Faculty of Electrical and Electronic Engineering Technology

PASSWORD BASE CIRCUIT BREAKER WITH IOT IMPLEMENTATION

IKRAM HAMZAH BIN RAJ MOHAMED

Bachelor of Technology in Electronic Industrial Automation with Honours

2023

PASSWORD BASE CIRCUIT BREAKER WITH IOT IMPLEMENTATION

IKRAM HAMZAH BIN RAJ MOHAMED

A project report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Technology in Electronic Industrial Automation with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this project report entitled “Password Base Circuit Breaker With IOT Implementation” 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 the candidature of any other degree.

Signature : *Hamzah*

Student Name : Ikram Hamzah Bin Raj Mohamed

Date : 23/12/2022

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 Electrical Engineering Technology with Honours.

Signature :

Supervisor Name : Puan Emy Zairah Binti Ahmad

Date : 13 JANUARY 2023

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

First and foremost, I would like to express my gratitude to my supervisor, Puan Nur Bahirah and my second supervisor, Puan Emy Zairah Binti Ahmad for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my family for the financial support throughout the whole semester which enables me to accomplish the project. Not forgetting my colleague, Mr Jaiswaraan and Mr Thinesh for their willingness of sharing their 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. An honourable mention also goes to Puan Emy Zairah Binti Ahmad for all the motivation and understanding. And to my friends, thanks for the ideas and support given to me.

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

ABSTRACT

This project is developed with the main purpose of avoiding power wastage and accidents that mainly happens in the household due to power outlets. This device also can help in case of fire or an emergency, the user could easily turn off the power flow to the household and save the damage that has been done from being worse. What can be done by users when they have forgotten to turn on or off the switches before leaving the house? How can a user determine and double-check the conditions of the power supply in the house while being away from home? The proposed project helps users to determine the conditions of the power supply in their household and if there is anything wrong it could also help them to easily turn on or off their switch. This may help users to save their energy consumption in the household while avoiding serious injuries and accidents. This project also may help users to turn on or off any power outlets in their household while being in an entirely different place. This project is built as a prototype for household usage, the plan for the project is so that it could be used in every industrial area, which is far more important because some of them are working in a high voltage area which causes many accidents due to communication problems. This accident can be avoided when users can monitor and control the condition of the switch while being away by only tapping on their phones. For further recommendations, this project can be improvised for security purposes and monitoring applications.

ABSTRAK

Projek ini dibangunkan dengan tujuan utama untuk mengelakkan pembaziran kuasa dan kemalangan yang kebanyakannya berlaku dalam isi rumah akibat saluran keluar elektrik. Peranti ini juga boleh membantu sekiranya berlaku kebakaran atau kecemasan, pengguna boleh mematikan aliran kuasa ke isi rumah dengan mudah dan menyelamatkan kerosakan yang telah berlaku daripada menjadi lebih teruk. Apakah yang boleh dilakukan oleh pengguna apabila mereka terlupa untuk menghidupkan atau mematikan suis sebelum meninggalkan rumah? Bagaimanakah pengguna boleh menentukan dan menyemak semula keadaan bekalan kuasa di dalam rumah semasa berada jauh dari rumah? Projek yang dicadangkan membantu pengguna untuk menentukan keadaan bekalan kuasa dalam rumah mereka dan jika terdapat apa-apa yang salah ia juga boleh membantu mereka menghidupkan atau mematikan suis mereka dengan mudah. Ini boleh membantu pengguna menjimatkan penggunaan tenaga mereka dalam isi rumah sambil mengelakkan kecederaan serius dan kemalangan. Projek ini juga boleh membantu pengguna untuk menghidupkan atau mematikan mana-mana soket kuasa dalam rumah mereka semasa berada di tempat yang sama sekali berbeza. Projek ini dibina sebagai prototaip untuk kegunaan isi rumah, perancangan projek adalah supaya ia dapat digunakan di setiap kawasan perindustrian, yang jauh lebih penting kerana ada di antara mereka yang bekerja di kawasan voltan tinggi yang menyebabkan banyak kemalangan akibat masalah komunikasi. Kemalangan ini boleh dielakkan apabila pengguna boleh memantau dan mengawal keadaan suis semasa berada jauh dengan hanya mengetik telefon mereka. Untuk cadangan lanjut, projek ini boleh ditambah baik untuk tujuan keselamatan dan aplikasi pemantauan.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Puan Nur Bahirah and my second supervisor, Puan Emy Zairah Binti Ahmad for their precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my family for the financial support throughout the whole semester which enables me to accomplish the project. Not forgetting my colleague, Mr Jaiswaraan and Mr Thinesh for their willingness of sharing their 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. An honourable mention also goes to Puan Emy Zairah Binti Ahmad for all the motivation and understanding. And to my friends, thanks for the ideas and support given to me.

Finally, I would like to thank all the staff at the FTKEE, colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being cooperative and helpful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

LIST OF ABBREVIATIONS

OCPD	Over Current Protective Device
TNB	Tenaga Nasional Berhad
CCTV	Closed-Circuit Television
ACB	Air circuit breaker
SF6	Sulphur hexafluoride
MCB	Miniature circuit breaker
MCCB	Moulded case circuit breaker
PCB	Printed circuit board
IDE	Integrated development environment

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Electrical appliances are the most common and one of the most basic needs in a household or industry. Every electrical appliance is connected to the switches and plugs which are connected to the distribution board which is controlled by the circuit breaker. A circuit breaker is an electrical safety device that protects electrical appliances or apparatus from overcurrent or short-circuits damage [1]. The primary purpose is to block the current flow to protect and save the equipment while avoiding the risk of fire. Unlike the function of a fuse which can only be used once and has the need to change, a circuit breaker can be easily reset for it to return to its normal operation. Other than that, circuit breaker also comes in a variety of sizes which is identified by where it is being used. Small devices safeguard low current circuits such as single household appliances. Huge switch gears protect high-voltage circuits that can be used to feed the entire city. OCPD (Over Current Protective Device) is a common abbreviation for the generic function of a circuit breaker or fuse as an automatic mechanism for eliminating power from a defective system.

Unfortunately, the circuit breaker that is attached can't be plugged out by a normal person without the qualifications and the cert needed. Only TNB personnel is allowed to replace, plug out and plug in the circuit breaker as even if the circuit breaker is broken it would be replaced also by TNB personnel. Other than that, even if the user is away for a long period, they are still not allowed to plug out the circuit breaker as it will be encountered as going

against the law. However, the homeowners tend to forget about things at times. It is normal to forget about things but when it comes to appliances it also comes with a great risk and a terrible outcome. That is why users must always double-check before leaving the house but still, users do tend to forget, that is why a solution has come up with an idea on how to resolve the issues regarding leaving the house safely without the need to worry about whether have users have turned off the switches or not yet.

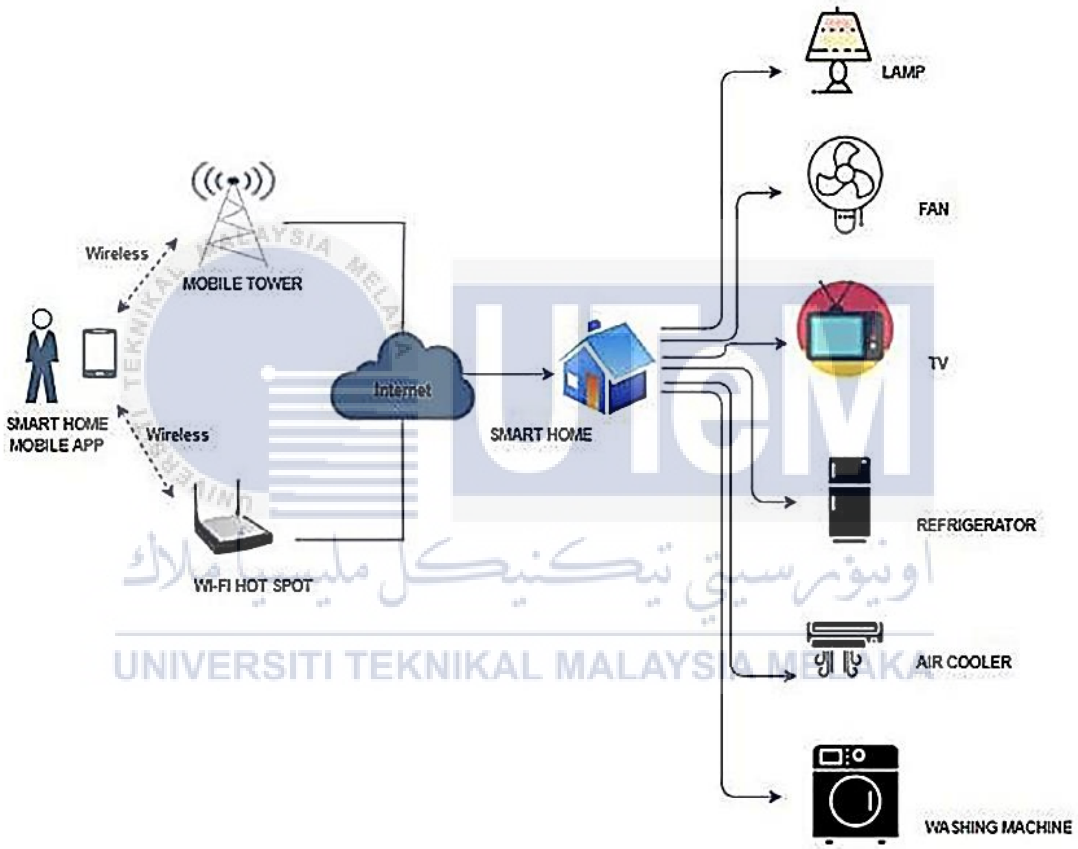


Figure 1.1 The principle layout of the developed project

The proposed project is illustrated in Figure **1.1**. The main focus of this project is to help homeowners to overcome the problem discusses earlier. The systsem is developed by connecting the circuit breaker to the ESP 32 IoT device which will turn the electrical supply on or off through/via mobile phones. The device will be placed before the position of the circuit breaker. These devices are controlled through our mobile phones using the application

of Blynk. Blynk application software is an application that is installed in smartphones through Playstore or Appstore applications. Blynk application acts as the switch control for the device installed in a household. All of the controlling is done through the Blynk application which includes turning on, turning off and password insertion for the device that is installed [2].

The proposed device is called a password-based circuit breaker, which has the main function of controlling the current flow to the circuit with the aid of a keypad in the Blynk application. It can help users to turn on and turn off the current flow without the need to turn off the circuit breaker manually. It is much easier and more trustworthy to see for ourselves and reduces the time that users need to take out to check all the outlets and switches in the house one by one. It is also an advanced way and more efficient way to control the power flow [3].

1.2 Problem Statement

One of the most important issues that users have been facing nowadays in daily life is whether they have unplugged all of the electrical appliances when users leave home. Sometimes users tend to leave the house in a hurry which makes them worry about that have they turned off all the switches before leaving the house or did they miss any. These worries can get carried away and distract users from working mainly if it involves main switches such as the iron or the induction stove or other big equipment which not only will cost users their bills it also may cost them serious accidents such as fires and explosions.

How do users confirm the condition of the switches for whether it is turned on or off? Users often double-check their household situations when they leave the house, but in case they were out stationed or not returning to their houses users might have second thoughts on the conditions of their house conditions, so how do they check and make sure that they are in safe conditions?

Some equipment in the household is only turned on when necessary and on important occasions, such as the CCTV and the alarm system. Although it is mainly fixed to be on at all times, some of the users do not on it at all times. It is because alarm systems are very sensitive, even a little movement will trigger its sensors and trigger the alarm. Often time, it makes the system to be a little bit tiring to reset it every time the alarm triggers. On the other hand, the recording from the CCTV is stored in a hard drive which needs to be cleared every month because if the storage is full then the recording will not be stored and making the CCTV to be functionless even when we have the device installed. So how do users make sure that they have turned their important switches on before leaving their houses?

1.3 Project Objective

The main goal of this project is to offer an organized and operative methodology on how to maintain a good electrical supply to users' households with the implementation of an IoT system which enables the users to control them by using their smartphones. The objectives are as follows:

I. To design and simulate a password-based circuit breaker system using Proteus Simulation Software.

II. To develop the prototype for the designed circuit breaker.

III. To analyze the developed system under various operating conditions.

1.4 Scope of Project

The scope of this project are as follows:

I. To achieve objective 1, the proposed circuit was simulated using Proteus Simulation software. The software was chosen due to its versatility of having almost all of the animated components and microprocessors to facilitate a complete microcontroller-based design.

II. Next is to achieve objective 2, a prototype design was built to perform the testing of the idea that was simulated into hardware design. This is to ensure that the idea was reliable as well as the hardware components are working exactly as planned and producing the desired output.

III. Lastly for achieving objective 3, the system was developed to be widely used and used anytime or anywhere. To achieve this, the system is tested in multiple locations to find out the effectiveness and reliability of the system despite the time and location where it will be used.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this modern era, energy proficiency is branded as a key stratagem to address rising issues in climate change and the energy crisis [4]. Circuit breakers remain some of the main components in a household that needs to be put greater emphasis on to find ways to reduce electrical accidents and wastage. For premeditated planning and development of an energy efficiency distribution network, technologist needs to come up with an operative methodology that works correctly and efficiently to produce a circuit breaker which has safety measurements that vary in many steps and counts [5]. It should also be properly planned and executed in an effective and timely manner.

Password-based circuit breaker aims to provide safety measures for energy flow in a household. A traditional circuit breaker is usually operated in manual mode configurations which turns on when the circuit breaker switch is pulled up and turns off when the circuit breaker switch is pulled down. The circuit breakers are typically categorized by their: (i) voltage level and (ii) the number of phases. Circuit breakers are distributed all over different supply zones. therefore, they are extensive in numbers [6].

2.2 Circuit Breakers

A circuit breaker is one of the most essential parts of an electrical distribution system, it is used everywhere in every electrical system that is created. It is because each of the circuit breakers that are fixed has its current ratings and sizes which determines where would the

circuit breaker be placed and how it is placed. The main priority of a circuit breaker is to stop or flow current through it. Even a small detection of overcurrent or leakage of current will make the circuit breaker to trip and cut the current flowing through it, that is why every electrical device that is fixed to either a household or industrial place comes with a circuit breaker.

2.3 Types of Circuit Breakers

Various types of circuit breakers were designed so that they will best suit the place it is being fixed to. There are many types of circuit breakers as illustrated in Figure **2.1**. Every residential, commercial and industrial building needs to have circuit breakers so that their electrical components and devices are protected. Typical classifications of circuit breakers are oil circuit breakers, air circuit breakers, SF6 circuit breakers, and vacuum circuit breakers [7].

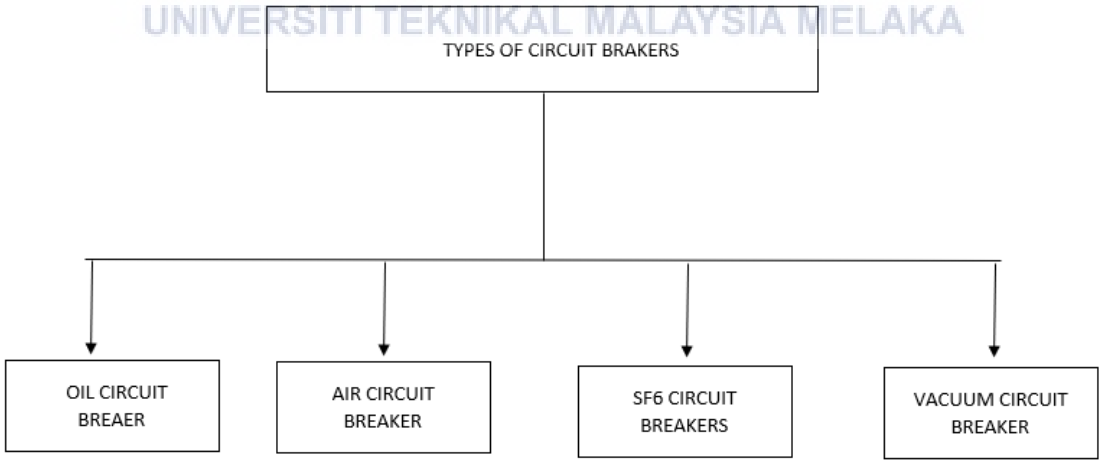


Figure 2.1 Classification of Circuit Breaker

2.3.1 Oil Circuit Breaker

Oil circuit breakers are the category of high voltage circuit breakers used in the transmission of electrical energy which makes use of oil for the extinguishing of arc during the separation of the breaker contact. Mineral oil is a more efficient circuit breaker than air. The fixed and movable contacts of an oil circuit breaker are immersed fully in the insulating oil, as shown in Figure **2.2** [8].

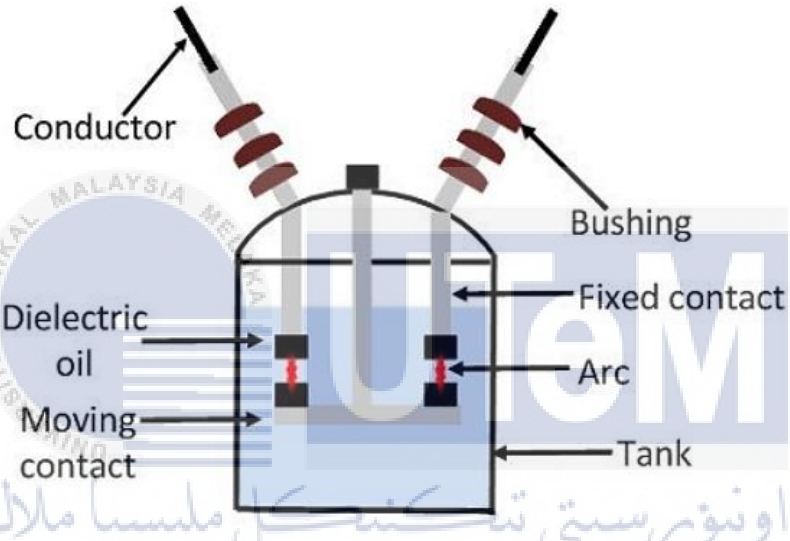


Figure 2.2 Oil circuit breaker (Circuit globe 2019)

When the current carries, contact in the oil separates, and the circuit breaker is activated while the oil is vaporized and degraded which is mainly into hydrogen gas which will eventually form a hydrogen bubble surrounding the arc. After the current reaches zero crossing of the cycle, this highly compressed gas bubble around the arc stops the arc from re-striking. This is also one of the oldest types of a circuit breakers. The ratings of oil circuit breakers range from 25 MVA at 2.5 kV to 5000 MVA at 230 kV while they are applied for a voltage range of 33 kV to 220 kV and breaking capacities of 1500 MVA to 7500 MVA.

2.3.2 Air Circuit Breaker

Air circuit breakers are at the top of the hierarchy when we consider low voltage (LV) protective devices that include miniature circuit breakers (MCB), moulded case circuit breakers (MCCB) and fuses [9]. ACBs are available for operation at 800A to 6300A and have breaking capacity from 50kA to 150kA. As they are low voltage protective devices, the maximum rated voltage is 1000Vac or 1500Vdc.

Figure 2.3 Air circuit Breaker (Circuit Globe 2019)

As shown in Figure 2.3, It's an air-operated electrical switch that protects an electrical circuit from harm caused by excessive current induced by an overload or short circuit. Its main purpose is to interrupt current flow once a fault has been discovered. An arc will develop between the contacts that have disrupted the circuit when this happens. To blow out the arc, an air circuit breaker employs compressed air, or the contacts are rapidly swung into a small, sealed chamber, causing the displaced air to escape, thereby blowing out the arc.

2.3.3 Sulphur Hexafluoride (SF6) Circuit Breaker

The sulphur hexafluoride (SF6) circuit breaker uses the SF6 gas as the arc quenching medium. The insulating properties of SF6 gas are excellent, and it has a strong electronegativity that makes it far superior properties than oil and air. This type of circuit breaker is normally applied in high voltage up to 800 kV.

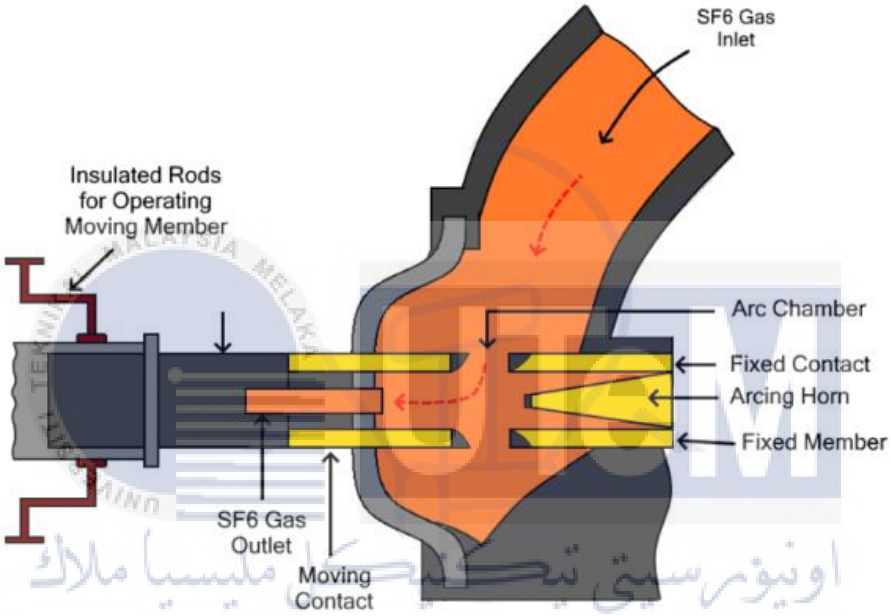


Figure 2.4 SF6 Circuit Breaker (Huo 2020)

As shown in Figure **2.4**, it absorbs electrons and forms negative ions as a result. Two different reactions can occur when an electron attaches to SF6 molecules. Since ions are substantially heavier than free ions, the total mobility of charged particles in SF6 gas is much lower than in other common gases. Furthermore, not only does gas have a high dielectric strength, but it also has the unique virtue of quick recombination once the arc is gone, as well as rapid heat transfer [10].

2.3.4 Vacuum Circuit Breaker

A vacuum circuit breaker is one in which the arc quenching takes take place in a vacuum. The vacuum switching technology has taken almost 100 years to rule the switching equipment, which was based on quenching media such as oils, air, and SF6 [11]. However, it requires high level of fabricating procedures and costly.

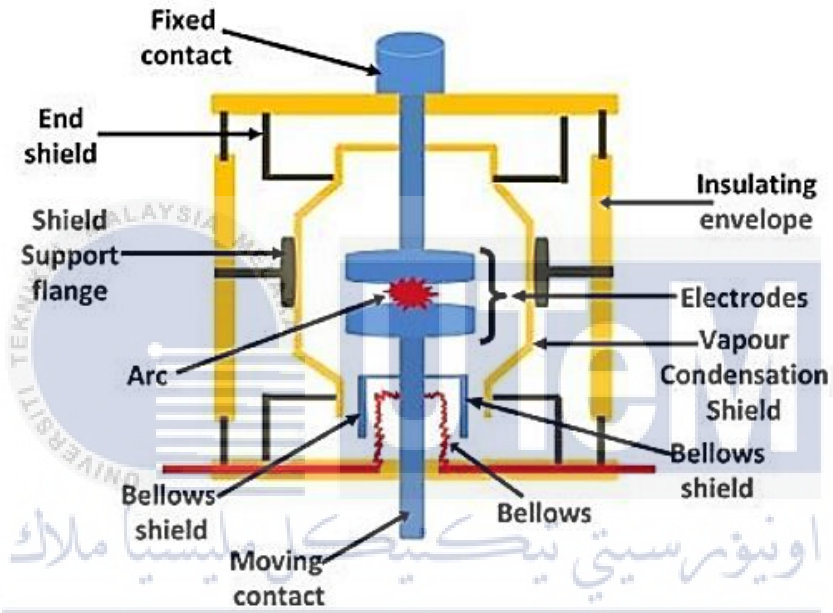


Figure 2.5 A Vacuum Circuit Breaker (circuit globe 2019)

As shown in Figure 2.5, vacuum technology for greater voltages has been developed. However, it is not commercially practical for low to medium voltage applications. In a vacuum chamber in the breaker termed a vacuum interrupter, the operation of opening and shutting current-carrying contacts and related arc interruption takes place. The vacuum interrupter is made up of a steal arc chamber and symmetrically distributed ceramic insulators in the centre [12].

2.4 Password Base Circuit Breaker

A password-based circuit breaker refers to a system in which a password or passcode is required to reset or deactivate a circuit breaker. This can be used as an added security measure to prevent unauthorized access or tampering with the electrical system. The circuit breaker will only be reset or deactivated once the correct password has been entered.

Previous researchers have examined may aspects on the implementation of password-based generated system for various applications including, network security, energy, and etc [13]–[15]. Passwords are mainly used for privacy and safety purposes, in this project, it is the main priority is to provide safety for users. The password is coded using Arduino software and is attached to the circuit breaker. This is because the number of serious injuries and accidents due to the current shock of linemen is on the rise. It is mainly because of the lack of communication and coordination between electrical personnel and maintenance. The lineman will be in charge of everything including the password, it is because they are the ones that are going to be on the spot so they will be deciding when to turn on or turn off the power flow in the circuit.

This ensures the safety of the lineman working. The system is created in a way that requires a password to turn on or turn off the power flow in the circuit. The lineman will have the password to control the panel and will have the power to decide on the current flow without the need to call or text the other person to turn it off or turn it on because they will and can do it themselves [16].

2.5 Arduino Application Software

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

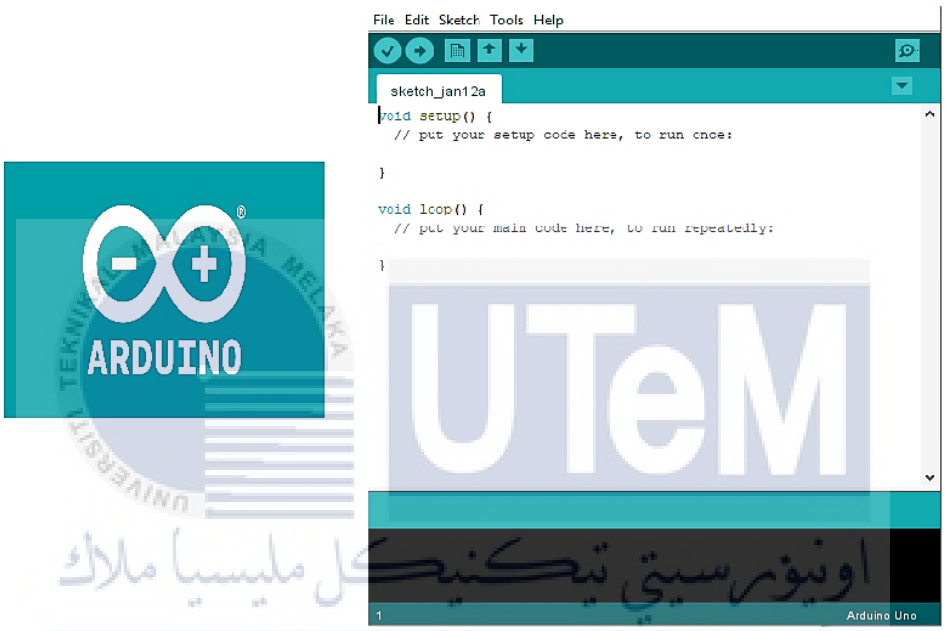


Figure 2.6 Arduino Software Interface

As shown in Figure **2.6**, Arduino is an open-source electronic platform which is based on easy-to-use hardware and software. Arduino boards can read inputs and turn them into outputs. It is having a set of instructions to be given to the microcontroller of the board. To do so, it will need to be given instructions through the Arduino programming language and the Arduino software based on the processing of the circuit for it to run smoothly [17].

2.6 Proteus Application Software

Proteus is a software suite for microcontroller simulation and PCB design. It allows users to design, test, and simulate their circuit diagrams before physically building them. The software includes a variety of tools for designing schematics, PCB layouts, and simulating microcontroller code. It also includes libraries of components and devices, making it easy to quickly add and test different parts in a circuit. Proteus Application Software is one of the most sophisticated applications to be used when it involves the usage of microcontroller chips and Arduino-based coding languages. It helps to bridge the gap between schematic and printed circuit board (PCB) for embedded design. Since the developed system is designed and tested in the software, fewer physical designs are required.

Figure 2.7 Proteus Software Interface

As shown in Figure **2.7**, the Proteus application software is a design suit which is a commercial software tool that is used mainly for electronic design automation. This software is mainly used by electronic design engineers and technicians for schematic creations and also for electronic prints for manufacturing printed circuit boards [18].

2.7 ESP 32

ESP 32 microcontroller is a series of low-cost and low-power consumption systems on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth functions. It is designed to be used in a wide range of applications, including home automation, IoT, and wearable devices. It is based on the popular ESP8266 microcontroller and offers a number of improvements, including a dual-core processor, more memory, and higher throughput. The ESP32 is also compatible with a wide range of development platforms, including the Arduino IDE, and can be programmed using C/C++ or MicroPython. ESP 32 can perform as a complete standalone system or as a slave device to reduce the communication stack on the main processor. ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. The typical microcontroller for ESP 32 is shown in Figure 2.8.

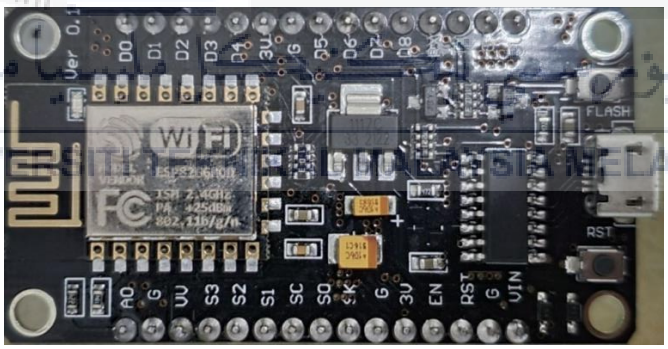


Figure 2.8 ESP 32 Microcontroller

ESP32 is highly integrated with in-built antenna switches, RF balun, power amplifiers, low-noise receive amplifiers, filters, and power management modules. Powered by advanced calibration circuitries, ESP 32 can dynamically remove external circuit imperfections and adapt to changes in external conditions. The implementation varies for mobile devices, wearable electronics and IoT applications [19].

2.8 Recent development in Circuit Breaker Applications

Based on the aforementioned studies, it is concluded that the circuit breaker is one of the most essential and basic devices which needs more safety supervision compared to the other electrical equipment. This topic regulates how the equipment functions and how many varieties there are in this equipment and also describes what other equipment's that are going to be used to make the project work successfully. Table **2.1**

Table 2.1 Recent development in circuit breaker applications

Author	Project's aim	Methodology
[5]	How to avoid lineman injuries	A passcode-based system
[6]	How do we create a password base system	Application of keypad and fingerprint reader
[7]	How to detect current leakage	Every circuit breaker detects current leakage
[8]	Review of recent circuit breakers	There are more than 4 types of circuit breakers including oil, air, vacuum, and SF6 circuit breakers.
[9]	How does the oil circuit breaker function	They are immersed fully in the oil. When current carries contact in oil separates, it activates.
[10]	Air circuit breakers	It is air operated electrical switch
[11]	SF6 circuit breakers	Through the insulations of SF6 gas

[12]	Vacuum circuit breaker	The arc quenching takes place in a vacuum
[13]	Password implementation	How does password help the lineman at work
[14]	Arduino software properties	The types of Arduino boards and where they can be used
[15]	Proteus software properties	The usage of where and how and whom uses it.
[16]	ESP 32 usages	It is being used widely and almost in every smart device

CHAPTER 3

METHODOLOGY

3.1 Introduction

In wide-ranging, effectiveness and accuracy are most likely to be prioritised as the two conflicting requirements for any electrical utilities in a household, especially for the circuit breaker. Here, accuracy refers to how the displaying device displays the state or condition the circuit breaker is in. Naturally, the higher the accuracy of the model, the higher the accuracy of the device. Meanwhile, efficiency refers to the capability of the model to turn off and turn on at the desired time.

There are three phases involved in this experiment which are to design a password-based circuit breaker using the proteus application software, to develop the prototype for the designed circuit breaker and to analyze the system under various conditions. Thie experiment was conducted using proteus application software as it is the most convenient and has the accuracy to display the prototype in simulation. Figure 3.1 explains on the flow of the project. It shows that from where the project began and to where it ends. This project consists of 3 phases; the flow chart narrates on how all the 3 phases of the project was conducted.

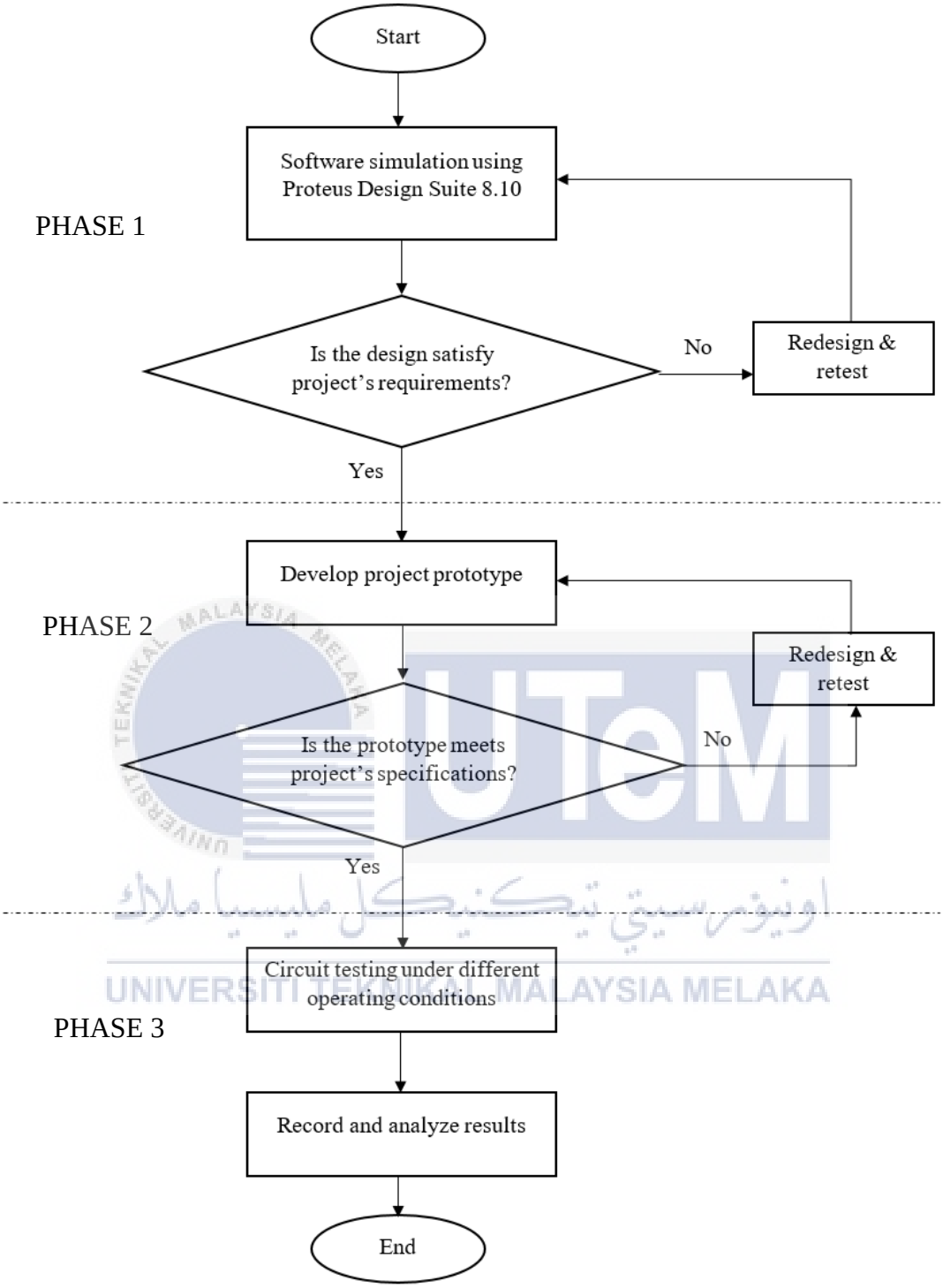


Figure 3.1 Project flow chart

3.2 Phase 1 Simulation Using Proteus Software

This stage was conducted to achieve the first objective of this experiment as to develop the ideas into simulation design. To complete Phase 1, there are 2 stages required, the first stage is to brainstorm and gather the ideas into design and the second stage is to build the exact code/ set of instructions so that the design would be as intended and desired.

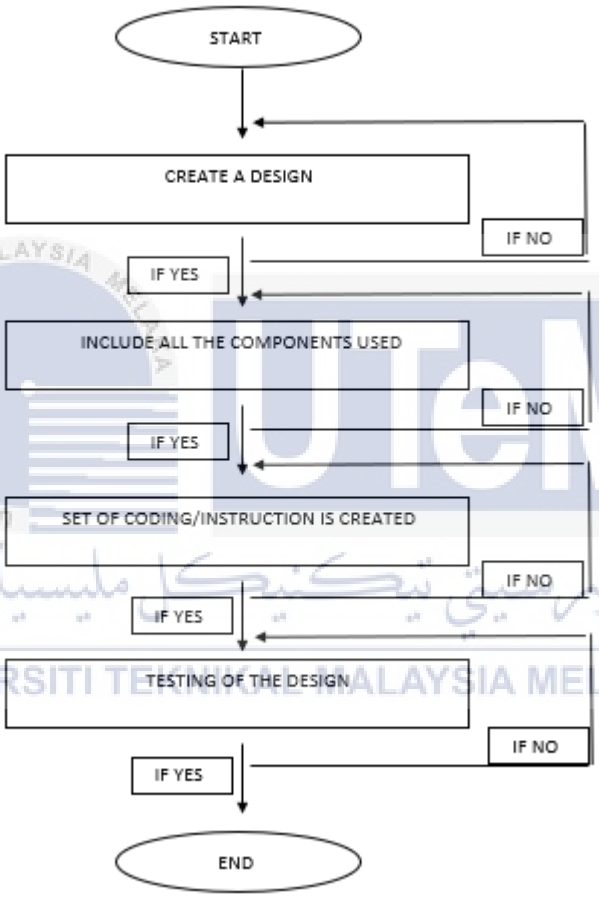


Figure 3.2 Flow Chart for Phase 1

Figure 3.2 shows the flow chart process from the beginning to the end of phase 1. It also shows that which was created first in order of conducting the project.

3.2.1 Simulation Design

This part was done on the beginning, as this part was the most crucial part in where it determines whether the project is capable to done.

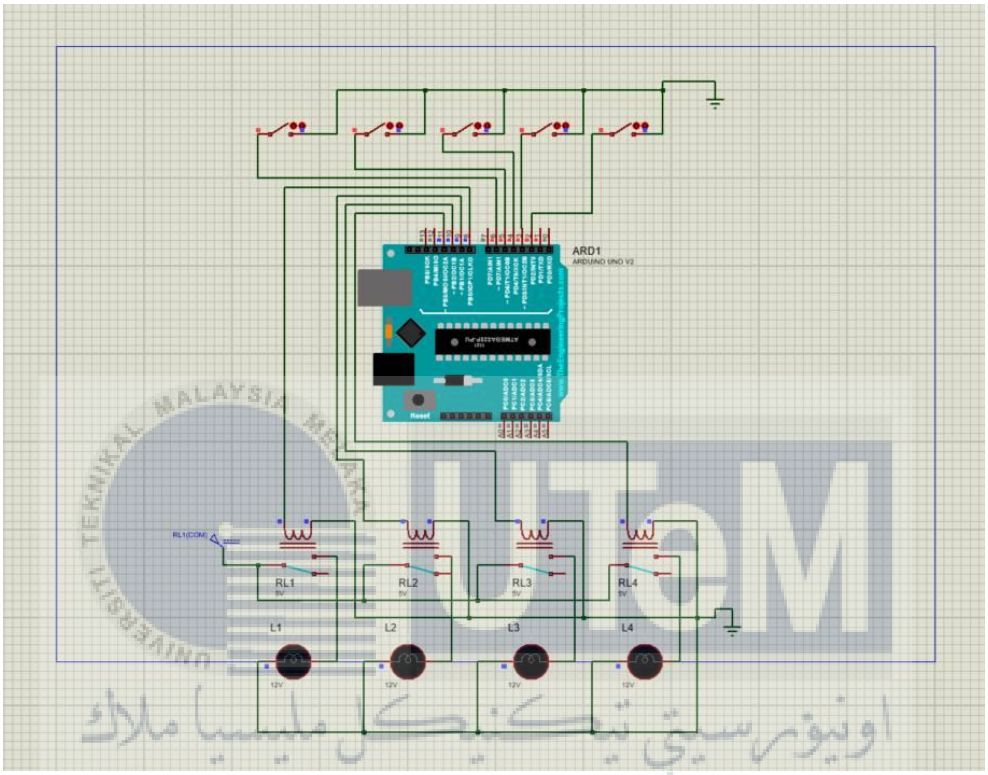


Figure 3.3 Simulation Design

Figure 3.3 shows the sample of design that was created in the Proteus Simulation Software application. It also shows what components are used and how the connections are made. The design includes the usage of push button, relays, light bulbs, grounding and Arduino Uno microcontroller. Arduino Uno microcontroller is used as a resmblance of ESP 32 microcontroller because the Proteus application isnt equipped with the ESP 32 microcontroller animated component.

3.2.2 Coding for the design

This part inculdes in phase 1, as the design requires coding for it to run smoothly and without any interruptions.

Figure 3.4 Completed coding for the design

Figure **3.4** shows the completed coding for the designed system in Proteus application software. In order to test the design functionallity, we have to create a code in which it will give instructions to the Arduino Uno mircrocontroller chip in Proteus application. Upon giving instructions the design will be able to run as it has the set of instruction on how to run the current flow and which set of request is available and not available accordingly.

3.3 Phase 2 Development of project Prototype

This phase was conducted upon the completion of phase 1. This phase is to transfer the idea of the designed simulation into prototype hardware. This phase includes assembling all of the components needed to build and run the project.

3.3.1 Flow Chart for Phase 2

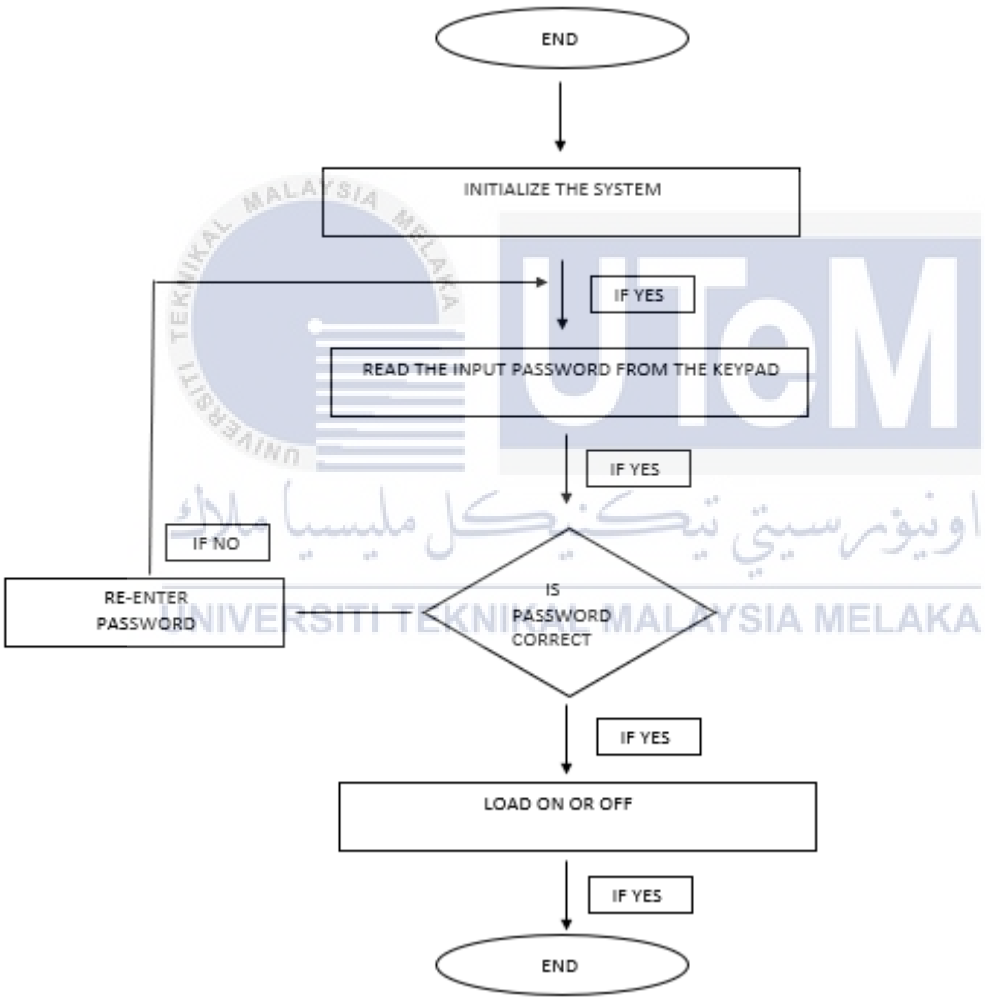


Figure 3.5 Flow Chart for Phase 2

Figure 3.5 shows the flow chart of works that are being done on phase 2 for completion of the project. It also shows from where the phase 2 of the project began and which part determines the end of phase 2.

3.3.2 List of Equipment

All of the components that are being used are listed and discussed in this section. These components are the main components for this project as it is the backbone of the project This includes the types and quantity of the components that are used to complete the project.

3.3.2.1 Connecting Wires

As shown in Figure 3.6, these are the types of connecting wires that are used to connect the wires from the ESP32 to the 4-channel relays and the light bulbs. These connecting wires are essential as they are the ones that interconnect to each of the components to transfer current and instructions that were created.

Figure 3.6 Connecting Wires

3.3.2.2 Light Bulbs

Figure 3.7 shows that the light bulbs are used as an indication for when each and every time the device is turned on or off the light also turns on and off accordingly. Light bulbs in this

experiment determine the insruction coding that were done was constructed correctly and aslo determines the connection for this project is in correct manner as it depends on it.

Figure 3.7 Light Bulbs

3.3.2.3 Relay (4-Channel)

Figure 3.8 shows the image of relay. This device is used in this project because every turning on and off for the equipment's goes through the relay as it controls the on and off of the equipment's. 4 channel relays are used because there are four indication bulbs which means every bulb uses one port of the relay.

Figure 3.8 Relay (4-Channel)

3.3.2.4 ESP 32 Microcontroller

Figure 3.9 shows the ESP 32 microcontroller used. ESP 32 is a wifi card which is activated by using the blynk application software to control the turning on and off for any equipment's that are connected to it. By using this device users will only need to connect it to a wifi and have an internet connection on their smartphones to be able to control the device.

Figure 3.9 ESP 32 Microcontroller

3.3.2.5 Power Supply

Figure 3.10 shows the power supply cable used for this project.This device is used to provide power supply to light bulbs so that when it is instructed to turn on the light bulbs will have current supply and be able to turn on. The device is connected to a wall plug point connection to allow current flow to the circuit.

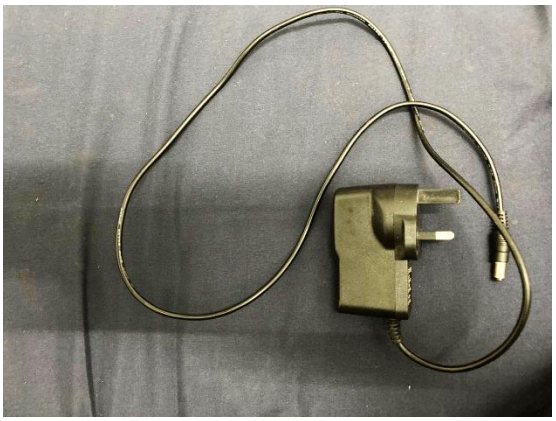


Figure 3.10 Power Supply Cable

3.3.2.6 Power Bank

Figure **3.11** shows the image of a power bank. This device is to provide power supply for the ESP 32 and keep supplying current supply so that the ESP 32 will have continues current supply. During the transfer of data to ESP32 microcontroller, current is supplied through computer or laptop to the ESP 32 microcontroller. After completion of transferring data into the ESP 32 microcontroller, for it to remain in turn on condition, we connect it to a power bank to have continuous supply to the ESP 32 microcontroller.

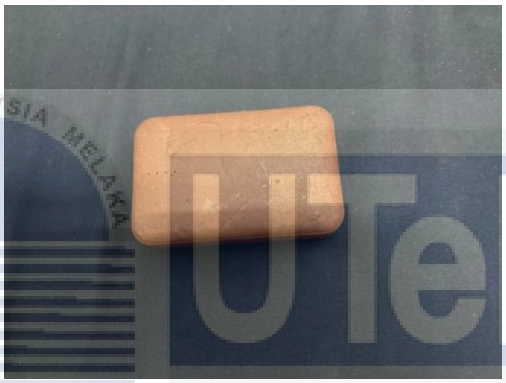


Figure 3.11 Power Bank

3.3.2.7 USB Cable

Figure 3.12 shows the cable that is used to connect the ESP 32 to the laptop to insert the coding and activate the ESP 32 microcontroller. It is also used to connect the power bank to the ESP 32 microcontroller to provide it with the current supply.

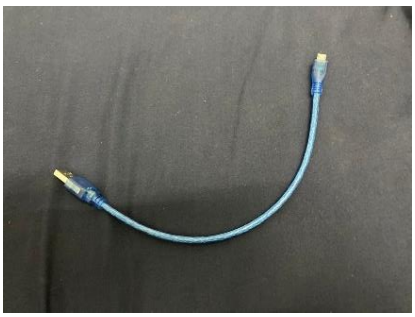


Figure 3.12 USB Cable

3.3.2.8 Hardware Connections

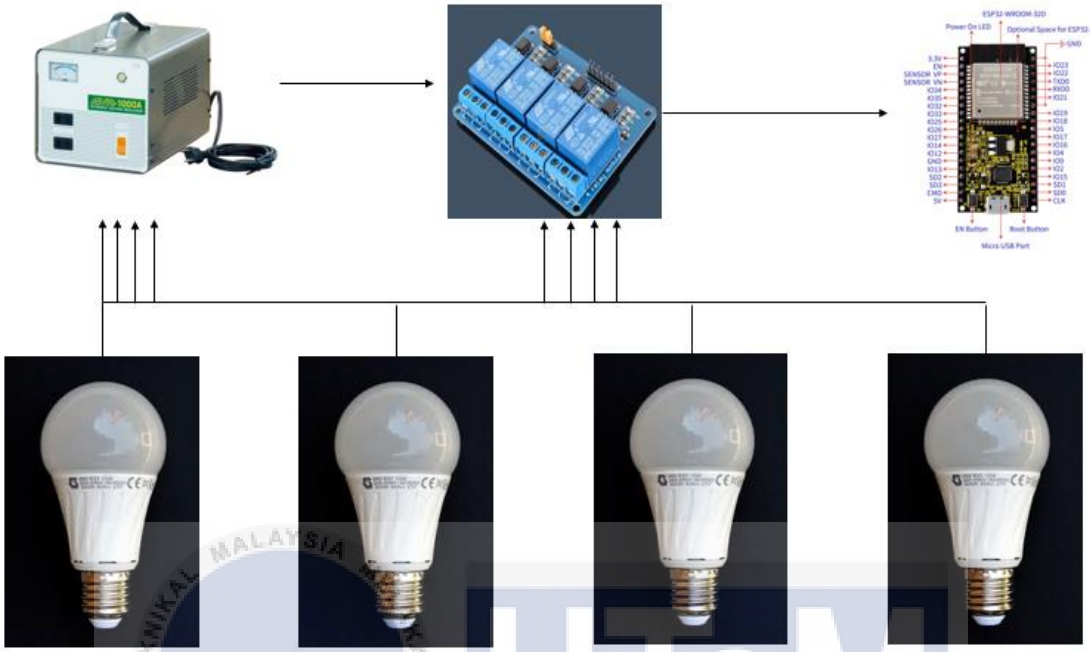


Figure 3.13 Hardware Connections

Figure **3**.**13** shows the connection of each of the components to and from where. It resembles on how the prototype is connected to each other in order for the project to run accordingly and smoothly withouth interruptions.

3.4 Gantt Chart

To ensure that every week has the progress that was done for this project, a Gantt chart was created to keep track of the weekly progress from week 1 to week 14 of Bachelors Degree Project (BDP) 1 and (BDP) 2 of the semesters.

ACTIVITY	WEEK													
	1	2	3	4	5	6	SEMESTER BREAK	7	8	9	10	11	12	13	14
BDP Tittle slesctions and Form Fillings															
Identification of project objectives and scopes															
Problem statement review															
Research on information, Articles, journals and referrence books															
progress for introduction and literature review															
Selection of hardwares and components															
implementation of hardwares and software components															
writing progress on methadology chapter 3															
Project methadology															
Completion and Revision on BDP 1 report															
Presentation of BDP 1															
Correction and submission of BDP 1 reprot															

Table 3.1 Gantt Chart of BDP 1

ACTIVITY	WEEK													
	1	2	3	4	5	6	SEMESTER BREAK	7	8	9	10	11	12	13	14
Project components purchasing															
IOT based project Research															
Proteus software Design															
Coding on arduino Software															
Report update until what was done															
Testing of hardwares															
Troubleshooting															
Update report tampelate															
Project report review															
Poster and video															
Modification of poster, report and video															
Submission of BDP 2reprot															

Table 3.2 Gantt Cahrt for BDP 2

3.5 Project cost

The table below shows the overall cost for the development of this project. The hardware materials were purchased online via Shopee Application while for the software application, there was no cost involved.

Table 3.3 Total cost for the project

Name	Quantity	Price
Relay (4-channel)	X1	RM 11.20
ESP 32 Microcontroller	X1	RM 35.00
DC 12V LED Bulb	X4	RM 5.80
Jumper Cable (male-male)	X30	RM 7.00
Power Supply Cable	X1	RM 12.00
USB Cable	X1	RM 10.00
	Total	RM 74.70

3.6 Summary

This chapter mainly talks about the proposed methodology which is the equipment required to develop an effective and new type of security involving circuit breakers. The main focus of the proposed methodology is to accomplish a better and simple while an effective method to bring a circuit breaker to a whole new level with a better security system. The components that are used in this experiment are the ones that can be easily fine and accessible for everyone. the ultimate goal is to accomplish the experiment and present a new safety circuit breaker which will save many lives and function better.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the result and analysis of the proposed project. This is phase 3 of the project. This includes the result obtained on software simulation which consists of Proteus Application Software for designing purposes and Arduino Ide application Software for coding instructions. This chapter also presents the hardware simulation process and details that were collected during the testing of the project's durability and stability for long-term usage.

4.2 Results and Analysis (software)

Proteus software and Arduino software were used to make this design complete and working. Both of the software is dependent on each other as they will not be complete unless they were used together and in sync.

4.2.1 Arduino Software Testing

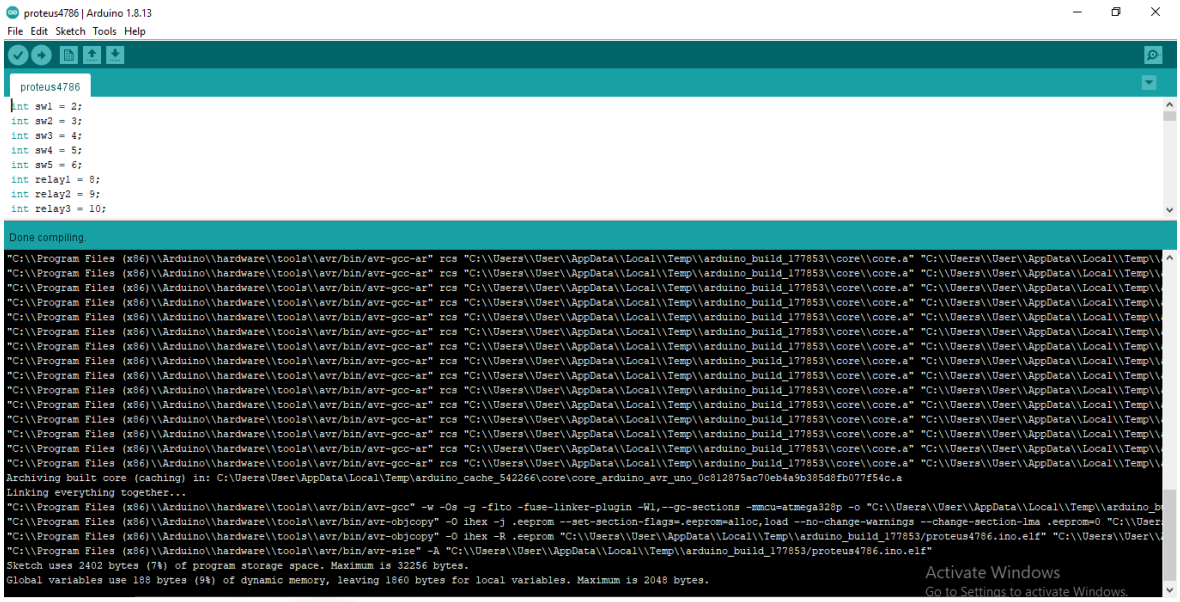


Figure 4.1 Arduino Software Testing

Figure 4.1 shows the completed set of coding / instructions to be used in Proteus Software application. This set of coding invloves with the set of password that was created for each of the components (light bulb) to either turn on or turn off. Each of the components has its own password to turn on and turn off. There is also a password that would turn all of the light bulbs simultaneously on or off.

4.2.2 Proteus Application Software Testing.

The Proteus application Software was tested upon the completion of the coding in Arduino Application Software. The coding is inserted into the animated component to test the designed circuit and the password whether they are in sync or not. It is done to prove that the design was usable and practical to be used on a daily routine.

4.2.2.1 Test 1

When the first password is entered (1111), the light bulb (L1) will turn on as per request.

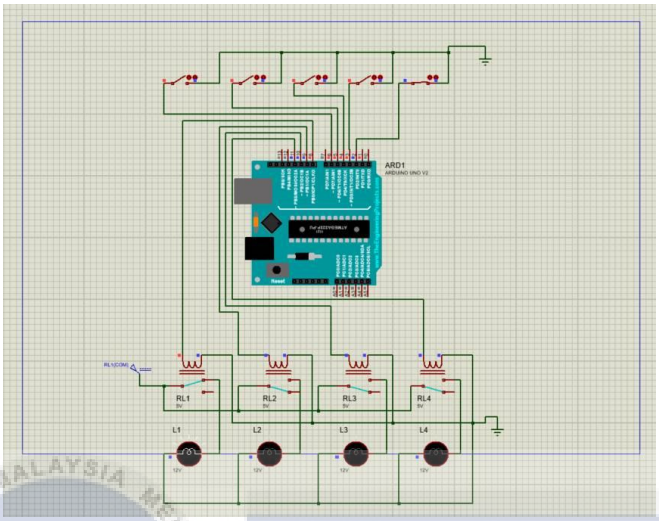


Figure 4.2 Testing 1

Figure 4.2 shows that the light bulb (L1) in on condition as the push button switches from normally open to normally closed condition.

4.2.2.2 Test 2

When the second password (2222) is entered, the light bulb (L2) will turn on as per request.

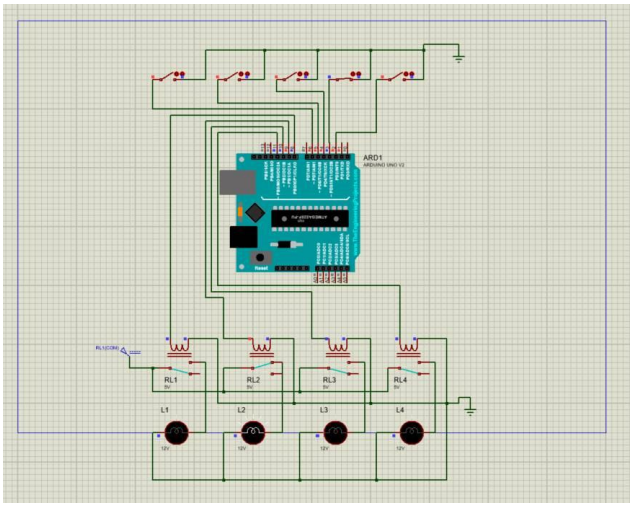


Figure 4.3 Testing 2

Figure 4.3 shows that the light bulb (L2) in on condition as the push button switches from normally open to normally closed condition.

4.2.2.3 Test 3

When the 3rd password (3333) is entered, the light bulb (L3) will turn on as per request.

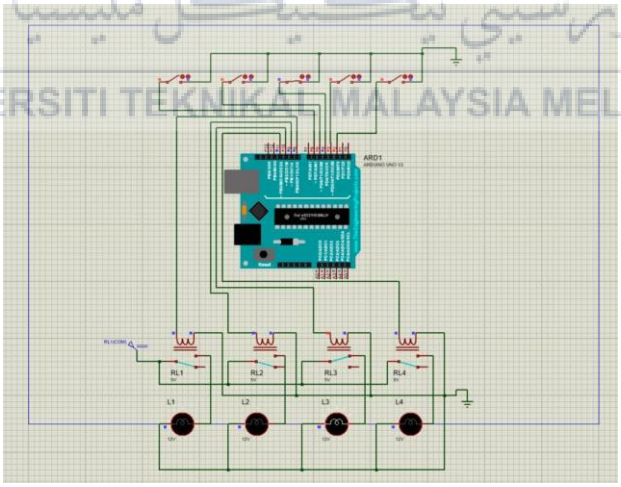


Figure 4.4 Testing 3

Figure 4.4 shows that the light bulb (L3) is on condition as the push button switches from normally open to normally closed condition.

4.2.2.4 Test 4

When the fourth password (4444) is entered, the light bulb (L4) will turn on as per request.

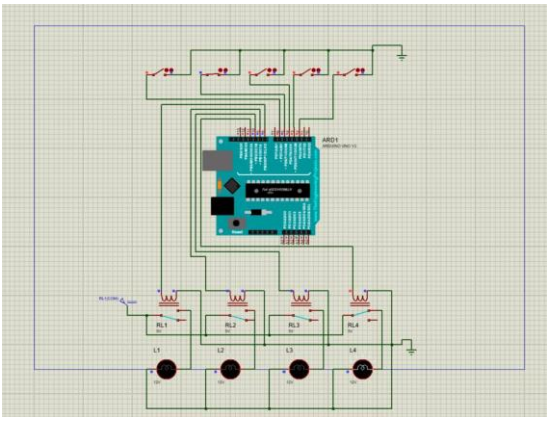


Figure 4.5 Testing 4

Figure 4.5 shows that the light bulb (L4) is on condition as the push button switches from normally open to normally closed condition.

4.2.2.5 Test 5

When the 5th password (5555) is entered, all the light bulbs (L1/L2/L3/L4) will turn on simultaneously.

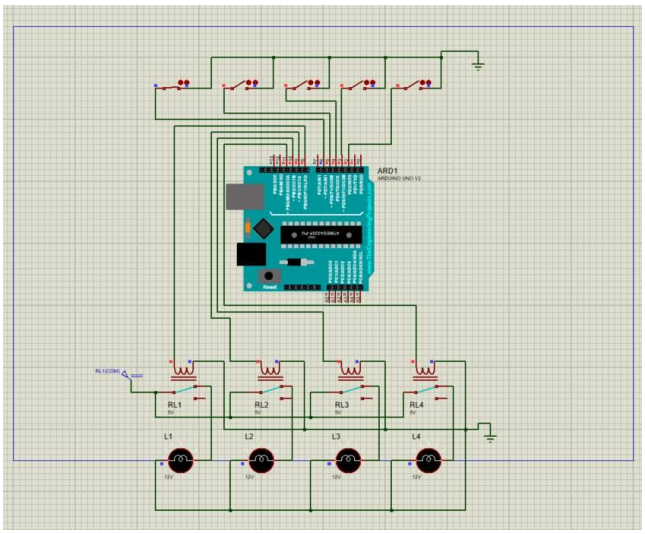


Figure 4.6 Testing 5

Figure 4.6 shows that the light bulb (L1/L2/L3/L4) is on condition as the push button switches from normally open to the normally closed condition.

4.3 Result and Analysis (hardware)

For the hardware, the result and analysis were done in two different methods. Firstly upon the construction of the hardware, the testing was done at the same location for each of the bulbs, after the success of the testing, another test was conducted but this time it was tested under several different locations to make sure of the reliability of the project.

4.3.1 Testing on the Same Location

This test was conducted by only one person and was done at only one location to test all of the password functions and the systems capability. The test was conducted at 760g, Taman kerjasama, Jalan Emas 1, Bukit Beruang Melaka.

4.3.1.1 Test 1

When the first password is entered (1111), the light bulb (L1) will turn on as per request.

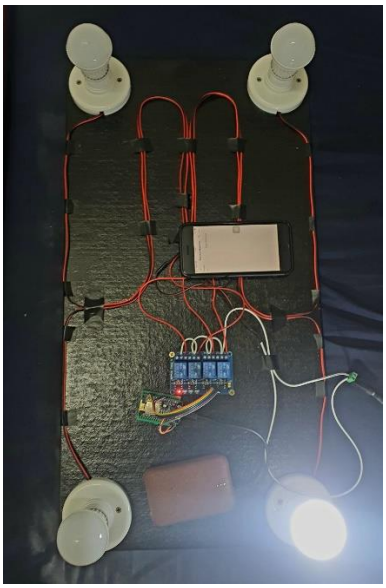


Figure 4.7 Same location testing 1

When the second password is entered (1212), the light bulb (L1) will turn off as per request.

4.3.1.2 Test 2

When the first password is entered (2222), the light bulb (L2) will turn on as per request.

Figure 4.8 Same location testing 2

When the second password is entered (2323), the light bulb (L2) will turn off as per request.

4.3.1.3 Test 3

When the first password is entered (3333), the light bulb (L3) will turn on as per request.

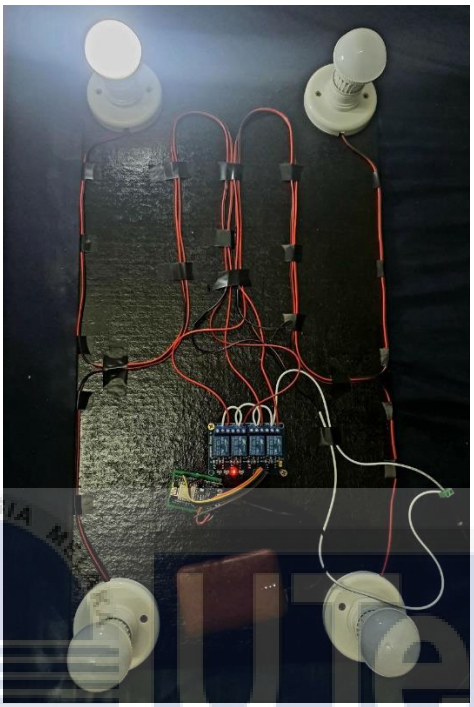


Figure 4.9 Same location testing 3

When the second password is entered (3434), the light bulb (L3) will turn off as per request.

4.3.1.4 Test 4

When the first password is entered (4444), the light bulb (L4) will turn on as per request.

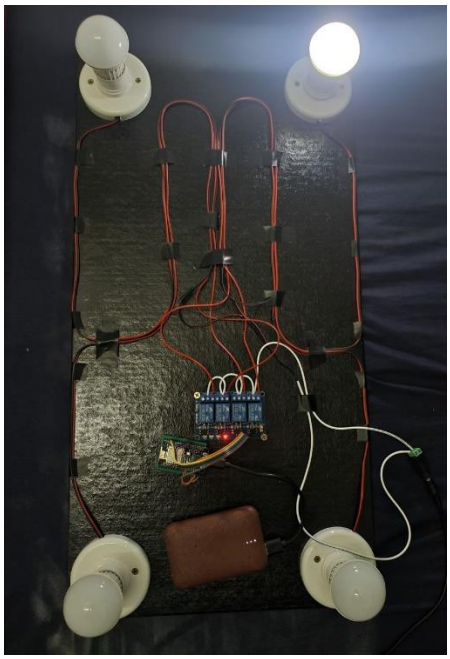


Figure 4.10 Same location testing 4

When the second password is entered (4545), the light bulb (L4) will turn off as per request.

4.3.1.5 Test 5

When the first password is entered (5555), the light bulb (L1/L2/L3/L4) will turn on as per request.

Figure 4.11 Same location testing 5

When the second password is entered (5656), the light bulb (L1/L2/L3/L4) will turn off as per request.

4.3.2 Testing on Different Locations.

This testing was conducted by selecting five different person. Each of them were asked to download the Blynk applications on their smartphones and turn on and off the devices while the project remains at Melaka. They were given the Email id and password to test the capability of the device to detect the instructions that was given to the device using WI-FI connection.

4.3.2.1 Location (Shah Alam Selangor)

The device was turned on form this location (Shah Alam) while the device reamins in Melaka. Figure 4.12 shows the details of the experiment on how it was conducted. The first tester was Ahmad Asyraf, Blynk Application was installed in his smartphone and tested. The test conducted was successfull.

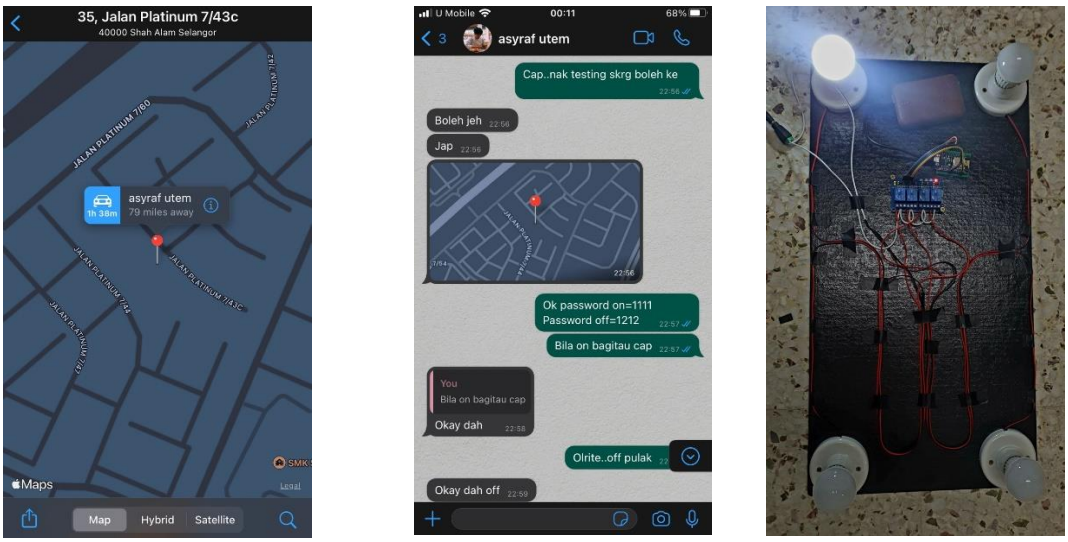


Figure 4.12 Different location testing L1

4.3.2.2 Location (Bandar Sungai Long Selangor)

The device was turned on form this location (Bandar Sungai Long Selangor) while the device reamins in Melaka. Figure 4.13 shows the details of the experiment on how it was conducted. The second tester was Thinesh, Blynk Application was installed in his smartphone and tested. The test conducted was successfull.

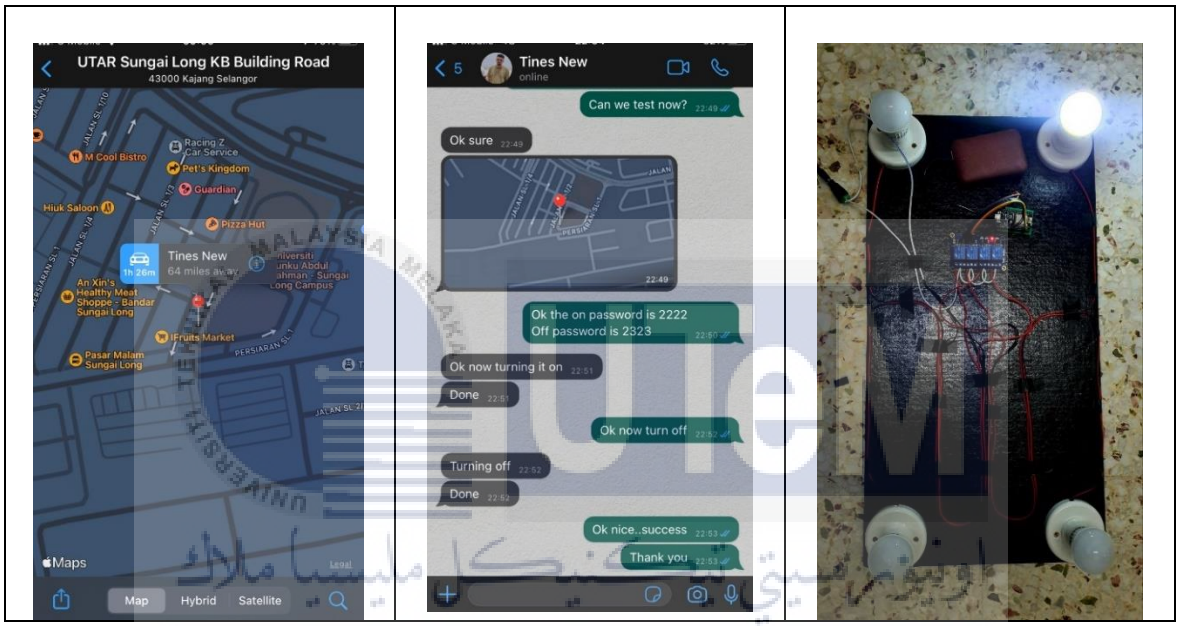


Figure 4.13 Different location testing L2

4.3.2.3 Location (Padang Serai Kedah)

The device was turned on form this location (Padang Serai Kedah) while the device reamins in Melaka. Figure 4.14 shows the details of the experiment on how it was conducted. The third tester was Thanus, Blynk Application was installed in his smartphone and tested. The test conducted was successfull.

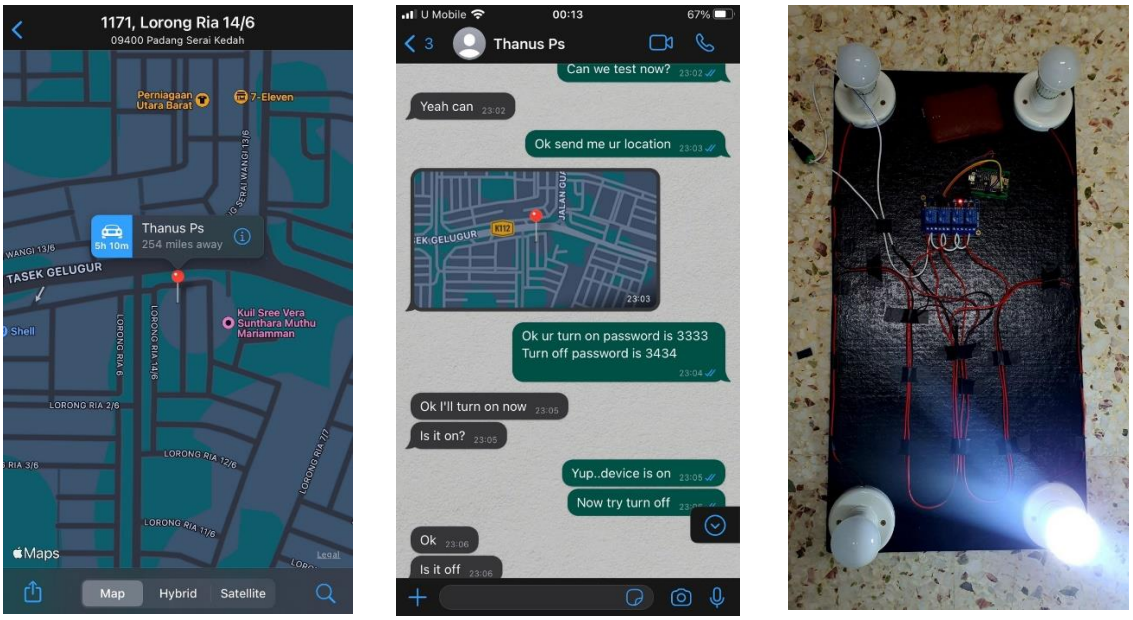


Figure 4.14 Different location testing L3

4.3.2.4 Location (Pedas Linggi Negeri sembilan)

The device was turned on form this location (Pedas Linggi Negeri Sembilan) while the device reamins in Melaka. Figure 4.15 shows the details of the experiment on how it was conducted. The fourth tester was Venosha, Blynk Application was installed in his smartphone and tested. The test conducted was successfull.

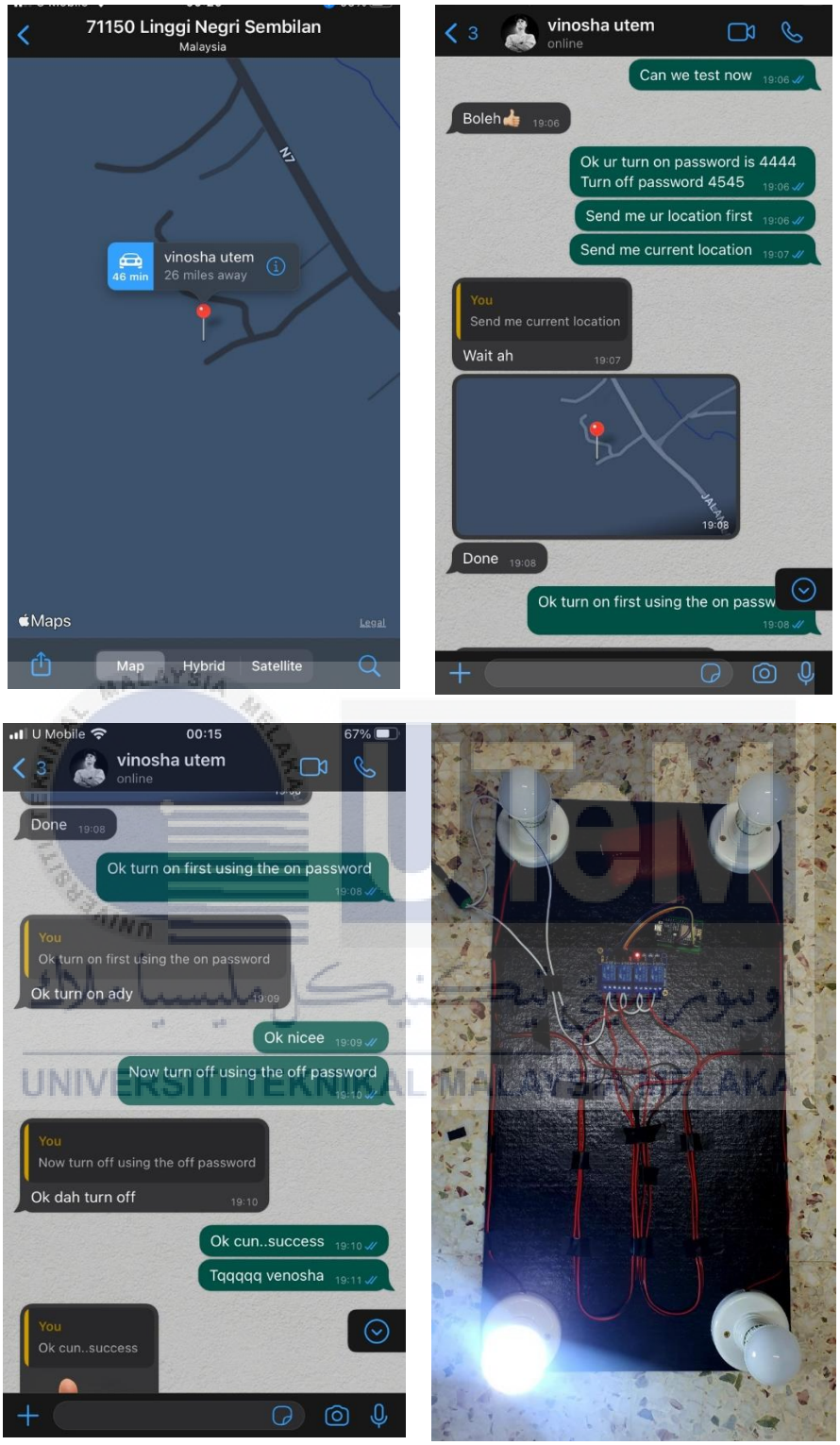
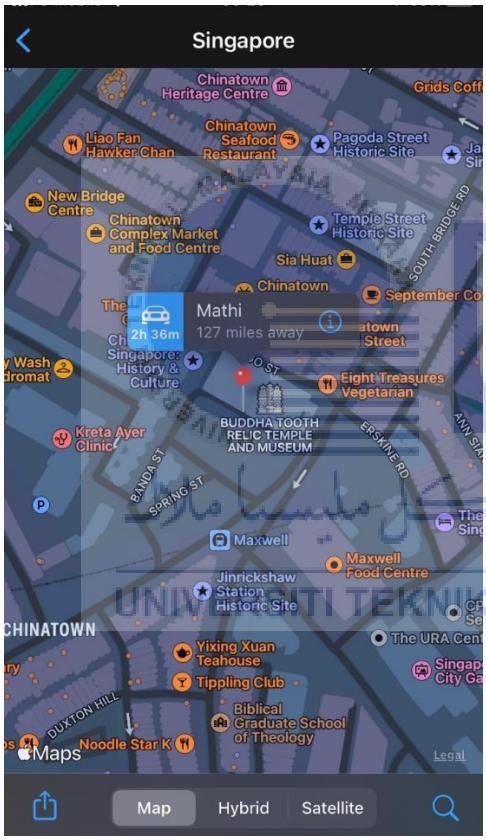
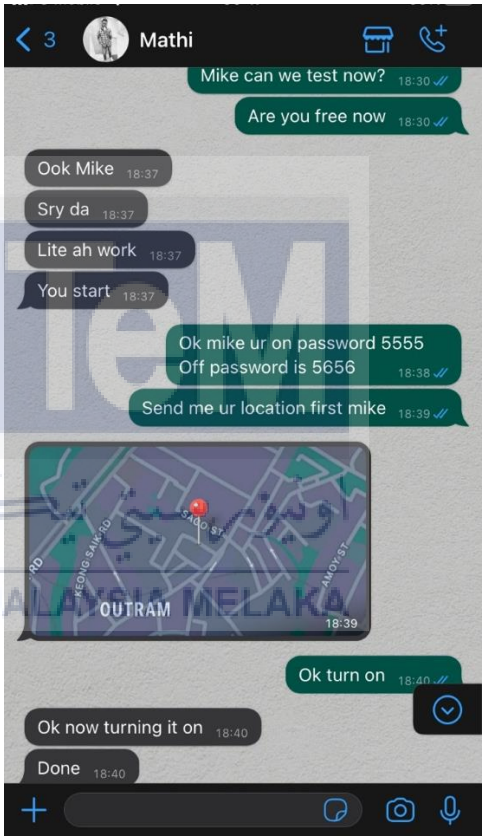


Figure 4.15 Different location testing L4

4.3.2.5 Location (Singapore)

The device was turned on form this location (Singapore) while the device reamins in Melaka. Figure 4.16 shows the details of the experiment on how it was conducted. The fifth tester was Mathivannan, Blynk Application was installed in his smartphone and tested. The test conducted was successfull.





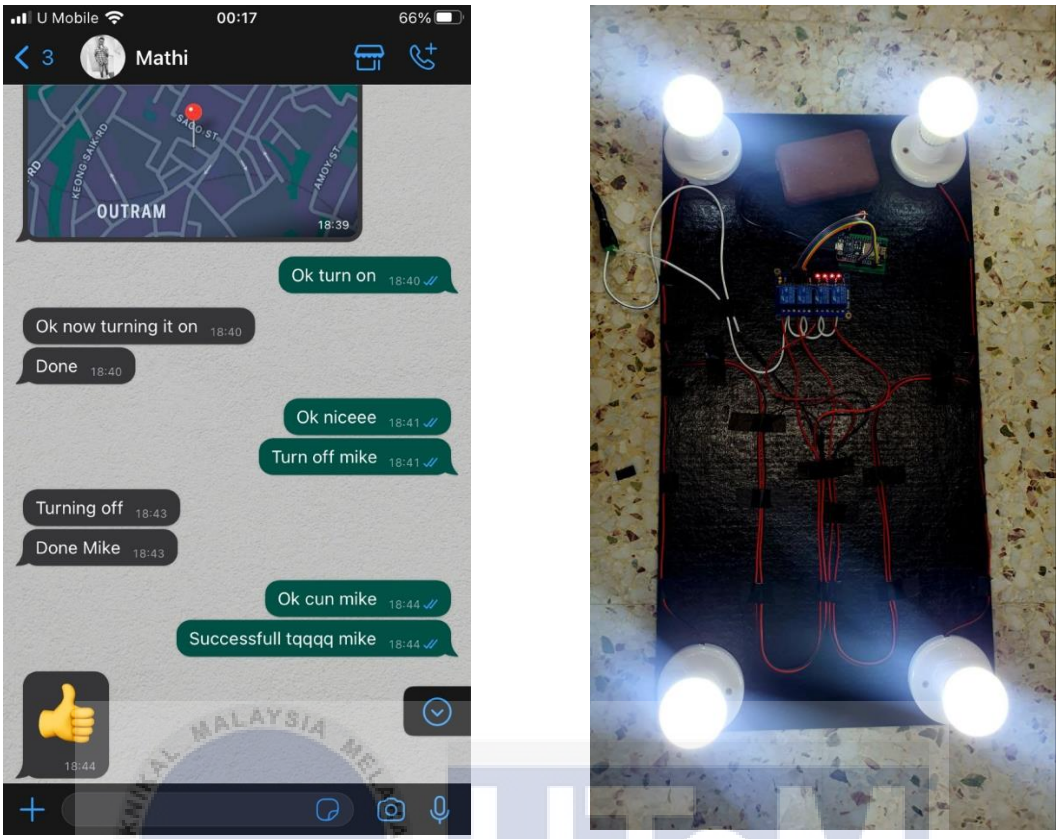


Figure 4.16 Different location testing for all devices

4.4 ESP 32 Comparison

ESP32 compared to ESP32-S2

Release Year	2016	2019
Microcontroller	Xtensa single/dual-core 32-bit LX6	Xtensa single-core 32-bit LX7
Clock Frequency	160/240 MHz	240 MHz
Co-processor	ULP	ULP (RISC-V)

Table 4.1 ESP32 vs ESP 32 S2

Work Mode	Description		ESP32 Current Consumption	ESP32-S2 Current Consumption
Active (RF working)	Transmit 802.11b, DSSS 1 Mbps, POUT = +19.5 dBm		240 mA	190 mA
	Receive 802.11b/g/n		100 mA	68 mA
Modem-Sleep	CPU is powered on	240 MHz	30 mA...68 mA	19 mA
		160 MHz	27 mA...44 mA	16 mA
		80 MHz	20 mA...31 mA	12 mA
Light-Sleep			0.8 mA	450 µA
Deep-Sleep	ULP co-processor is powered on		150 µA	235 µA
	ULP sensor-monitored pattern		100 µA @1% duty	22 µA @1% duty
	RTC timer + RTC memory		10 µA	25 µA
Hibernation	RTC timer only		5 µA	20 µA

Figure 4.17 Consumption for both microcontrollers

4.5 Summary

Based on the analysis that was done on the project, it was concluded that the device works under different situation and under different location. ESP 32 was connected to a wifi and was tested in the same location and different location by different users and managed to comply with all of the instructions that was created and produced the desired output.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The development of Password Base Circuit Breaker with IoT Implementation is to introduce to users what is a Circuit Breaker and how it function. Circuit Breakers are in many forms in which in this thesis it was presented in ESP 32 form. ESP 32 is used as a circuit breaker in this thesis as it was given a set of instructions to comply with so that when users use the device it will be working as intended. The data collected was tested in five different locations to check whether the device is functioning wherever it is intended to be used. The overall experiment conducted on this project was successful.

5.2 Future Works

For future improvements, the system could be enhanced as follows:

i) A wider range of use, and not limited to certain devices.

ii) Used in the industrial working environment, it may save the lives of wiremen working on the field and saves time for each turning on and off of the devices.

iii) Produce multiple applications to control the device as some smartphones may not support the Blynk Application, or if an error occurs, users may have multiple choices of applications to be installed and used for controlling purposes.

REFERENCES

[1] S. M. S. Lumen, "DC Circuit Breaker : A Comprehensive Review of Solid State Topologies," *IEEE Int. Conf. Power Energy*, pp. 1–6, 2020.

[2] M. A. Omran, B. J. Hamza, and W. K. Saad, "Materials Today : Proceedings The design and fulfillment of a Smart Home (SH) material powered by the IoT using the Blynk app," *Mater. Today Proc.*, vol. 60, pp. 1199–1212, 2022, doi: 10.1016/j.matpr.2021.08.038.

[3] T. Karthick, C. R. S, J. Drusila, J. Nesamalar, and K. Chandrasekaran, "Sustainable Energy , Grids and Networks Design of IoT based smart compact energy meter for monitoring and controlling the usage of energy and power quality issues with demand side management for a commercial building," *Sustain. Energy, Grids Networks*, vol. 26, p. 100454, 2021, doi: 10.1016/j.segan.2021.100454.

[4] Enerdata, "Global Energy Statistical Yearbook 2019," *Global Energy Trends - 2019 edition*, 2019. .

[5] G. K. Kirui, L. L. Chiloane, and Y. J. Yen, "Remote Mechanical Switch to Regulate Electricity Consumption in a Household," *IEEE Int. Power Electron. Motion Control Conf.*, vol. 3, 2021.

[6] R. E. Alden, S. Member, P. Han, and D. M. Ionel, "Smart Plug and Circuit Breaker Technologies for Residential Buildings in the US," *IEEE Int. Conf. Renew. Energy Res. Appl.*, pp. 1018–1021, 2019.

[7] Q. Huo, J. Xiong, N. Zhang, X. Guo, and L. Wu, "Review of DC circuit breaker application," *Electr. Power Syst. Res.*, vol. 209, no. October 2021, p. 107946, 2022, doi: 10.1016/j.epsr.2022.107946.

[8] C. S. E. and E. A. A. P. I. Obi*, "APPLICATIONS OF VARIOUS TYPES OF

CIRCUIT BREAKERS IN ELECTRICAL POWER SYSTEMS: A REVIEW," *Arid Zo. J. Eng. Technol. Environ.*, vol. 17, no. December, pp. 481–494, 2021.

[9] P. M. Sen and S. S. Kanojia, "Analysis of Thermal Performance of an Air Circuit Breaker," *IEEE Int. Conf. Comput. Power Commun. Technol.*, pp. 1–6, 2021.

[10] M. Barnes, S. Member, D. S. Vilchis-rodriguez, X. Pei, A. C. Smith, and S. Member, "HVDC Circuit Breakers – A Review," *IEEE Access*, pp. 211829–211848, 2020, doi: 10.1109/ACCESS.2020.3039921.

[11] X. Yao, J. Wang, S. Ai, Z. Liu, Y. Geng, and Z. Hao, "Vacuum Switching Technology for Future of Power Systems," *Engineering*, vol. 13, pp. 164–177, 2022, doi: 10.1016/j.eng.2021.11.020.

[12] K. Ma *et al.*, "Bus-Coupler Fast Vacuum Circuit Breaker," *Energies*, pp. 1–14, 2021.

[13] P. Punithavathi, S. Geetha, M. Karuppiah, and S. K. Hafizul, "A lightweight machine learning-based authentication framework for smart IoT devices R," *Inf. Sci. (Ny).*, vol. 484, pp. 255–268, 2019, doi: 10.1016/j.ins.2019.01.073.

[14] J. P. D. Comput, R. Amin, S. Kunal, A. Saha, D. Das, and A. Alamri, "CFSec : Password based secure communication protocol in cloud-fog environment," *J. Parallel Distrib. Comput.*, vol. 140, pp. 52–62, 2020, doi: 10.1016/j.jpdc.2020.02.005.

[15] H. Fatima, H. U. Khan, and S. Akbar, "Home Automation and RFID-Based Internet of Things Security : Challenges and Issues," *Secur. Commun. Networks*, vol. 2021, 2021.

[16] N. Khandelwal, T. Manglani, G. Singh, A. Kumar, and D. Khatri, "Automated Load Distribution with Password Protected Circuit Breakers," vol. VIII, no. 1, pp. 16–25, 2015.

[17] A. K. Tossa *et al.*, “Energy performance of different silicon photovoltaic technologies under hot and harsh climate,” *Energy*, vol. 103, pp. 261–270, 2016, doi: 10.1016/j.energy.2016.02.133.

[18] M. H. Bhuyan and M. Hasan, “Design and Simulation of Heartbeat Measurement System Using Arduino Microcontroller in Proteus,” *Int. J. Biomed. Biol. Eng.*, no. October, 2020.

[19] A. W. Putra, R. Nuryanto, and A. Tafrikhatin, “Fitur Pengingat Kegiatan Masjid Dengan Kontrol Wi-Fi Berbasis ESP-32 Pada Jam Digital Mosque Activity Reminder Feature With ESP-32 Based Wi-Fi Control On Digital Clock,” vol. 5, pp. 6177–6187, 2021.

APPENDICES

Example A

Appendix A

Pin layout for ESP 32

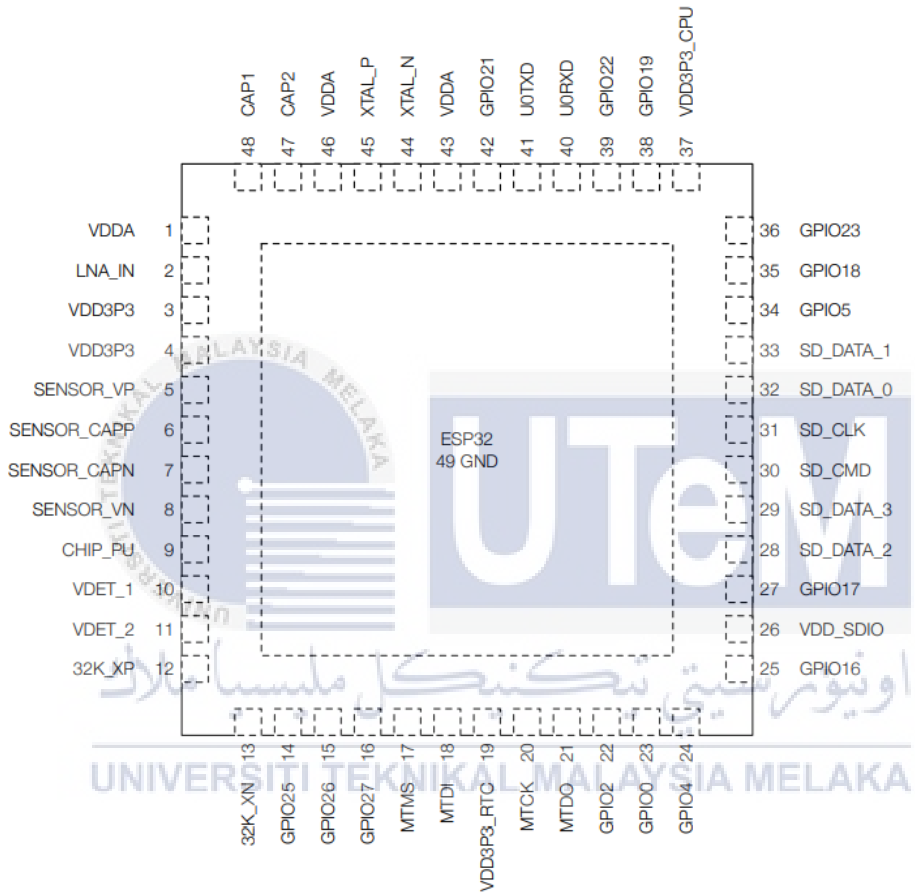


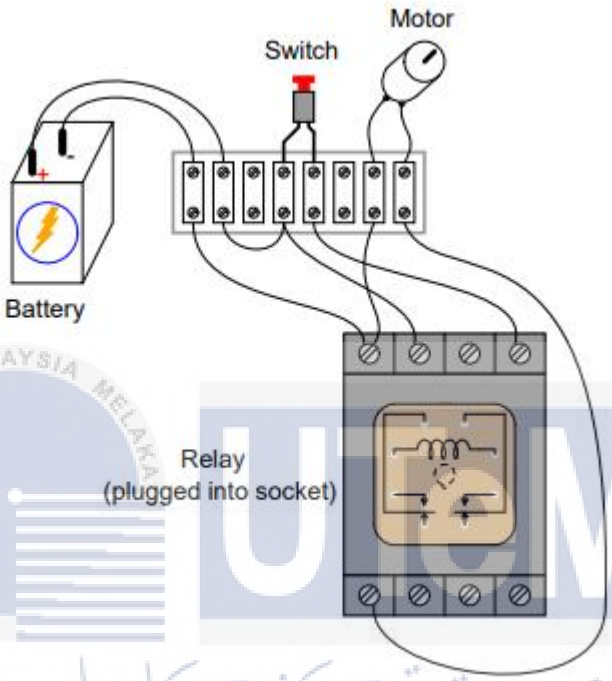
Figure 2: ESP32 Pin Layout (QFN 6*6, Top View)

Appendix 1: Appendix A

Example B

Appendix B

Relay Connection Layout

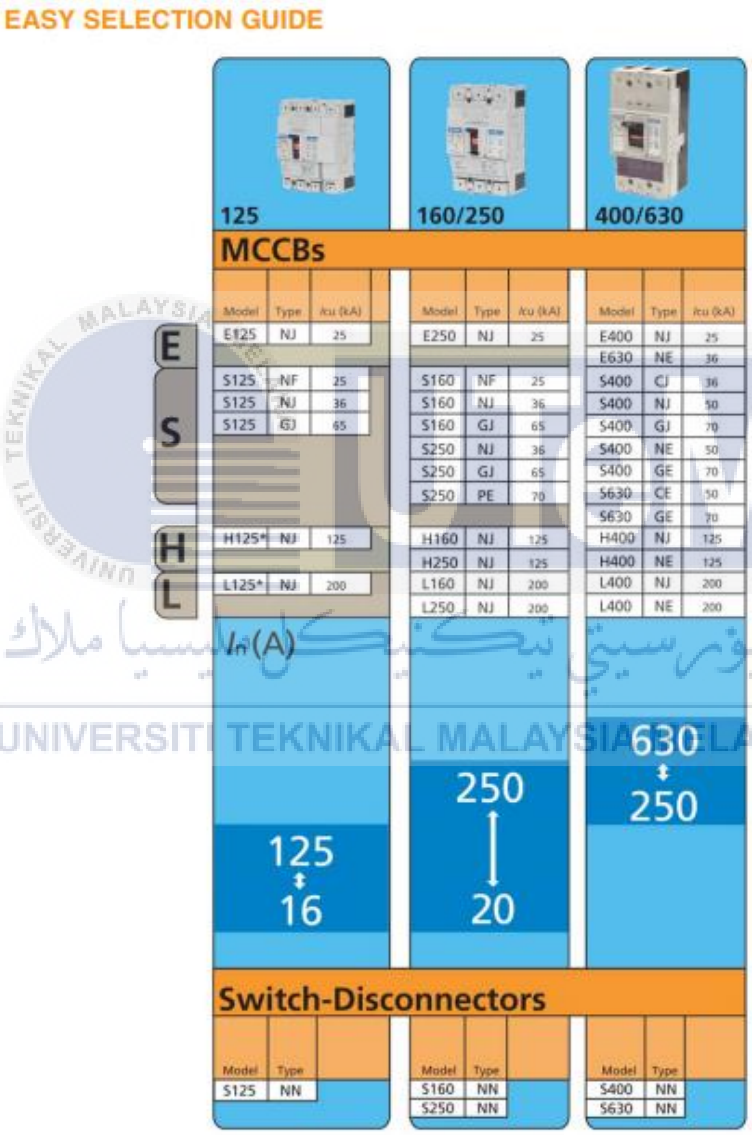


Appendix 2: Appendix B

Example C

Appendix C

How to choose a Circuit Breaker.



Appendix 3: Appendix C