modernization, the process of improving and upgrading the living standard of the house have been increased. Home Automation System is implemented for more than a decade, but due to the costing of the project, it remains as a niche product for consumers.

In 1950, the first television with a remote-control system was created by Zenith Radio Corporation [1]. Besides, there are also many useful home appliances that were invented to the people and some of them are still in the integrating process. For example, the first engine-powered vacuum cleaner was created by Hubert Cecil Booth in 1901. But the machine invented was placed outside of a building while the operator will clean in the inside. It was not a portable device like modern vacuum cleaner as its huge size hence it was difficult to move. In 1905, a smaller and portable vacuum cleaner which invented by Walter Griffiths had bring a lot of convenience to the community [2]. Hence, it shows that human is trying to make a better life and it shows that it is possible to create a smart home system in the future.

Examples of smart home hubs are Amazon Echo, Google Home, and Wink Hub. Some smart homes are invented, but due to high cost, it is costly. Hence, this project is targeted to produce cheaper price which people can afford to buy. Example1.1 show number of smart

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homes. In this table, we can see that USA is the number one country in the world that consume smart home in year 2020. USA have 40.3 million smart home consumers. Moreover, we can see that China is close to USA. China contains 19.3 million smart home consumers.

TABLE 1: Cross country summary on smart homes [12].

Rank (number of smart homes)	Country	Number of smart homes (millions)	Percentage of smart homes (% of total homes)
1	USA	40.3	32
2	China	19.3	4.9
3	Japan	7	15
4	Germany	6.1	15.7
5	UK	5.3	19.7
6	South Korea	4	20
7	India	2.2	<1
8	Australia	1.8	19.12
9	Brazil	1.2	1.9
10	Russia	0.9	1.7

Figure 1.1 Number of smart homes

1.2 Problem Statement

In the era of globalization, technology smart home not only capable for person who want to use it, but more critical to the person who really need it such as handicap person or elderly person. For example, elderly person powerless to reach high or lower places due to her back problems. Elderly person had to enlist the help of other people to open the fan and lamp switch [3]. By applying smart home, elderly person can open lamp and fan easily.

Moreover, smart home device unable Connect to the Network due to network connectivity.Network connectivity is one of the most common issues that Malaysia smart

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home device owners will encounter [4]. By applying smart home that connected with Bluetooth it can solve this problem.

Furthermore, when person rang the doorbell when it rained, they faced a small electric shock and tingling in their finger [5]. This will cause danger to the person. By applying smart home, the person can open the gate using smart home and make it safe.

1.3 Project Objective

Specifically, the objectives are as follows:

a) To develop a smart home automation system using Arduino with door security.

b) To integrate the system with mobile application through Bluetooth.

1.4 Scope of Project

The project scope is to create a smart home automation by using Arduino. It will use Bluetooth serial controller app to switch on or off lamp and fan. Besides, it also can open and close door by using smartphone Furthermore, PIR sensor is used to open gate by detect the movement of person.

1.5 Thesis Outline

The thesis outline is to discuss about the overall flow of this project, which is "Development of Smart Home Automation using Arduino". Basically, this project is made up of five (5) chapters, which are stated as follows:

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• Chapter 1 introduces about the background of the smart home. A problem statement is stated and objectives are listed to set to solve the problems.This chapter also covers the scope of project and also the outlines of this project.

• Chapter 2 consist of literature review. In this section, inserted discussion about the related research done by researchers based on the project implementation and functionality. A comparison between the samrt home projects is done to discover the main idea, theory and provide a advantage and disadvanatge of each project which will be satisfactory for this project.

• Chapter 3 consists of project methodology that used to execute in this project. The methodology is done by taking certain steps to develop this project while obeying the objectives stated. Then, a flowchart is designed to illustrate the whole function of this project system. Moreover, block diagram is design to understand the project system.Furthermore,component use in this project is stated to develop this project. Besides, circuit diagram is constructed to show project system.

• Chapter 4 are included the details of results obtained from the performance of this project. Furthermore, the discussion ellobarate based on this project results.Moreover, analysis is done based on project result.

• Chapter 5, basically concludes and summarizes the main ideas and states whether the project output has achieved the main objectives that have been list out previously. Lastly, in this chapter there will be a section that gives suggestions on further improvement for this project in future.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the deeper understanding of the project Development of IOT based Smart home automation by using Arduino can be done by discussion and determination from previous research, projects and journals which related to the title. All information and knowledge from the previous research, projects and journals which obtained from Internet will be clearly cited.

2.2 Microcontroller Technology

A microcontroller is a kind of microcomputer that is based on a single metal-oxide-semiconductor (SMOS) integrated circuit (IC). A microcontroller consists of one or more central processing units (CPUs), memory, and programmable input/output peripherals. Besides, on-chip programme memory in the form of ferroelectric RAM, NOR flash, or OTP ROM is prevalent, providing a tiny amount of RAM [4]. In modern use, a microcontroller is similar to, but less complicated than, a system on a chip (SoC). A microcontroller may be one of the components of a system-on-chip (SoC), although it is commonly combined with advanced peripherals such as a graphics processing unit (GPU), a wireless module, or one or more coprocessors[4]. For my project, I used the Arduino Uno microcontroller for research. As a result, the Methodology section discusses the usage of hardware and the kind of microcontroller in this project in more depth. Figure2.1 show example of microcontroller which is NodeMCU.

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NodeMCU is an open-source development board based on the ESP8266 microcontroller. The ESP-8266 module is a wireless microcontroller board that may be programmed. The ESP8266 Wi-Fi board is a system-on-chip (SOC) with an integrated TCP/IP protocol stack that can connect any secondary microcontroller to a Wi-Fi network [6]. Figure 2.1 shows NodeMCU ESP8266.

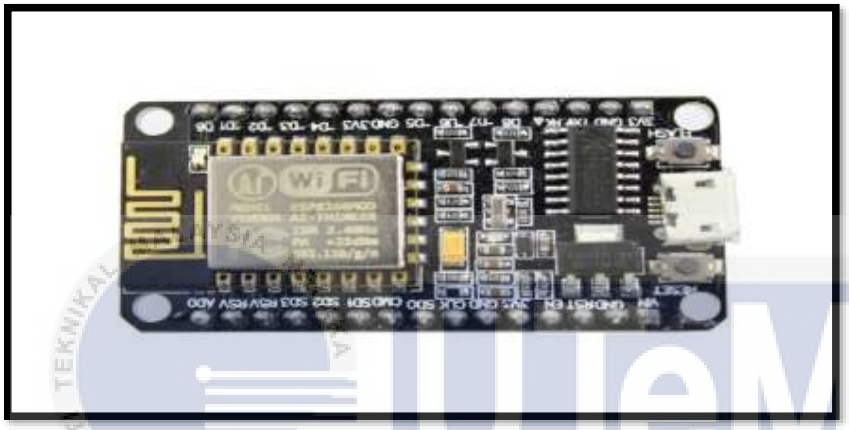

Figure 2.1 NodeMCU ESP8266

Second example of microcontroller is Arduino. Arduino is an 8-bit microcontroller development board equipped with a USB programming port for connecting to a computer and other connections for interfacing to other devices such as sensors, motors, and diodes. It has input pin and output pin, with the inputs being either digital (0–13) or analogue (A0–A5), while the output pins are all digital (0–13). The Arduino board design, as well as the integrated development environment that includes a cross-compiler, a debugger, and a serial monitor for controlling the inputs and outputs, is open source [7]. Arduino may be powered through a USB cable connected to a computer, a 9V battery, or an external power source. Figure 2.2 shows Arduino Uno.

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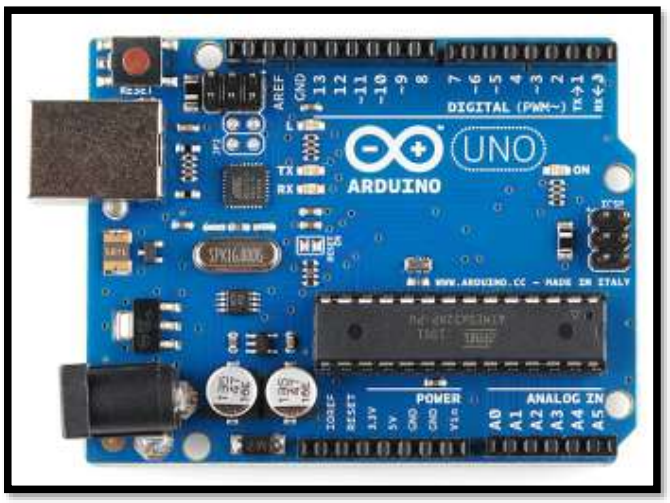

Figure 2.2 Arduino UNO

2.3 Automated Smart Home Research

Robert A. Sowah (2020) was proposed a Secure Wireless Home Automation System with an Open Home Automation Bus Framework. The research used OpenHAB software. Mega microcontrollers are used in a secure wireless home automation system [8].

R, Rathish Ganesh (2020) was proposed IoT Based Home Automation using Passive Infrared (PIR) Motion Sensor and Node MCU. This research integrating PIR motion sensor and google voice assistant software. This system will work when there detects any motion within the sensor range. It can also be controlled through the mobile application, which is by using Blynk application [9].

Sudha Kousalya(2018) was proposed IOT Based Smart Security and Smart Home Automation. This research is controlling lights and fans and providing Smart security by sending an captured image through an E-mail to the owner using internet when an object is detected [10].

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Madhu G M(2018) was propose IOT Smart Home Controller with Android Application by using Node MCU. This researcher is designing each device is connected to the internet through the IOT protocol. Hypertext Transfer Protocol (HTTP) requests sent from the Android mobile application for controlling [11].

Mukhammad Andri Setiawan(2018) was proposed a Smart Home by using Raspberry Pi and NodeMCU. This research discusses the calculation of how much power consumption in electrical appliances. The communication between user and the system is done by using Telegram [12].

`

2.4 Comparison of Previous Project

Table 2.1 Summary of Previous Project

Smart Home Type	Project Description	Component used	Advantage	Disadvantage
Wireless Home Automation System	OpenHab integrates several cross-platform home automation systems into a single solution.	Raspberry Pi Model and OpenHab software.	It more security. This is because the OpenHAB software does not require any access control mechanism for it users.	This project more expensive.

`

IoT Based Home Automation using PIR Motion Sensor and Node MCU	This developed system works when there is any motion within the defined sensor range and it also can be controlled through the mobile application.	PIR Motion sensor and Nodemcu	It can control using smartphone.	It only can be use in short range motion.
Smart Security and Smart Home Automation	This project controlling lights and fans. Besides, it is providing Smart security.	Nodemcu and IR sensor	This project will help Handicapped and aged people.	It needs strong internet network connection.
Smart Home Controller with Android Application	User can control their devices using the Android.	Nodemcu	Cost Effective Smart Home.	It needs strong internet network connection.

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Smart Home by using Raspberry Pi	The communication between user and the system is done by using Telegram Bot.	Raspberry Pi and NodeMCU	User can calculate the electrical appliances power and electricity fee.	This project needs a high cost.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discuss the project methodology. In this chapter, will discuss the hardware choice and the software used to achieve the objectives of this project.

3.2 Block Diagram

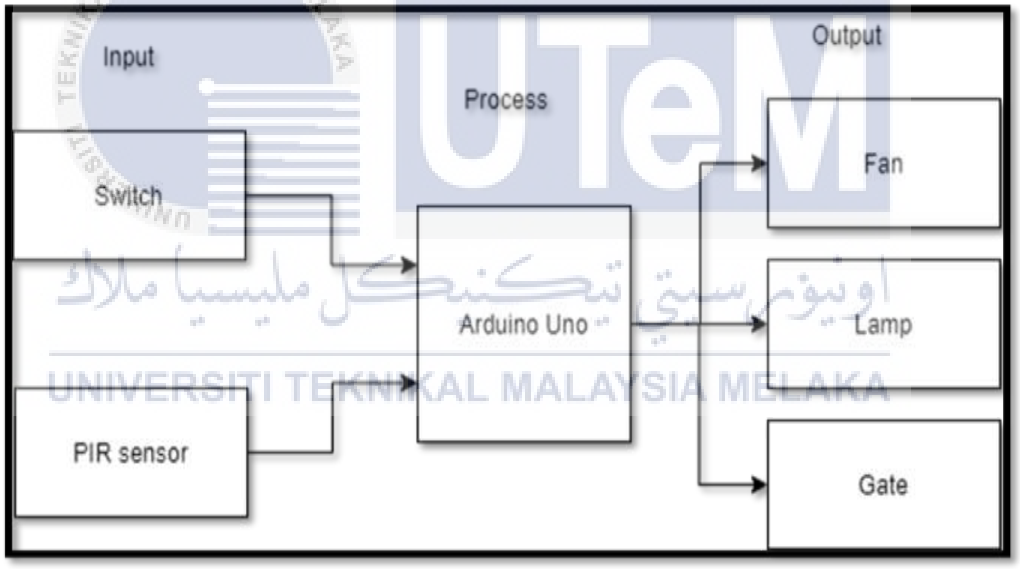

Figure 3.1 Block Diagram

Figure 3.1 shows the block diagram of the of Development Smart Home Automation **by** using Arduino. Switch button and PIR sensor been used as Input. Arduino Uno is the process component. Fan, light, and gate been used as output.

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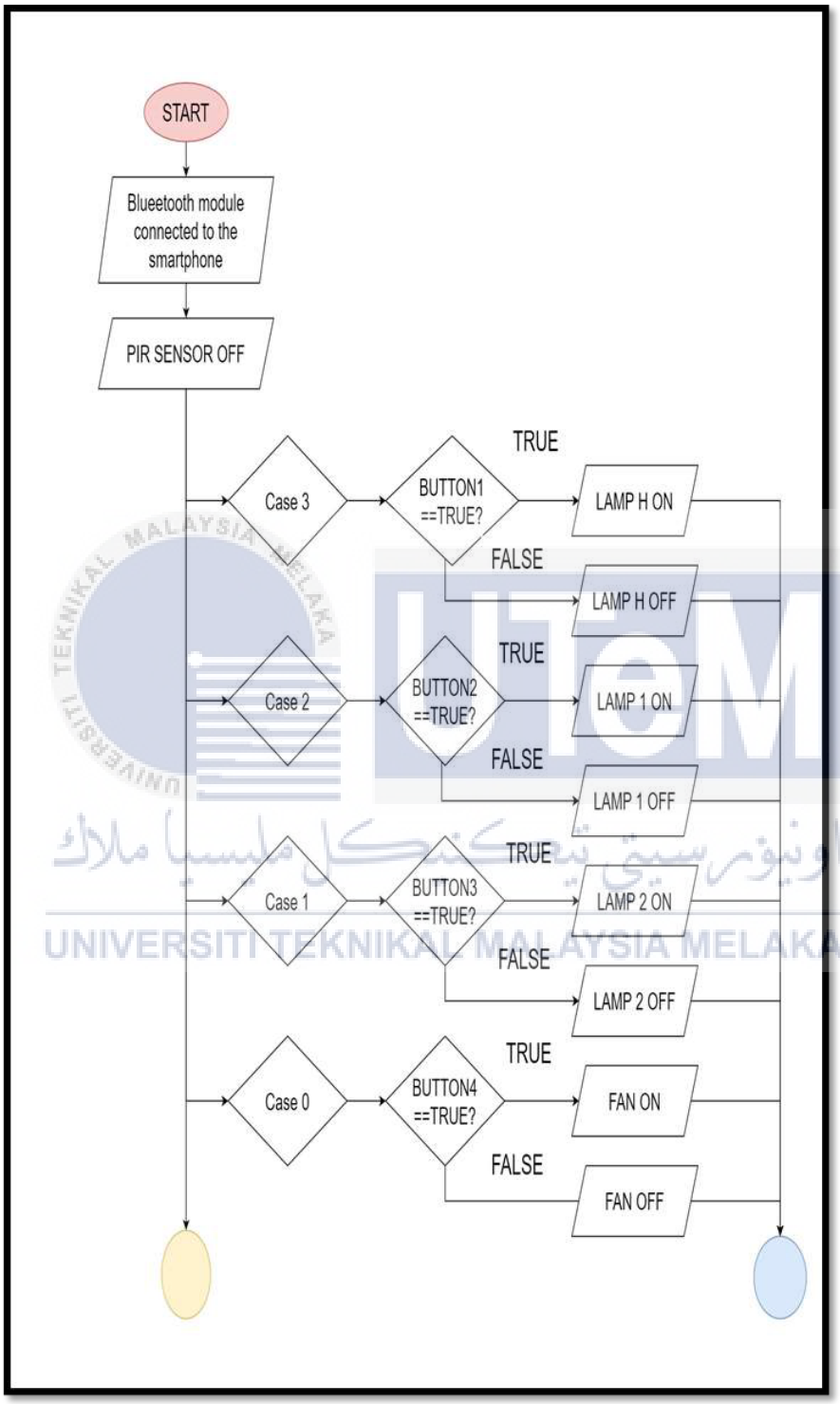
3.3 Flow Chart



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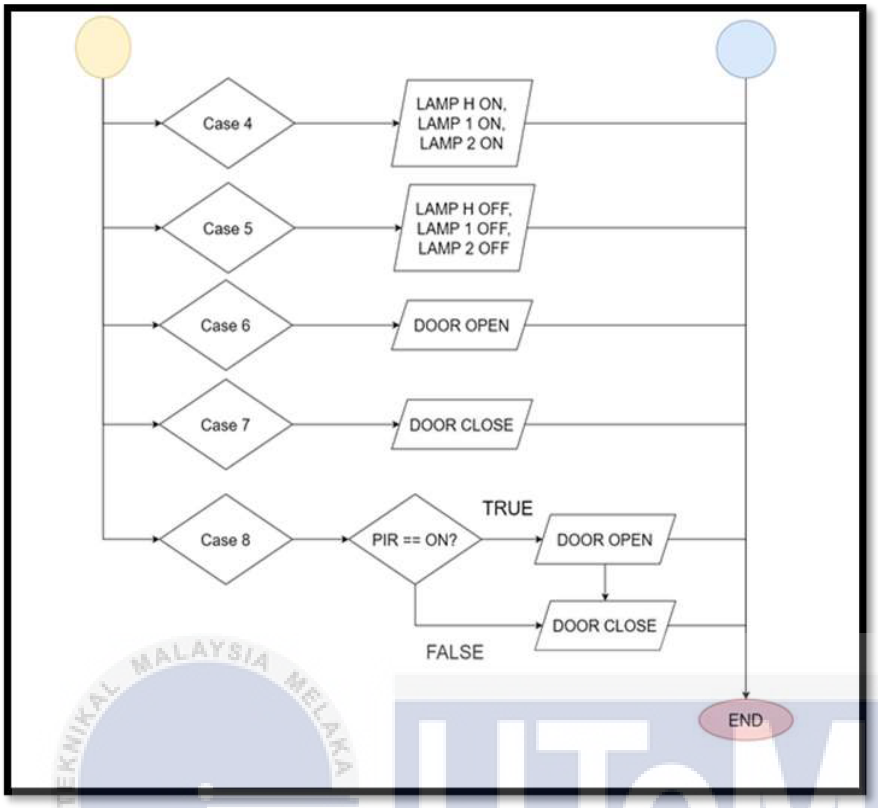

Figure 3.2 Flow Chart

Figure 3.2 shows the flowchart of Development smart home automation by using Arduino. First, this system needs to connect to power supply to power on the system. In case 3, when the button is press, the lamp H will turn on else lamp H remain off. In case 2, when the button is press, the lamp1 will turn on else lamp 1 remain off. In case 1, when the button is press, the lamp2 will turn on else lamp 2 remain off. In case 0, when the button is press, the fan will turn on else fan will remain off. In case 4, when the button is press, all electrical appliances such as fan, lamp h, lamp 1 and lamp 2 will tun on. In case 5, when the button is press, all electrical appliances such as fan, lamp H, lamp 1 and lamp2 will tun off. In case 6, when the button is press, the door gate will open. In case 7, when the button is press, the door gate will close. In case 8, when we press the pir enable the pir sensor will activated. When PIR sensor detect any motion, the door will open.

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3.4 List of Materials

3.4.1 Arduino Uno

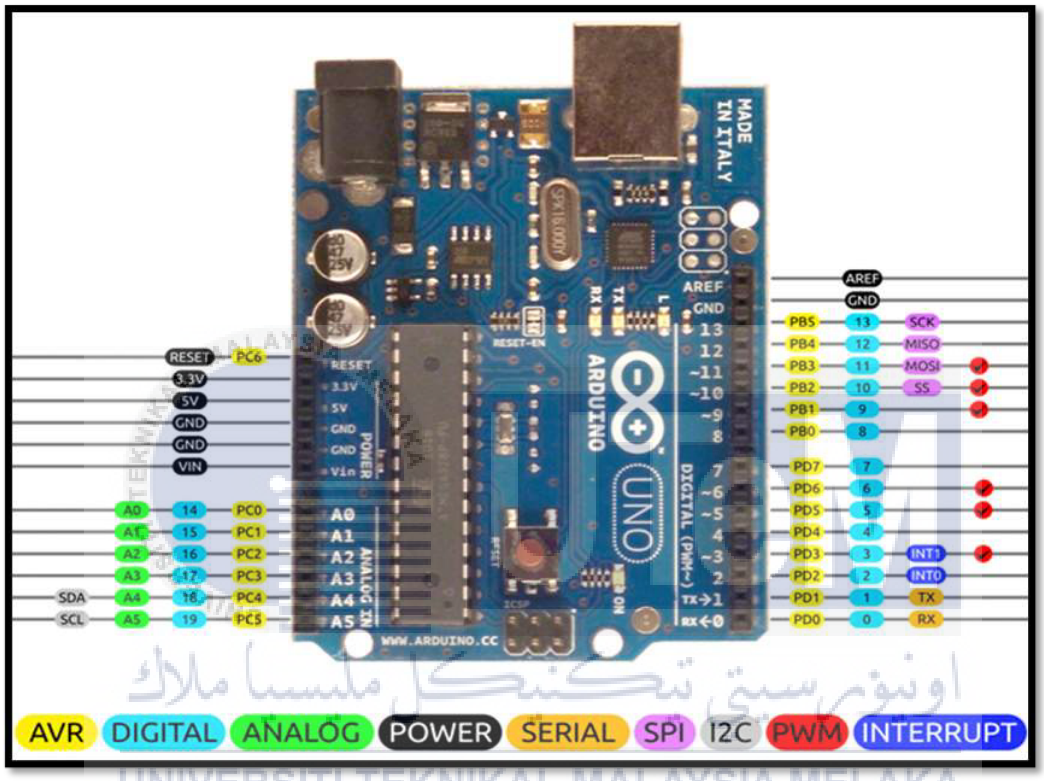

Figure 3.3 Arduino Uno

Figure 3.3 show Arduino Uno. Arduino Uno is a microcontroller installed with an 8-bit ATmega328P. Arduino Uno have 14 digital input or output pins. 6 pins used as PWM outputs, 6 in analogue input, 1 USB connection, and a power barrel jack [13].

`

3.4.2 Bulb

Figure 3.4 Bulb

Figure 3.4 shows a bulb. A bulb transforms electrical energy to light. When electric current flows through it, the bulb will produce light. This bulb produces 200w power.

3.4.3 Breadboard

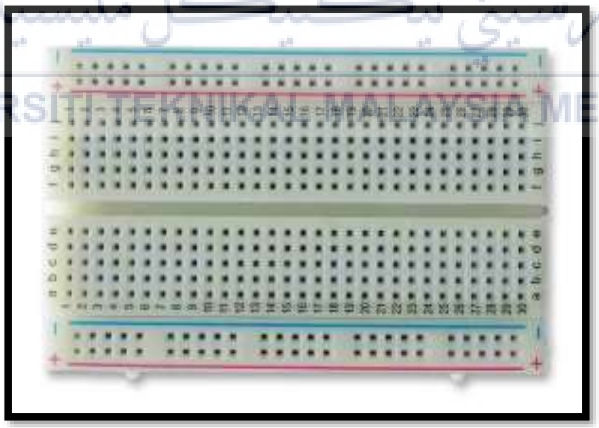

Figure 3.5 Breadboard

Figure 3.5 shows breadboard. Breadboard are used to set up temporary test. No soldering is required when using breadboard so it can easily switch connections and replace components. Parts of breadboard are not easily damaged, and it can eventually be used again.

`

The holes in the Breadboard allow diodes, LEDs, resistors, wire and virtually all device forms of terminals to fit into it. The breadboard consists of several size such as 8.5x 5.55cm, and 16.5 x 5.55cm. In 8.5x 5.55cm, it consists of 400 holes while in 16.5 x 5.55cm it consists of 800 holes.

3.4.4 Power Supply Module

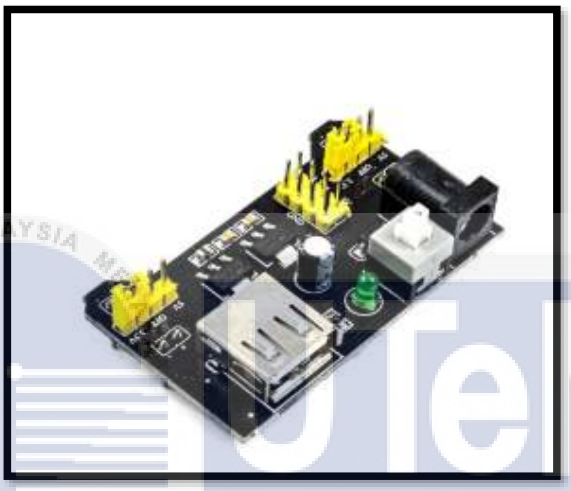

Figure 3.6 Power Supply Module

Figure 3.6 shows power supply module. Power supply module transform the AC input source power into DC signal level voltage used by the PLC processor. It can switch to 5v or 3.3v. Power supply module will produce DC voltage that are free noise.

`

3.4.5 Jumper Wire

Figure 3.7 Jumper Wire

Figure 3.7 shows jumper wire. Jumper wire are use on breadboard to construct electronic circuits, and it can simply as jumpers. Jumper wire provide connectors that conveniently mount to the breadboard, or hardware, and it no need to do soldering process.

3.4.6 Fan

Figure 3.8 Fan

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Figure 3.8 shows fan. Fan is a mechanical device that creates a movement of air. It used to induce airflow for a cooling goal. Fans are generally used for spreading air in rooms.

3.4.7 Relay Module

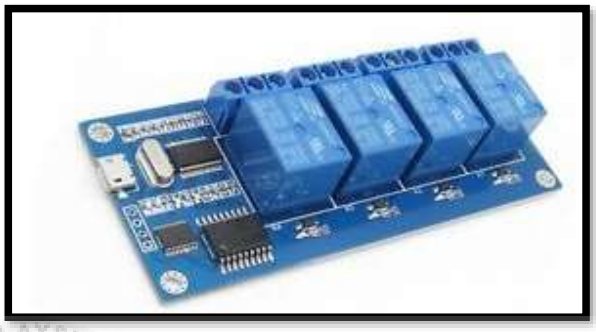

Figure 3.9 Relay Module

Figure 3.9 shows 4 channel relay modules. Relay module is an electrically run as switch that able to switch on or off determine either to let current flow through or not. 4 Channel Relay Module is a convenient board which be used to control high voltage and current load such as motor, lamps, and AC load.

`

3.4.8 Resistance

Figure 3.10 Resistance

Figure 3.10 shows resistance. Resistance is a component to limit the current in an electrical circuit.

3.4.9 Servo Motor

Figure 3.11 Servo Motor

Figure 3.11 shows Servo motor. A servo motor is an electric device to control angle rotation. By applying a Pulse Width Modulation (PWM) signal, the rotation angle of the

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servo motor can be controlled. By applying width of the PWM signal, rotation angle and direction of the motor can be adjusted.

3.4.10 HC05 Bluetooth Module

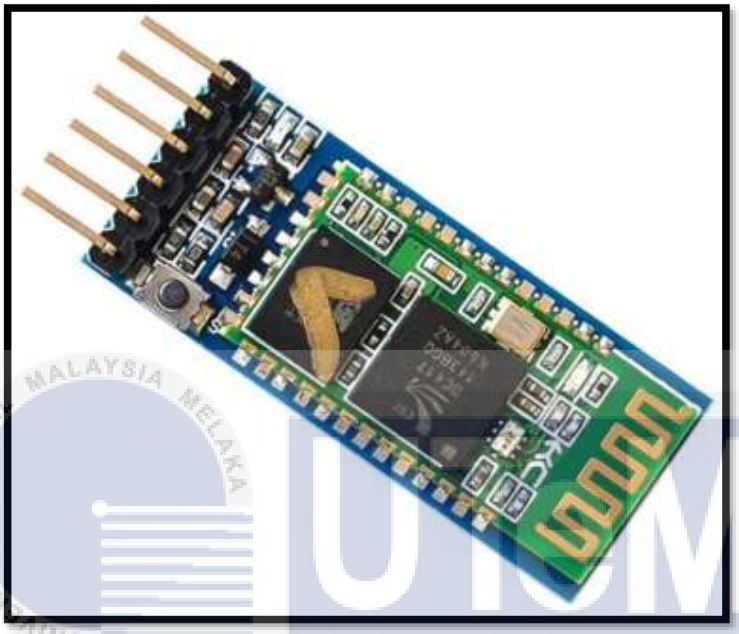

Figure 3.12 HC05 Bluetooth Module

Figure 3.12 shows HC05 Bluetooth Module. It contains 6 pins. It acts as wireless serial connection to communicate with electronic such as smartphone.

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3.5 Circuit Diagram

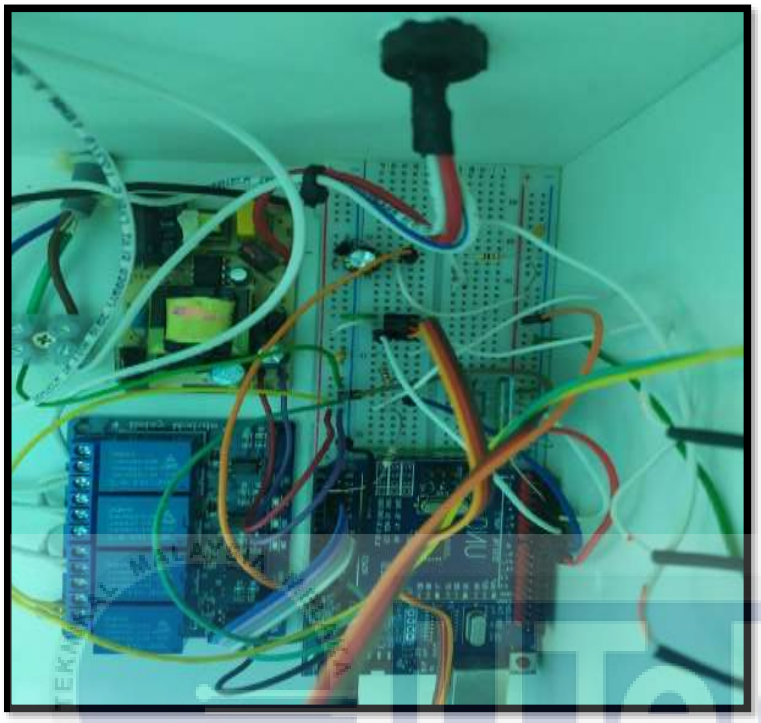

Figure 3.13 Circuit Diagram

Figure 3.13 shows circuit diagram that use in this project. It consists of 10k ohm resistor, Arduino Uno, HC05 Bluetooth module, power supply module and 4 channel relay modules.

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3.6 APPLICATION DEVELOPMENT

The programme that used in this project is as follows:

3.6.1 BLUETOOTH SERIAL CONTROLLER

This software use to send serial data to the Arduino Bluetooth module when a button is pressed on the app. The Arduino Bluetooth module receives data from Bluetooth serial controller app and sends it to the Arduino through the TX pin of the Bluetooth module. Bluetooth Serial Controller can do wireless serial communication with PIC microcontroller, Arduino and Raspberry Pi. Figure 3.14 shows the Bluetooth Serial Controller App.

Figure 3.14 Bluetooth Serial Controller App

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3.6.2 ARDUINO IDE

The Arduino IDE are used to write, compile and upload the code to the Arduino Computer or board. Figure 3.15 shows Arduino IDE software.

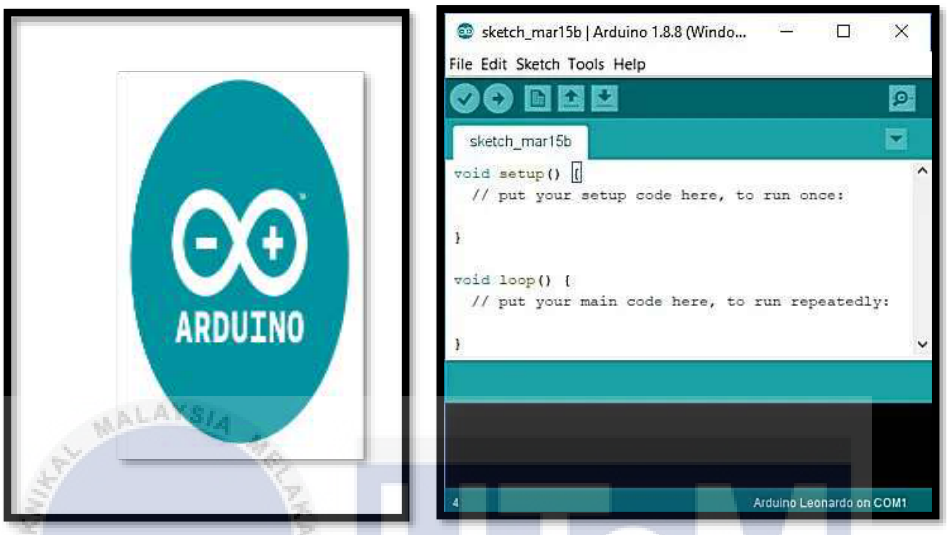
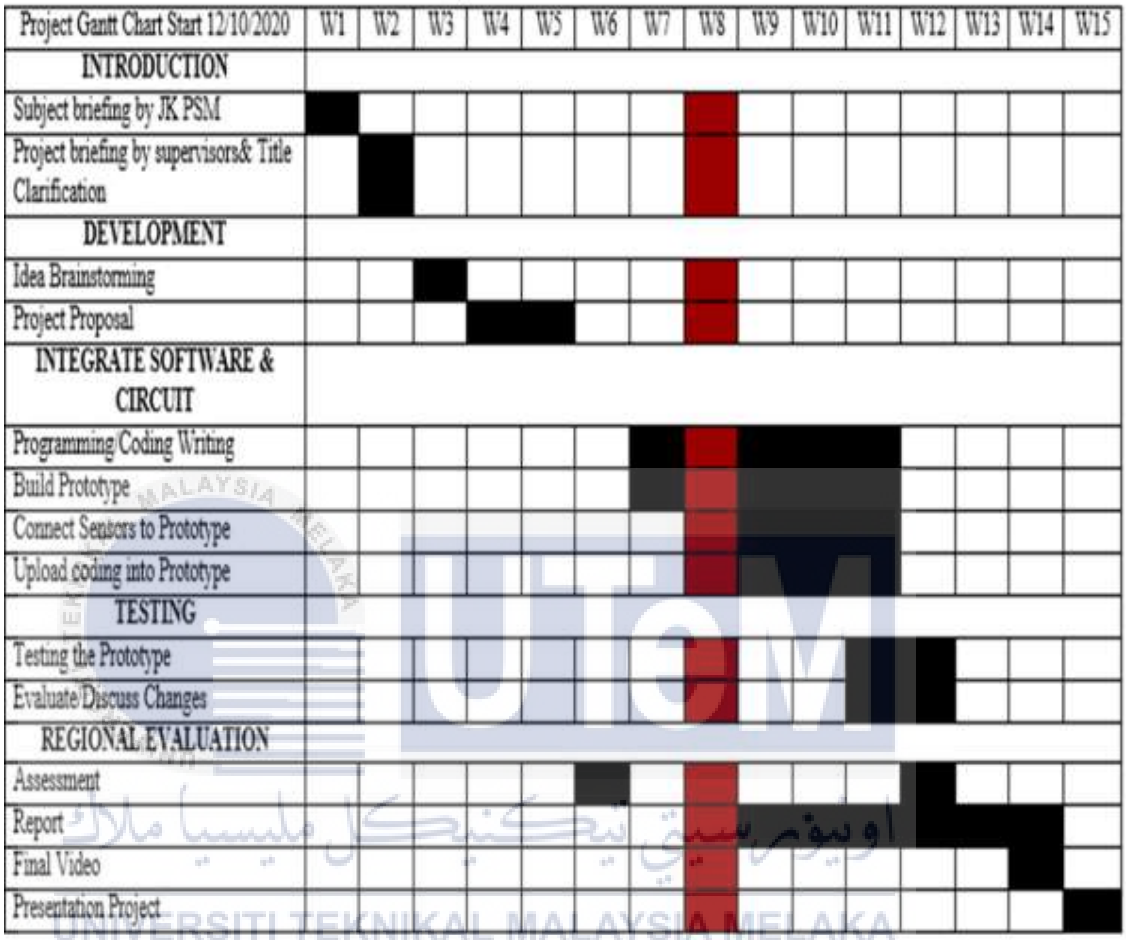


Figure 3.15 Arduino IDE software

3.7 Gant Chart

Table 3.1 Gant Chart



Project Gantt Chart Start 12/10/2020	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
INTRODUCTION															
Subject briefing by JK PSM															
Project briefing by supervisors& Title Clarification															
DEVELOPMENT															
Idea Brainstorming															
Project Proposal															
INTEGRATE SOFTWARE & CIRCUIT															
Programming/Coding Writing															
Build Prototype															
Connect Sensors to Prototype															
Upload coding into Prototype															
TESTING															
Testing the Prototype															
Evaluate/Discuss Changes															
REGIONAL EVALUATION															
Assessment															
Report															
Final Video															
Presentation Project															

Table3.1 shows the Gant Chart for this project. It consists of Introduction, development of project, integrated software, and circuit, Testing and regional Evaluation

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CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter briefly discuss hardware implemented results and discussion of smart home result. Moreover, this chapter also discusses all the details about phone application used, result,analysis and hardware design.

4.2 Phone Application

Phone application that uses are call Bluetooth Serial Controller. This software application is used to control the system by using smartphone. This application is connected using Bluetooth. This application is easy to use by pressing button to turn on or off lamp, fan, and gate. Figure 4.1 shows the Bluetooth Serial Controller interface. It can on and off lamp, fan, and gate. Besides, it also can enable and disable PIR motion sensor. Figure 4.2 shows Button Name. It can set button name for button one until button9.

`

Figure 4.1 Bluetooth Serial Interface

Figure 4.2 Button Name

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4.3 Hardware Design

Figure 4.3 shows hardware design that had been produced. The hardware design component easy to find at electronic shop or purchase at Shopee. PVC foam board are used to make smart home design.

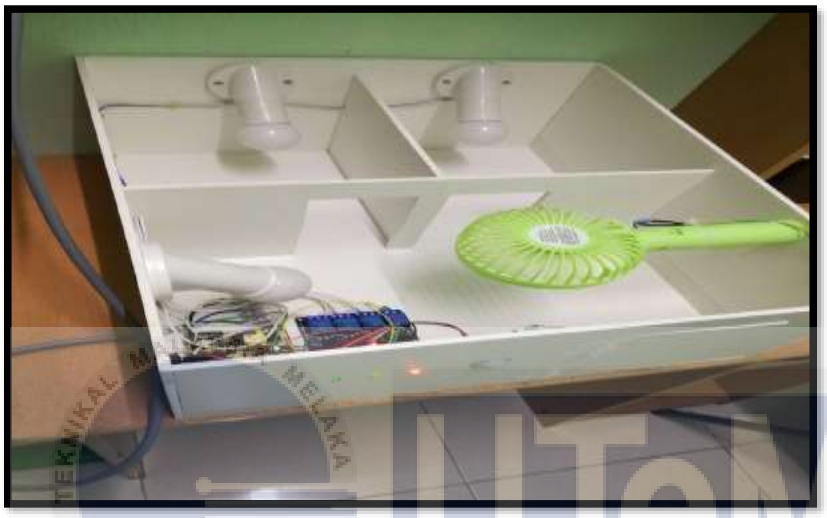

Figure 4.3 Hardware Design

4.4 Final Result

In this topic, preliminary results that can be generated. User can connect to Bluetooth serial controller app to control electrical equipment. Figure 4.4 shows Lamp Hall. Lamp Hall can be turn on by pressing button 1. Lamp Hall also can be turn off by pressing button 1 again.

`

Figure 4.4 Lamp Hall

Figure 4.5 shows Lamp 1. Lamp 1 is represented lamp in dining room. Lamp 1 can be turn on by pressing button 2. Lamp l also can be turn off by pressing button 2 again.

Figure 4.5 Lamp In Dining Room

Figure 4.6 shows Lamp 2 turn on. Lamp 2 is represented bedroom. Lamp 2 can be turn on by pressing button 3. Lamp 2 also can be turn off by pressing button 3 again.

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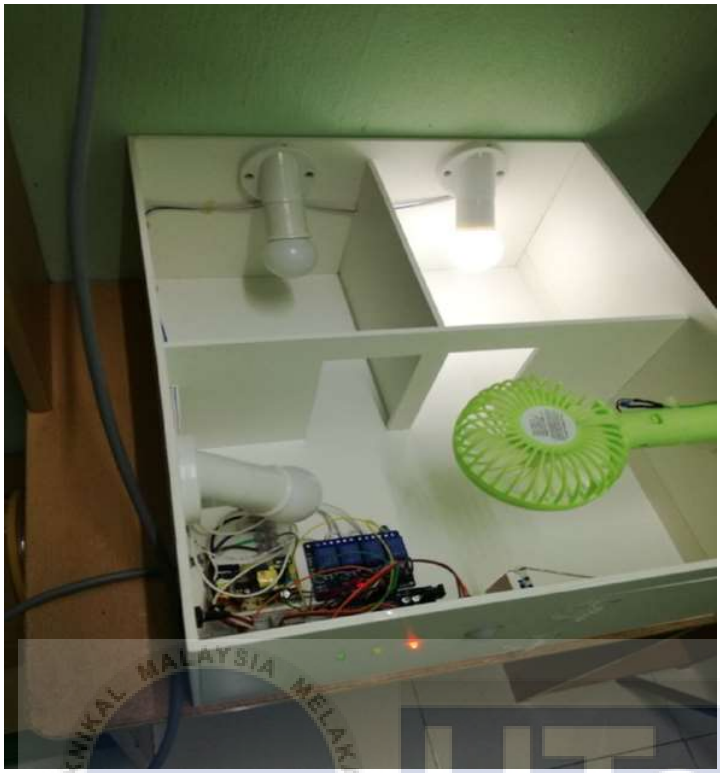

Figure 4.6 Lamp In Bedroom

Figure 4.7 shows fan in hall. Fan can be switch on by pressing button 4. Fan also can be turn off by pressing button 4 again.

Figure 4.7 Fan In Hall

`

Figure 4.8 shows the switch on all components. By pressing button 5, lamp hall, lamp 1, lamp 2, and fan will switch on.

Figure 4.8 Switch On All Component

Figure 4.9 shows the switch off all components. By pressing button 6, lamp hall, lamp 1, lamp2 and fan will switch off.

`

Figure 4.9 Switch Off All component

Figure 4.10 shows door open. By pressing button 7, door will open.

Figure 4.10 Door Open

`

Moreover, figure 4.11 shows door close. By pressing button8, door will close.

Figure 4.11 Door Close

Besides, PIR sensor in disabled mode. By pressing button 9, it will enable the PIR sensor. PIR sensor will detect motion at the door. When PIR sensor detect any motion, the door will open. Figure4.11 shows PIR enable condition.

`

Figure 4.12 Door Open in Enable Mode

4.5 Analysis

4.5.1 Distance For Bluetooth Receive Signal vs Time Taken To Connect

FIRST ATTEMPT

Table 4.1 Distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 1

N0	NUMBER OF ATTEMPT	DISTANCE FOR BLUETOOTH RECEIVE SIGNAL (m)	TIME TAKEN TO CONNECT (s)
1	1	1	20.34
2	1	2	18.46
3	1	3	16.23
4	1	4	10.52
5	1	5	12.32
6	1	6	14.47
7	1	7	18.37
8	1	8	20.54
9	1	9	24.31
10	1	10	25.51

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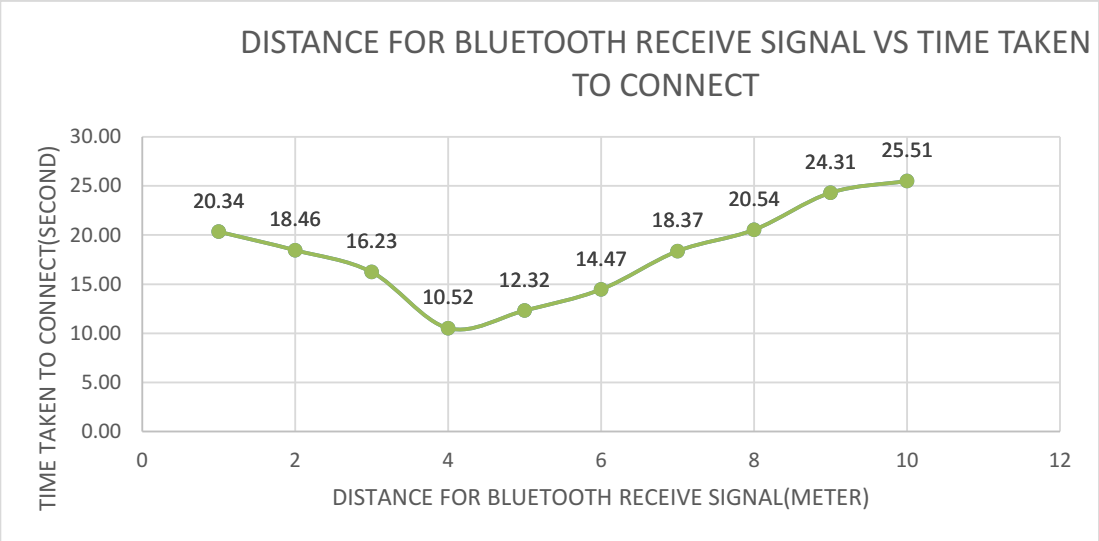

Figure 4.13 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 1

Table 4.1 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 1. Measure the time taken to connect by using stopwatch. Besides, measure distance for Bluetooth receive signal by using meter ruler. Figure 4.13 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 1. In 4-meter distance, it reacts the lowest time taken to connect which is 10.52 seconds. In 1 meter distance, it takes 20.34 seconds to connect which is 20.34 seconds. In 10-meter distance, it reacts the highest time taken to connect which is 25.51 seconds. In this graph, maximum distance for Bluetooth receive signal is 10 meters. Besides, from this graph also we can obtain time taken for Bluetooth to connect is between 10 to 26 seconds.

`

Second Attempt

Table 4.2 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 2

N0	NUMBER OF ATTEMPT	DISTANCE FOR BLUETOOTH RECEIVE SIGNAL (m)	TIME TAKEN TO CONNECT (s)
1	2	1	20.25
2	2	2	18.34
3	2	3	16.12
4	2	4	10.42
5	2	5	12.23
6	2	6	14.36
7	2	7	18.26
8	2	8	20.45
9	2	9	24.21
10	2	10	25.01

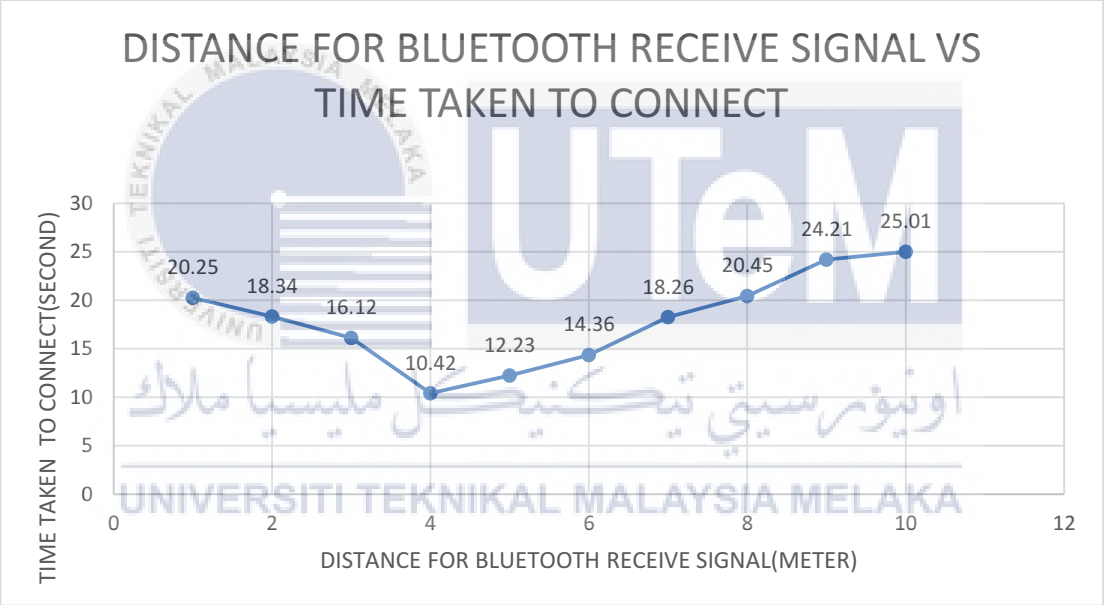

Figure 4.14 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 2

Table 4.2 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 2. Measure the time taken to connect by using stopwatch. Besides, measure distance for Bluetooth receive signal by using meter ruler. Figure 4.14 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 2. In 4-meter distance, it reacts the lowest time taken to connect which is 10.42 seconds. In 1 meter distance, it takes 20.25

`

seconds to connect. In 10-meter distance, it reacts the highest time taken to connect which is 25.01 seconds. In this graph, maximum distance for Bluetooth receive signal is 10 meters. Besides, from this graph also we can obtain time taken for Bluetooth to connect is between 10 to 26 seconds.

Third Attempt

Table 4.3 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 3

N0	NUMBER OF ATTEMPT	DISTANCE FOR BLUETOOTH RECEIVE SIGNAL (m)	TIME TAKEN TO CONNECT (s)
1	3	1	20.45
2	3	2	18.53
3	3	3	16.31
4	3	4	10.59
5	3	5	12.51
6	3	6	14.55
7	3	7	18.43
8	3	8	20.57
9	3	9	24.40
10	3	10	26.03

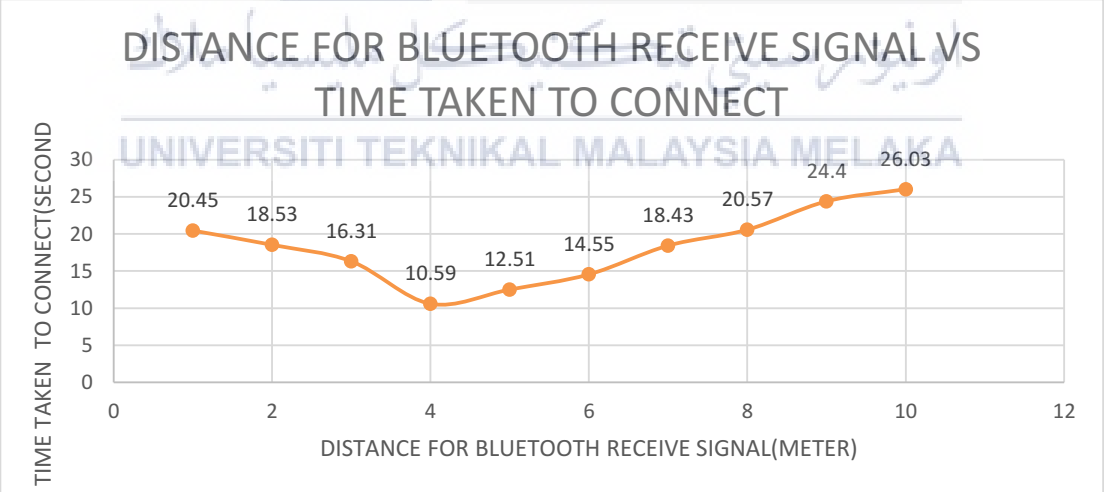

Figure 4.15 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 3

Table 4.3 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 3. Measure the time taken to connect by using stopwatch. Besides, measure distance

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for Bluetooth receive signal by using meter ruler. Figure 4.15 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 3. In 4-meter distance, it reacts the lowest time taken to connect which is 10.59 seconds. In 1 meter distance, it takes 20.45 seconds to connect. In 10-meter distance, it reacts the highest time taken to connect which is 26.03 seconds. In this graph, maximum distance for Bluetooth receive signal is 10 meters. Besides, from this graph also we can obtain time taken for Bluetooth to connect is between 10.5 to 26.5 seconds.

Four Attempt

Table 4.4 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 4

N0	NUMBER OF ATTEMPT	DISTANCE FOR BLUETOOTH RECEIVE SIGNAL (m)	TIME TAKEN TO CONNECT (s)
1	4	1	20.31
2	4	2	18.42
3	4	3	16.23
4	4	4	10.49
5	4	5	12.35
6	4	6	14.49
7	4	7	18.38
8	4	8	20.59
9	4	9	24.33
10	4	10	25.54

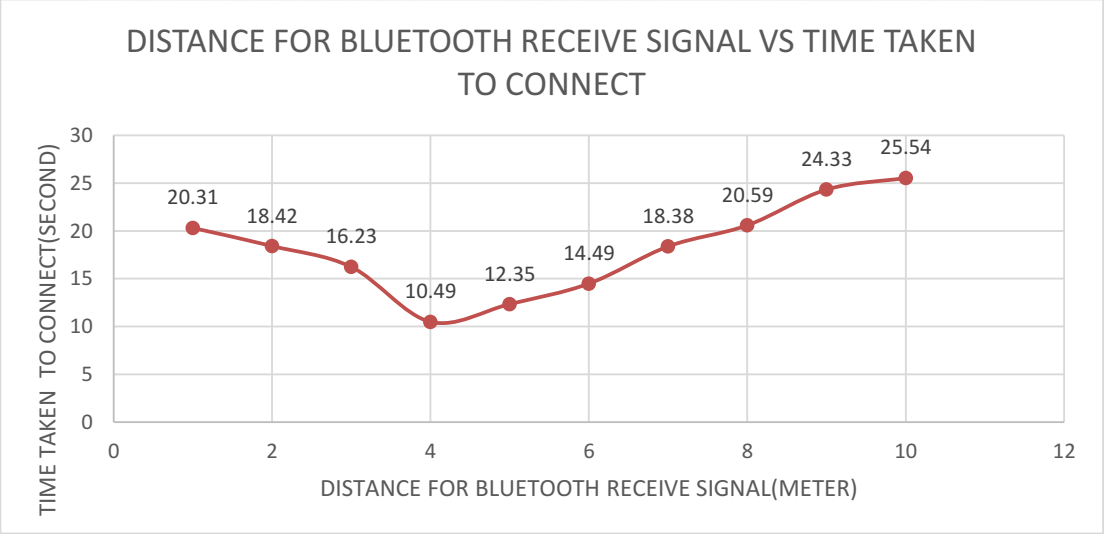

Figure 4.16 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 4

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Table 4.4 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 4. Measure the time taken to connect by using stopwatch. Besides, measure distance for Bluetooth receive signal by using meter ruler. Figure 4.16 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 4. In 4-meter distance, it reacts the lowest time taken to connect which is 10.49 seconds. In 1 meter distance, it takes 20.31 seconds to connect. In 10-meter distance, it reacts the highest time taken to connect which is 25.54 seconds. In this graph, maximum distance for Bluetooth receive signal is 10 meters. Besides, from this graph also we can obtain time taken for Bluetooth to connect is between 10.5 to 26 seconds.

Five Attempt

Table 4.5 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 5

N0	NUMBER OF ATTEMPT	DISTANCE FOR BLUETOOTH RECEIVE SIGNAL (m)	TIME TAKEN TO CONNECT (s)
1	5	1	20.42
2	5	2	18.54
3	5	3	16.35
4	5	4	10.58
5	5	5	12.44
6	5	6	14.58
7	5	7	18.48
8	5	8	20.53
9	5	9	24.45
10	5	10	25.46

`

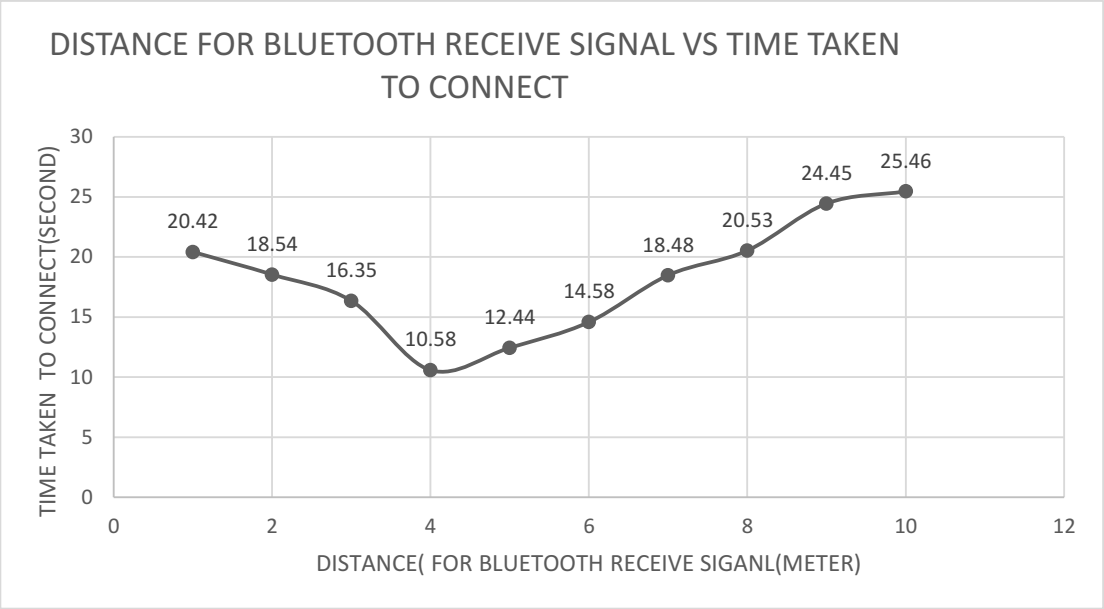

Figure 4.17 Distance for Bluetooth Receive Signal VS Time Taken to connect in Attempt 5

Table 4.5 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 5. Measure the time taken to connect by using stopwatch. Besides, measure distance for Bluetooth receive signal by using meter ruler. Figure 4.5 shows distance for Bluetooth Receive Signal vs Time Taken to connect in Attempt 5. In 4-meter distance, it reacts the lowest time taken to connect which is 10.58 seconds. In 1 meter distance, it takes 20.42 seconds to connect. In 10-meter distance, it reacts the highest time taken to connect which is 25.54 seconds. In this graph, maximum distance for Bluetooth receive signal is 10 meters. Besides, from this graph also we can obtain time taken for Bluetooth to connect is between 11 to 26 meters.

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4.5.2 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

First Attempt

Table 4.6 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

NO	NUMBER OF ATTEMPT	DISTANCE BETWEEN PIR SENSOR AND OBJECT(m)	TIME TAKEN For PIR SENSOR TO REACT (s)
1	1	0.5	5.42
2	1	1.0	5.41
3	1	1.5	5.43
4	1	2.0	5.40
5	1	2.5	5.47
6	1	3.0	5.45
7	1	3.5	5.47
8	1	4.0	5.50
9	1	4.5	5.55
10	1	5.0	5.55

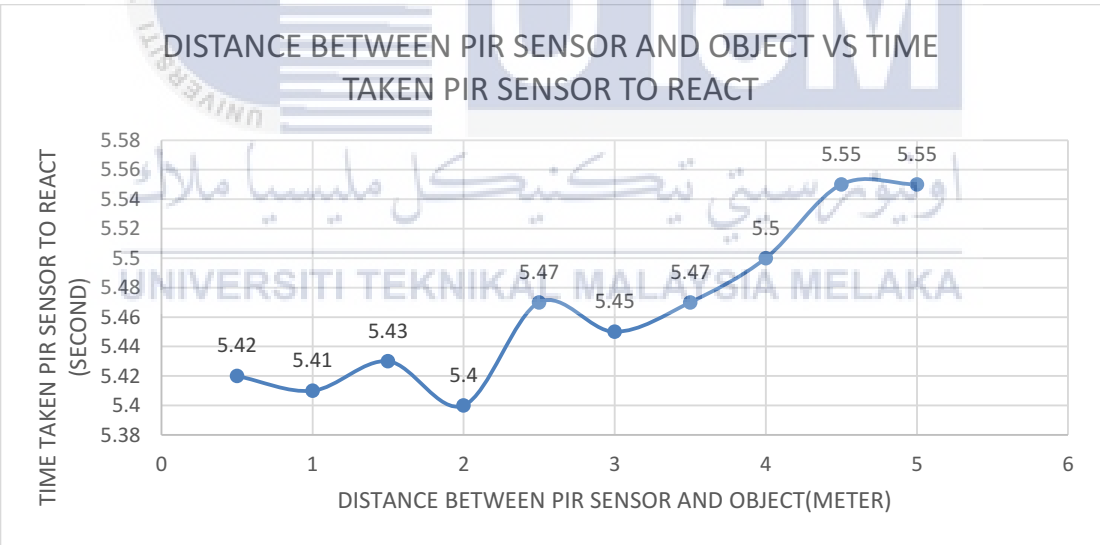

Figure 4.18 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

Table 4.6 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 1. Measure the time for PIR Sensor to react by using stopwatch. Besides, measure distance between PIR sensor and object by using meter ruler. Figure 4.6 shows

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distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 1. In 2 meter distance, it react the lowest time taken to connect which is 5.4 seconds. The highest time taken for PIR sensor to react which is 5.55seconds. Start from 4.5-meter distance, PIR reach the peak time taken for PIR sensor to react. In this graph, we can obtain PIR sensor need 5 to 6 seconds to react.

Second Attempt

Table 4.7 Distance Between PIR Sensor And Object vs Time Taken For PIR Sensor To React

NO	NUMBER OF ATTEMPT	DISTANCE BETWEEN PIR SENSOR AND OBJECT(m)	TIME TAKEN For PIR SENSOR TO REACT (s)
1	2	0.5	5.32
2	2	1.0	5.31
3	2	1.5	5.33
4	2	2.0	5.30
5	2	2.5	5.37
6	2	3.0	5.35
7	2	3.5	5.37
8	2	4.0	5.40
9	2	4.5	5.45
10	2	5.0	5.45

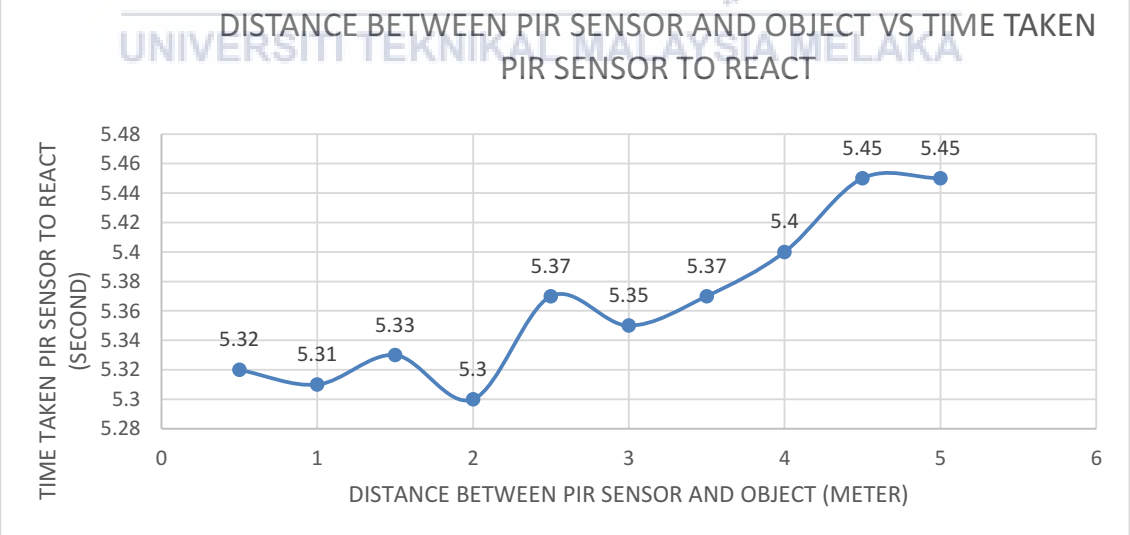

Figure 4.19 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

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Table 4.7 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 2. Measure the time for PIR Sensor to react by using stopwatch. Besides, measure distance between PIR sensor and object by using meter ruler. Figure 4.7 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 2. In 2-meter distance, it reacts the lowest time taken to connect which is 5.3 seconds. The highest time taken for PIR sensor to react which is 5.55seconds. Start from 4.5-meter distance, PIR reach the peak time taken for PIR sensor to react. In this graph, we can obtain PIR sensor need 5 to 6 seconds to react.

Third Attempt

Table 4.8 Distance Between PIR Sensor and Object vs Time Taken for PIR Sensor to React

NO	NUMBER OF ATTEMPT	DISTANCE BETWEEN PIR SENSOR AND OBJECT(m)	TIME TAKEN For PIR SENSOR TO REACT (s)
1	3	0.5	5.42
2	3	1.0	5.41
3	3	1.5	5.43
4	3	2.0	5.40
5	3	2.5	5.47
6	3	3.0	5.45
7	3	3.5	5.47
8	3	4.0	5.50
9	3	4.5	5.65
10	3	5.0	5.65

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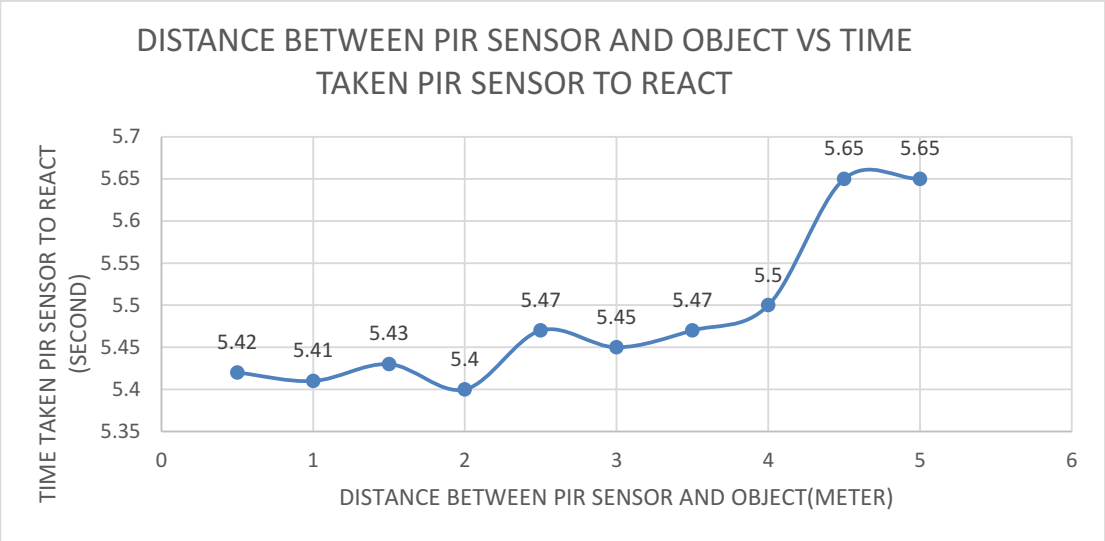

Figure 4.20 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

Table 4.8 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 3. Measure the time for PIR Sensor to react by using stopwatch. Besides, measure distance between PIR sensor and object by using meter ruler. Figure 4.8 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 3. In 2-meter distance, it reacts the lowest time taken to connect which is 5.4 seconds. The highest time taken for PIR sensor to react which is 5.65seconds. Start from 4.5-meter distance, PIR reach the peak time taken for PIR sensor to react. In this graph, we can obtain PIR sensor need 5 to 6 seconds to react.

`

Four Attempt

Table 4.9 Distance Between PIR Sensor and Object vs Time Taken for PIR Sensor To React

NO	NUMBER OF ATTEMPT	DISTANCE BETWEEN PIR SENSOR AND OBJECT(m)	TIME TAKEN For PIR SENSOR TO REACT (s)
1	4	0.5	5.52
2	4	1.0	5.51
3	4	1.5	5.53
4	4	2.0	5.50
5	4	2.5	5.57
6	4	3.0	5.55
7	4	3.5	5.57
8	4	4.0	5.65
9	4	4.5	5.70
10	4	5.0	5.70

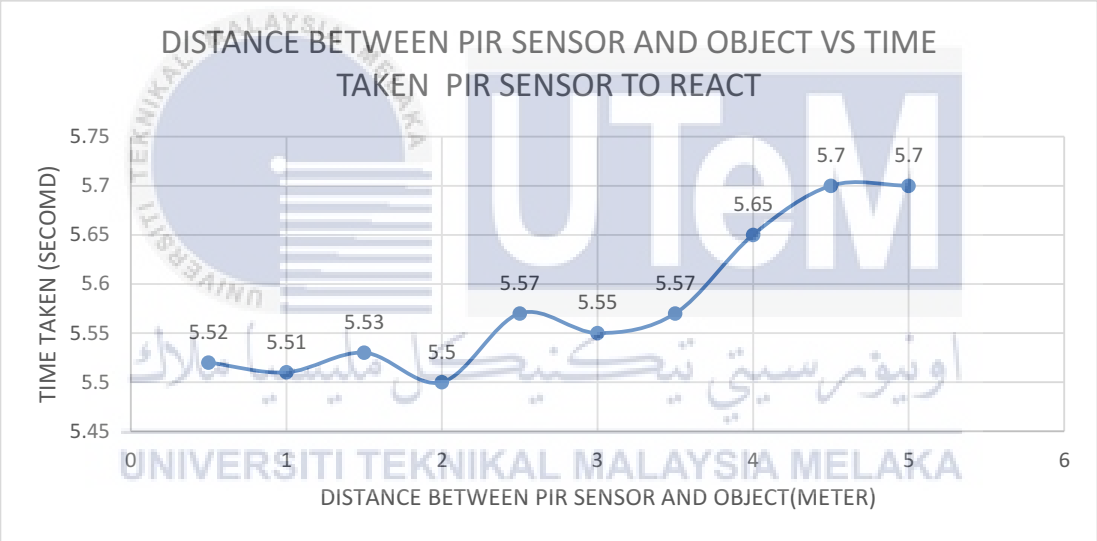

Figure 4.21 Distance Between PIR Sensor and Object vs Time Taken for PIR Sensor To React

Table 4.9 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 4. Measure the time for PIR Sensor to react by using stopwatch. Besides, measure distance between PIR sensor and object by using meter ruler. Figure 4.9 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 3. In 2-meter distance, it reacts the lowest time taken to connect which is 5.5 seconds. The highest time taken for PIR sensor to react which is 5.7seconds. Start from 4.5-meter distance,

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PIR reach the peak time taken for PIR sensor to react. In this graph, we can obtain PIR sensor need 5 to 6 seconds to react.

Five Attempt

Table 4.10 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

NO	NUMBER OF ATTEMPT	DISTANCE BETWEEN PIR SENSOR AND OBJECT(m)	TIME TAKEN For PIR SENSOR TO REACT (s)
1	5	0.5	5.47
2	5	1.0	5.46
3	5	1.5	5.49
4	5	2.0	5.45
5	5	2.5	5.51
6	5	3.0	5.50
7	5	3.5	5.52
8	5	4.0	5.55
9	5	4.5	5.60
10	5	5.0	5.60

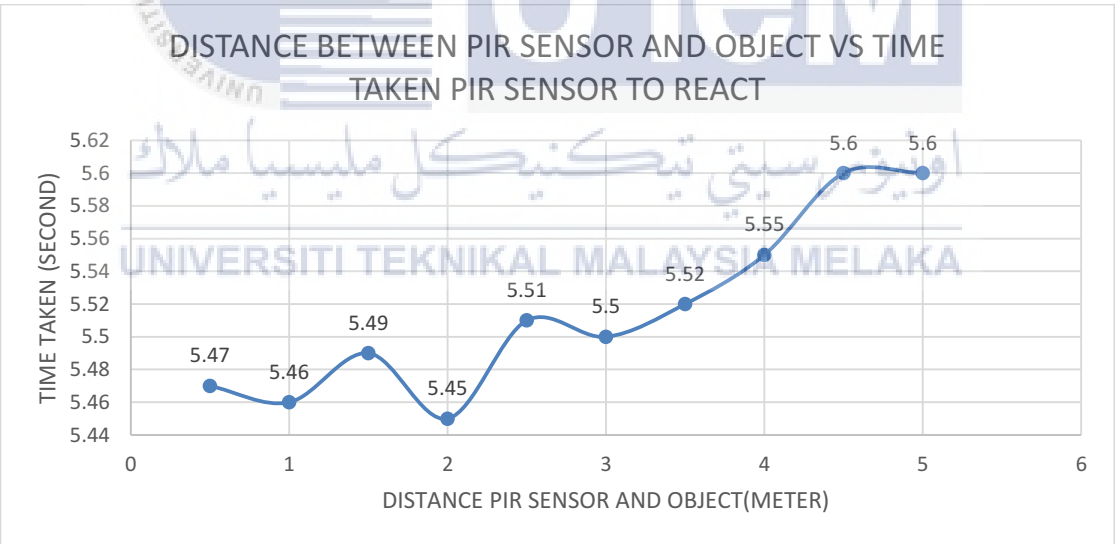

Figure 4.22 Distance Between PIR Sensor and Object vs Time Taken For PIR Sensor To React

Table 4.10 shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 5. Measure the time for PIR Sensor to react by using stopwatch. Besides, measure distance between PIR sensor and object by using meter ruler. Figure 4.10

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shows distance between PIR sensor and object vs Time Taken for PIR sensor to react in Attempt 3. In 2-meter distance, it reacts the lowest time taken to connect which is 54.5 seconds. The highest time taken for PIR sensor to react which is 5.6seconds. Start from 4.5-meter distance, PIR reach the peak time taken for PIR sensor to react. In this graph, we can obtain PIR sensor need 5 to 6 seconds to react.

4.6 Summary

To conclude, this chapter is discussing about the phone application, hardware design and preliminary result. Besides, this chapter also discuss about analysis distance for Bluetooth receive signal vs time taken to connect. Furthermore, this chapter also discuss the distance between PIR Sensor and object vs time taken for PIR Sensor to React.

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter discussed the conclusion that obtained from this project. Besides, this chapter also explain the recommendation for the project future development to improve the development of smart home.

5.2 Conclusion

In conclusion, the field of Home Automation is a very important field that is growing quickly. In this project, Bluetooth serial controller app are used. The Bluetooth controller apply to allow the user to control the fan, lamp, and gate. Moreover, PIR sensor are used to open gate. When PIR sensor detect any motion, the door will open. The main purpose of this project is to integrate the system with mobile application through Bluetooth. Last but not least, develop a home automation system implemented with Bluetooth to control home appliances are achieved successfully. This system might be beneficial to elderly and handicapped on their daily task at home

5.3 Recommendation

Based on this project, the recommendation to improves this project is by apply security in the smart home. Besides, smart home can be improved by add on voice recognition.

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`

APPENDICES

Appendix A Coding

```
/*
 * Program: BT_Home_Auto_R1.ino
 * System controls lights and fan via bluetooth interface.
 * The PIR sensor opens the door on detecting motion.
 * .
 */

#include <SoftwareSerial.h>    // Software serial library for HC05
#include <VarSpeedServo.h>     // Servo library

#define btTX        3    // HC05 Tx pin
#define btRX        2    // HC05 Rx pin

#define ledBT       A4   // BT Receive indicator YEL
#define ledPIR      6

#define serPin      4    // Servo pin output
#define lampHall    A0   // Relay control pins
#define lampRoom1   A1
#define lampRoom2   A2
#define fanHall     A3
```

```
#define senPIR      7    // PIR sensor input

char BTdata   = '0';     // Bluetooth data received
int openDoor  = 20;      // Door open angle
int closeDoor = 145;     // Door close angle
int pirValue;
bool pirActive = false;  // PIR active status, false = not active

SoftwareSerial HC05(btTX, btRX);  // HC05 object with pin assignment
VarSpeedServo servoDoor;          // Feeder servo object

void setup() {
  HC05.begin(9600);               // Initialise HC05 com
  pinMode(ledBT, OUTPUT);
  pinMode(ledPIR, OUTPUT);
  pinMode(lampHall, OUTPUT);
  pinMode(lampRoom1, OUTPUT);
  pinMode(lampRoom2, OUTPUT);
  pinMode(fanHall, OUTPUT);
  pinMode(senPIR, INPUT);

```

`

```
43   digitalWrite(lampHall, HIGH);  // Turn OFF all relays
44   digitalWrite(lampRoom1, HIGH);
45   digitalWrite(lampRoom2, HIGH);
46   digitalWrite(fanHall, HIGH);
47
48   servoDoor.attach(serPin);       // Connect servo to pin
49   servoDoor.write(closeDoor, 200, false);
50 }
51
52 void loop() {
53   // PIR sensor routine
54   if(pirActive == true){
55     pirValue = digitalRead(senPIR);
56     if(pirValue){        // PIR detects motion
57       digitalWrite(ledPIR, HIGH);
58       servoDoor.write(openDoor, 150, false);  // Move angle 10, speed, no wait
59       delay(500);
60     }else{
61       servoDoor.write(closeDoor, 150, false);
62       delay(500);
63       digitalWrite(ledPIR, LOW);
```

```
64     }
65   }
66
67   // Bluetooth data reception routine
68   if (HC05.available()> 0)  {     // BT data available
69     BTdata = HC05.read();         // Read BT data
70     digitalWrite(ledBT, HIGH);    // Blink Data received LED
71     delay(50);
72     digitalWrite(ledBT, LOW);
73
74     // Actions based on BT data received
75     switch (BTdata) {
76       case '3':             // Hall lamp on/off
77         digitalWrite(lampHall, !digitalRead(lampHall));
78         if(digitalRead(lampHall)){
79           HC05.print("Hall Lamp OFF");
80         }else{
81           HC05.print("Hall Lamp ON");
82         }
83         break;
84       case '2':             // Room 1 lamp on/off
```

`

```
85          digitalWrite(lampRoom1, !digitalRead(lampRoom1));
86          if(digitalRead(lampRoom1)){
87            HC05.print("Room 1 Lamp OFF");
88          }else{
89            HC05.print("Room 1 Lamp ON");
90          }
91          break;
92        case '1':              // Room 2 lamp on/off
93          digitalWrite(lampRoom2, !digitalRead(lampRoom2));
94          if(digitalRead(lampRoom2)){
95            HC05.print("Room 2 Lamp OFF");
96          }else{
97            HC05.print("Room 2 Lamp ON");
98          }
99          break;
100       case '0':              // Hall fan on/off
101         digitalWrite(fanHall, !digitalRead(fanHall));
102         if(digitalRead(fanHall)){
103           HC05.print("Hall Fan OFF");
104         }else{
105           HC05.print("Hall Fan ON");
```

```
106       }
107       break;
108     case '4':              // Turn off all devices
109       digitalWrite(lampHall, HIGH);  // Turn OFF all relays
110       digitalWrite(lampRoom1, HIGH);
111       digitalWrite(lampRoom2, HIGH);
112       digitalWrite(fanHall, HIGH);
113       HC05.print("--- All OFF ---");
114       break;
115     case '5':              // Turn off all devices
116       digitalWrite(lampHall, LOW);  // Turn ON all relays
117       digitalWrite(lampRoom1, LOW);
118       digitalWrite(lampRoom2, LOW);
119       digitalWrite(fanHall, LOW);
120       HC05.print("--- All ON ---");
121       break;
122     case '6':              // Open the main door
123       HC05.print("--- Door Open ---");
124       servoDoor.write(openDoor, 200, false);  // Move angle 10, speed, no wait
125       delay(200);
126       break;
```

```
127       case '7':             // Close the main door
128         HC05.print("--- Door Close ---");
129         servoDoor.write(closeDoor, 200, false);
130         delay(200);
131         break;
132       case '8':             // Disable PIR
133         HC05.print("--- Disable PIR ---");
134         if(pirActive == true){
135           pirActive = false;
136         }else{
137           pirActive = true;
138         }
139         delay(200);
140         break;
141     }
142   }
143 }
144
145 void doorGuard(){
146   servoDoor.write(openDoor, 255, false);  // Move angle 10, speed, no wait
147   delay(200);
```

```
148   servoDoor.write(closeDoor, 255, false);
149   delay(200);
150 }
```