Faculty of Electrical Technology and Engineering

DESIGN AND DEVELOPMENT OF USER-FRIENDLY SMART SWITCH WIRING AND CASING THAT ENDURE LOCAL CLIMATE ENVIRONMENT

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Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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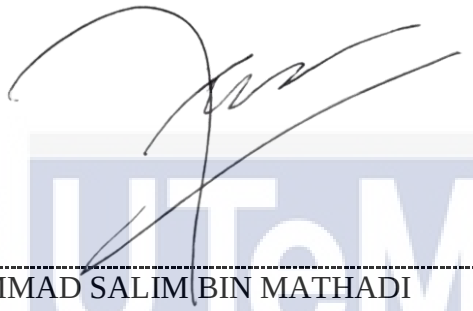

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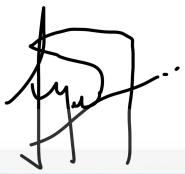
Signature : 

Supervisor Name : TS. MOHAMED BIN SAID

Date : 12 JANUARY 2024

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

In the name of Allah, my Creator, and my Master,
In reverence to the great teacher and messenger, Mohammed (May Allah bless and grant him), who illuminated the purpose of life.,

To my beloved mother, JURIAH BINTI ARSADIN,
a woman of unparalleled strength and resilience. Despite facing the challenges of raising me alone, your love, wisdom, and unwavering support have been the guiding lights of my journey.,

To my father, MUHAMMAD HADI BIN FADHLI,
even though you're currently AFK i would gladly thank that you your presence has been a source of inspiration and strength. Your legacy continues to shape my path, and for that, I am eternally grateful.

To my truly brotherhood, DT15
our shared experiences have been invaluable. Your camaraderie and support have been a pillar of strength. As we part ways, I wish each one of you success and hope to see you all on top of your respective journeys.

Last but not least,
I wanna thank me
I wanna thank me for believing in me
I wanna thank me for doing all this hard work
I wanna thank me for having no days off
I wanna thank me for,
for never quitting.

With humility and sincere affection,
MUHAMMAD SALIM BIN MATHADI

ABSTRACT

Smart Switch has enhance automation implemention in home that can ensure easier lifestyle. However, Conventional smart switch wiring setups is present potential hazards during the installation process. The objective of is to develop a smart switch and casing that is easy to use for the end-user. The proposed design is a plug-and-play (PnP) approach, during the wiring installation and device configuration processes. Connectivity challenges and unreliable network infrastructure often effect the effectiveness of smart phone applications in controlling smart switches. The smart switch under consideration can be conveniently installat and replacement by end-users, while simultaneously providing monitoring and regulation capabilities through a Wi-Fi communication-enabled smartphone. By this project presence it will reduce potentional hazard during installation process that can enhance a smart switch implemention. The project goal is to provide consumers with a safe and convenient solution that requires minimal expertise for installation, offer control and monitor by smart phone application.

ABSTRAK

Pengenalan mengenai Smart Switch telah meningkatkan implementasi automasi di pengunaan rumah yang dapat meningkat gaya hidup. Walaubagaimanapun, proses pemasangan Smart Switch konvensional berpotensi meyebabkan risiko kejutan elektrik. Objektif projek ini adalah untuk mengembangkan Smart Switch dan selongsong yang digunakan dengan mudah. Reka bentuk yang dicadangkan adalah menggunakan konsep PnP, semasa proses pemasangan kabel dan konfigurasi peranti. Cabaran proses pemasangan dan rangkaian yang tidak stabil seringkali mempengaruhi keberkesanan aplikasi telefon pintar dalam mengawal Smart Switch. Smart Switch yang sedang dipertimbangkan boleh dipasang dan digantikan dengan mudah oleh pengguna, pada masa yang sama dapat menyediakan keupayaan pengawalan dan pantauan melalui telefon pintar yang disambung Wi-Fi. Dengan kehadiran projek ini, ia akan mengurangkan potensi berbahaya seperti tegangan electrik semasa proses pemasangan yang dapat meningkatkan pemasangan Smart Switch. Projek in bertujuan untuk menyediakan penyelesaian yang mempermudahkan dan selamat kepada pengguna yang mempunyai pengetahuan terhad dalam pemasangan elektrik, serta menawarkan kawalan dan pemantauan melalui aplikasi telefon pintar.

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I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my family for the financial support that enables me to accomplish the project. Not forgetting my fellow housemate, I extend my sincere thanks to DT15 for their willingness to share thoughts and ideas regarding the project. Their contributions have added depth and richness to the overall endeavor.

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ALIST OF SYMBOLS LIST OF ABBREVIATIONS

$Wi-Fi$	-	Wireless Fidelity
IoT	-	Internet of Thing
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
PIC	-	Peripheral Interface Controller
$GPIO$	-	General Pin Input Output
SSR	-	Solid State Relay
TCP	-	Transmission Control Protocol
$3D$	-	3D Design Protocol
UDP	-	User Datagram Protocol
$MQTT$	-	MQ Telemetry Porotocol
APP	-	Application
PnP	-	Plung n Play
$HTTP$	-	Hyper Text Transfer Protocol

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CHAPTER 1

INTRODUCTION

1.1 Background

The rising popularity of technological advances in smart home systems has radically altered how we interact with our living areas. Particularly smart switch has drawn a lot of interest because of their capacity to offer automation and remote-control capabilities, boosting comfort and energy efficiency in homes. The local climate conditions in which these devices operate, however, can have a significant impact on their performance and durability.

Smart switches in the conventional market have complex wiring installations that must be done by consumers. The wiring depends on whether existing wiring is single-phase or three-phase. Moreover, when it comes to replacing device process, consumers need to go through the same step during the first installation process. Also, during wiring installation, there is a risk of the consumer getting an electric shock if the wrong wiring connection is made. This project aims to design a smart switch and case to ease the consumer's wiring installation and setup process. By applying the plug-and-play concept (PnP), it will be easier for consumers to install and change devices at any time. Therefore, with this product, it has an easy installation process.

1.2 Addressing Global Warming by Implementing Smart Switch

The implementation of smart switch, while offering convenience and energy-saving benefits, can also have negative implications. One concern is the generation of electronic waste due to the production and disposal of smart switches. If not properly managed, the disposal of outdated models can contribute to environmental pollution and harm ecosystems. Additionally, the increased connectivity and data collection associated with smart switch require energy, which can contribute to the carbon footprint and escalate global warming.

However, it is important to recognize the positive impact that smart switches can have on combating global warming. By enabling remote control and scheduling of devices, smart switch promotes more efficient energy consumption. Users can easily turn off or adjust the power supply to their appliances when not in use, reducing unnecessary energy consumption and lowering carbon emissions. Moreover, the automation features of smart switches allow for the implementation of energy-saving routines and schedules, optimizing energy usage and contributing to the fight against global warming.

1.3 Problem Statement

The Smart device is gaining consumer approval and generating interest for home or building implementation. Smart switch installation and setup can be challenging due to high voltage and single or three-phase wiring. Fundamental wiring knowledge is necessary to guarantee a safe connection and avoid mishaps while installing the intelligent switch. Faulty wiring can damage the smart switch and pose a risk of electric shock, requiring replacement. Furthermore, smart switch replacement can give the same challenge as first installation procedure.

Smart phone applications for controlling smart switches face several challenges that impact their usability and effectiveness. Reliable connectivity is crucial for smart phone

applications to communicate with smart switches. However, fluctuations in connectivity or unreliable network infrastructure can cause delays or failures in transmitting commands to the smart switch, impacting the user experience.

1.4 Project Objective

The main aim of this project is to enhance the function of smart switches with additional features that are user-friendly. Specifically, the objectives are as follows:

i) To design a smart switch casing that applied PnP concept.

ii) To develop a smart switch with a casing that has simple installation, setup, and replacement that is user-friendly.

iii) To analyze a smart switch that enhancing wiring efficiency and user accessibility.

1.5 Scope of Project

The scope of this project are as follows:

a) Design smart switch casing by using 3D

b) Eco friendly and reliable communication technology to be implemented in device smart phone as monitoring and controlling the smart switch

c) Analysis for performance and durability of smart switch wiring and casing design with stability of communication to consumers.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is focused on the theory and concept of smart switch wiring and case that can endure local climate environments. This section will carry discussion and research related to smart switch devices, such as wiring construction and case design. Main resource for research documents that relate to smart switch, such as journals, books, articles, etc., with trust resources' selection of these resources their alignment with the project scope and objectives.

2.2 Understanding Smart Switch Global Issue

The global implementation and optimal utilization of smart switch necessitates the resolution of various issues. Inadequate implementation of security measures and outdated firmware can render smart switches vulnerable to hacking attempts, thereby posing a significant threat to user privacy, and potentially facilitating unauthorized access to home networks. The establishment of trust in smart switch technology is contingent upon the implementation of robust security measures and the safeguarding of user data. Furthermore, efficient management of energy consumption is to achieve the energy-conserving advantages of smart switch. Finally, it is imperative to address the issue of electronic waste by implementing responsible recycling and disposal procedures to minimize the environmental consequences associated with obsolete smart switch models. Through addressing these obstacles, smart switch has the potential to enhance global accessibility, security, and environmental sustainability for end-users.

2.3 Overview of Smart Switch

Smart switches are a specific category of electrical switches that are internet-connected and can be remotely controlled through mobile applications or voice commands. These switches utilize IoT-enabled devices to establish an internet connection and provide the capability to manage the power state of various electrical appliances [1]. The advancement of smart switch systems has resulted in the development of user-friendly electrical interfaces that offer enhanced control over household appliances. One such system, known as MorSocket, has been introduced. MorSocket is a smart socket system that enables users to conveniently control multiple individual sockets through a central control webpage.

Based on [2], a recent journal article, a group of researchers aimed to develop a smart switch system using IoT-enabled devices. The design of the smart switch system includes a user-friendly electrical interface. The primary aim of developing this IoT-enabled smart switch, as stated in [2], is to provide users with the capability to control their household appliances remotely through internet connectivity. In [3], a PDF document, researchers from the University of Lagos explain the process of creating a web-based technology-driven smart switch for home appliances. Figure 2.1 below shown sample of smart switch device.

Figure 2.1 Smart Switch

2.3.1 Smart Switch connectivity

Smart switches are internet-connected electrical switches that can be remotely controlled via mobile apps or voice commands. These switches use IoT devices to connect to the internet and control the power of electrical appliances [1]. Smart switch systems have led to user-friendly electrical interfaces that provide better control over household appliances.

Researchers developed a smart switch system using IoT-enabled devices, as described in a recent journal article [2]. The smart switch system features a user-friendly electrical interface design. The main objective of creating this IoT-based smart switch, as mentioned in reference [3], is to enable users to remotely manage their home appliances using internet connectivity. Researchers from the University of Lagos describe the development of a web-based smart switch for home appliances [4].

2.3.1.1 Wi-Fi

Nowadays, Wi-Fi is widely available in most structures. This technology allows wireless communication and internet access without cables [4]. It operates on various wireless standards and frequencies, offering varying ranges and speeds. A router or access point serves as the internet signal transmitter in a typical Wi-Fi setup. Encryption protocols can secure a network from unauthorized access. Wireless hotspots provide broadband internet access. Wi-Fi Direct facilitates direct device-to-device connections. Figure 2.2 illustrates Wi-Fi connectivity.

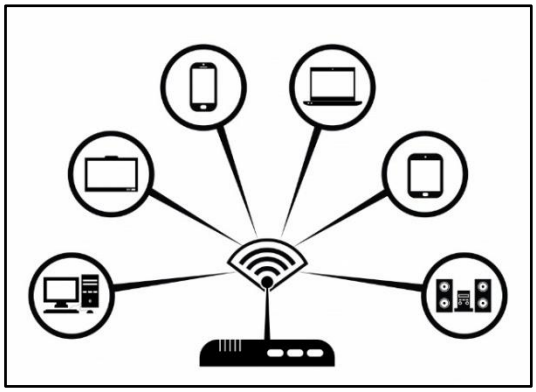

Figure 2.2 Wi-Fi connectivity

Smart switches are a novel technology that enables users to remotely manage their electrical devices through IoT-enabled devices, providing Wi-Fi connectivity for automation and control [4]. Smart switches may revolutionize our interaction with electrical devices, offering greater control, convenience, and potentially improved energy efficiency. Data protection and privacy concerns must be addressed. Figure 2.3 depicts the Wi-Fi IoT ecosystem.

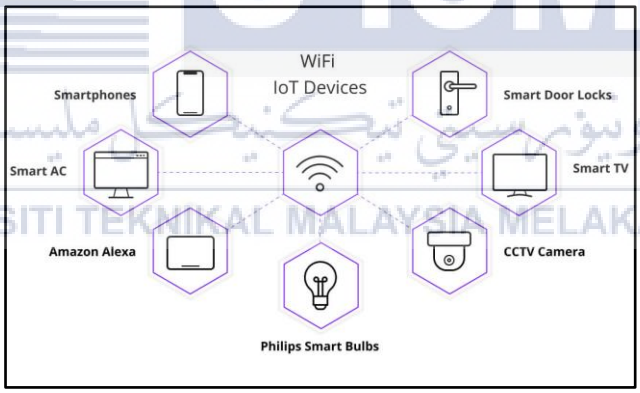

Figure 2.3 Wi-Fi IoT ecosystem

2.3.1.2 Zigbee

Zigbee is a low-power wireless communication standard used in home and industrial automation. It operates on the 2.4 GHz frequency and employs a mesh network design for scalability and reliability [5]. Zigbee is ideal for low-power, low-data-rate applications and is commonly used in household, industrial, and sensor network automation. It utilizes the IEEE 802.15.4 standard and consists of coordinators, routers, and end devices that manage

the network. With a range of up to 100 meters, Zigbee can support up to 65,000 devices. It is known for its reliability and energy efficiency, but proper installation and adherence to manufacturer guidelines are crucial for reliable and secure operation. Figure 2.4 show Zigbee Networking topology

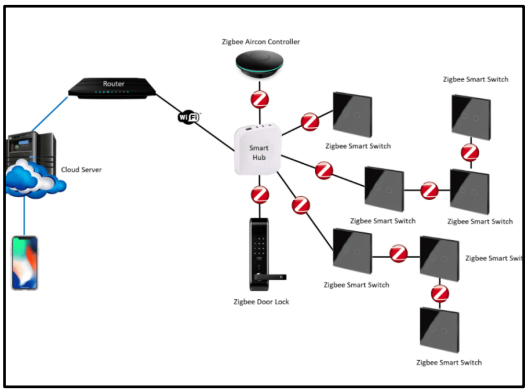

Figure 2.4 Zigbee Networking topology

Zigbee is often used in IoT devices for home automation[5]. Zigbee-compatible smart switches make intelligent home lighting control easy and green. These switches can be controlled by voice, mobile app, or central hub. Figure 2.5 show mesh connected IoT device.

Figure 2.5 Zigbee IoT Topology

2.3.1.3 Bluetooth

Bluetooth lets devices share data wirelessly. Bluetooth employs UHF radio wavelengths between 2.400 and 2.485 GHz [6]. It connects non-cabled devices cheaply and efficiently. Bluetooth lets phones, laptops, headphones, and speakers exchange and

communicate. This technology allows wireless file transfers, music streaming, and device connections. Harald Bluetooth, a 10th-century Danish monarch who united Denmark and Norway, gave it its name

Bluetooth allows customers to remotely control electrical appliances via an IoT-enabled device. Smart switches with Bluetooth capability can be deployed without a hub or bridge. Voice commands, scheduling, and energy monitoring are provided on the devices. Follow manufacturer instructions and recommended practices for safe installation and operation. Smart switch connected to Bluetooth-enabled electrical equipment are the easiest and cheapest way to control home lights. Bluetooth is restricted to their class as shown in table 2.1 [6] and depends on the limits and density of the walls separating the devices.

Table 2.1 Comparison Bluetooth Device Class

Device Class	Maximum Transmit Power (mW)	Maximum Range (Meter)
Class 1	100	100
Class 2	2.2	10
Class 3	1	1

2.3.1.4 Z-Wave

Z-Wave is a wireless protocol for home automation [5]. Smart devices within a home ecosystem can communicate and be remotely controlled. Z-Wave network integrates devices like temperature controls, door locks, and sensors for control via a controller/gateway [5]. Smart devices such as security systems, thermostats, and lights can communicate with each other through a source-routed mesh network technology. The protocol's mesh architecture utilizes devices as signal repeaters to ensure broad coverage and reliability. The protocol operates on low-frequency bands and provides transmission rates

for small data packets with AES 128 encryption, IPv6, and multichannel operation. Z-Wave is retroactively compatible, and all smart home products with Z-Wave branding must be certified. Z-Wave technology offers a low-cost and low-power alternative to Wi-Fi, with a range of 98 to 328 feet and up to four hops. The diagram in figure 2.6 below shows z-wave node diagram.

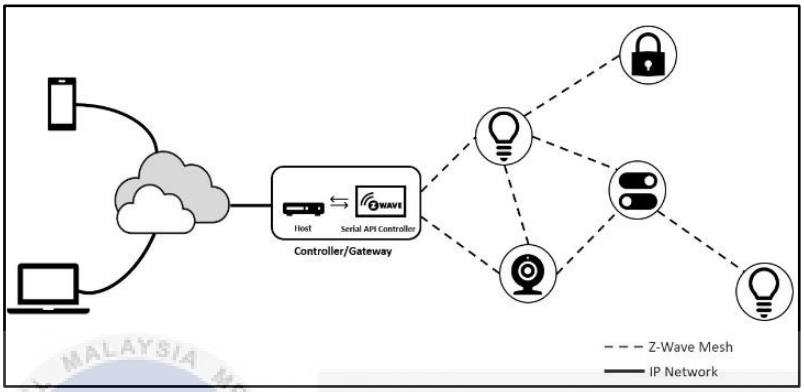

Figure 2.6 Z-Wave node diagram

Z-Wave is advantageous for smart switches in smart home networks and IoT devices. Z-Wave has limitations including limited coverage, support for only tree topology structure, limited number of nodes, and low data communication speed [5]. Although limited, Z-Wave is still a popular option for smart homes because of its ability to work with other wireless devices in the IoT industry.

2.3.1.5 Comparison of Connectivity Technology

Based on the subtopic above, we have explained several wireless communication technologies such as Wi-Fi, Bluetooth, Zigbee, and Z-Wave that are usually used by smart switches and IoT devices [5]. Connectivity plays a crucial role in the IoT ecosystem by establishing connectivity between devices. The selection of technology must be considered in terms of its advantages, limitations, and suitability for building [5]. For instance, Wi-Fi is ideal for high-bandwidth applications; Bluetooth is better suited for low-power and short-range applications; Z-Wave is designed for home automation and has a longer range than

Bluetooth; and Zigbee has low power consumption and is suitable for battery-operated devices [5].

However, the efficacy of each technology varies based on the use case and devices employed. A comprehensive study comparing the power consumption, range, cost, scalability, and interoperability of these technologies can help users choose the best wireless technology for their home automation system. The study [5] proposed five indices to simplify the selection process. It is important to consider the risks of these technologies, as discussed in previous literature reviews. Table 2.2 compares wireless communication technologies across five indices.

Table 2.2 Comparison of Wireless Technologies

Indices	Wi-Fi	Zigbee	Bluetooth	Z-Wave
Power consumtion	High	100 mW	10 mW	1 mW
Range	1000 M	100 M	10 M	30 M
Cost	Medium	Low	Very low	High
Scalability	32	6000	20	>6000
Interoperability	Wi-Fi compatible device	Same manufacterers	Bluetooth compatible device	Different Manufacturer

2.3.2 Microcontroller

A microcontroller is a small computing system designed for specific applications in integrated systems. The system comprises a CPU, memory, input processors, and interface and output ports for peripheral devices. Microcontrollers can perform real-time control tasks efficiently despite their limited computing power and capacity. These devices are widely used in industries such as consumer electronics, industrial automation, robotics, automotive systems, and medical devices. Specialized languages and tools programmable microcontrollers for autonomous task performance. Input and output ports enablecommunication between sensors, actuators, displays, or communication modules by

facilitating the interfacing of other devices. Figure 2.7 below is a block diagram of a microcontroller.

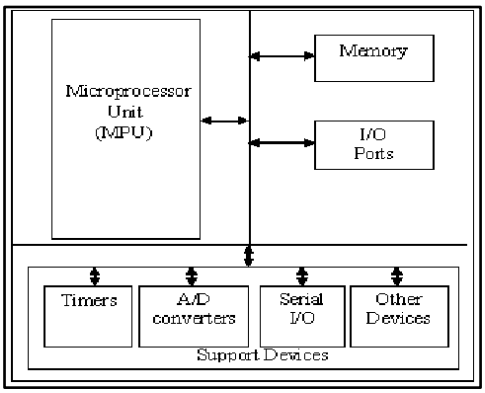

Figure 2.7 Microcontroller block diagram

According to the article "Smart Switch for Home Automation Using Micro Controllers," written by P. Gupta and R. Kumar, it deals with the use of microcontrollers in smart switches. The article considers the design and implementation of a smart switch that uses microcontrollers to control the status of appliances in your home. From the two journals, we can see the importance of the microcontroller as the main device in smart switches. Figure 2.8 below represents popular microcontroller used IoT.

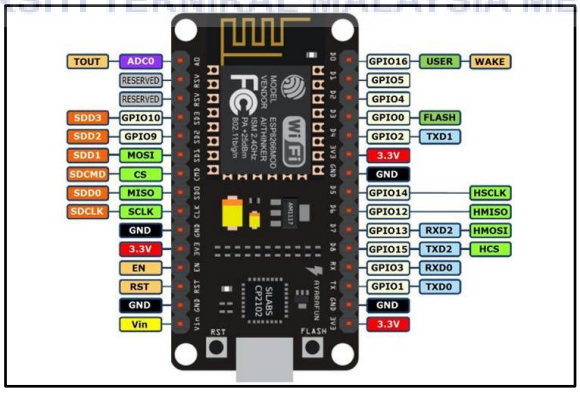

Figure 2.8 Popular Microcontroller in IoT

2.3.2.1 ESP 8266

The ESP8266 is a highly popular and widely used Wi-Fi-enabled microcontroller module developed by Expressive Systems. It integrates a microcontroller unit with built-in Wi-Fi capabilities, making it an excellent choice for creating IoT devices and projects that require wireless connectivity [7]. The ESP8266 module is known for its affordability, compact size, and versatility. The ESP8266 supports a wide variety of communications protocols, including TCP and UDP, HTTP, MQTT. This flexibility enables seamless integration with different IoT platforms and services. It also allows for interfacing with external devices and sensors, expanding its capabilities for interacting with the physical world. Figure 2.9 below shows ESP 8266 Architecture.

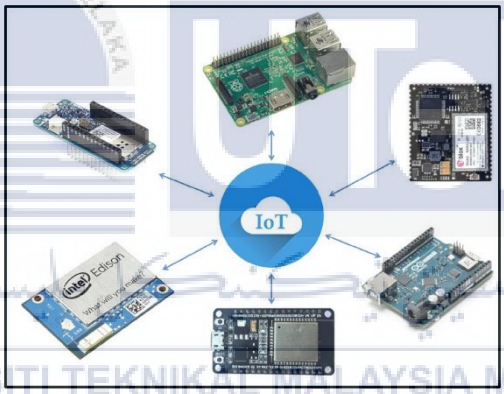

Figure 2.9 ESP 8266 Architechture

To use ESP8266 as a smart switch, it needs to be programmed to connect to a Wi-Fi network and receive commands from a mobile application or a web interface. The microchip can be programmed using various programming languages, such as Arduino, Lua, and MicroPython. There are many resources available online for learning how to program it. In a scholarly publication within the Journal of Automation, Mobile Robotics and Intelligent Systems, a team of researchers affiliated with the University of Novi Sad, Serbia, showcased their utilization of the ESP8266 microcontroller module to develop a mobile app-controlled smart switch.

Within their research investigation, the scholars employed the ESP8266 microcontroller to establish a connection between the smart switch and a Wi-Fi network. By utilizing the Arduino IDE, they programmed the microcontroller to perform desired functions. In conjunction, they developed a mobile application that enables seamless communication with the smart switch via the established Wi-Fi network. This mobile app empowers users to remotely activate or deactivate the lights and fans, as well as conveniently adjust their respective intensities. Figure 2.10 below shows a working between App to ESP 8266 with Wi-Fi connection.

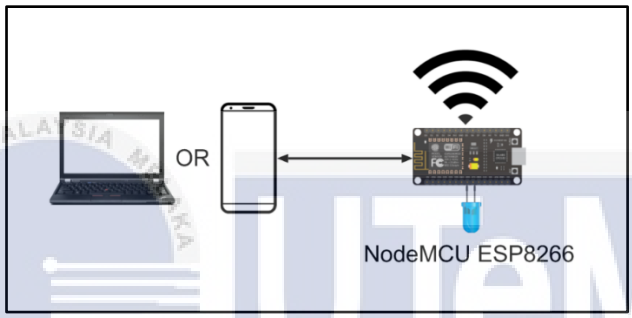

Figure 2.10 ESP8266 with Wi-Fi

2.3.2.2 Arduino

Arduino is an open-source e platform based on easy-to-use hardware and software. The platform consists of a microcontroller, sensors, actuators, and a development environment for programming the microcontroller. In 2005, Arduino was invented by students at the Interaction Design Institute Ivrea in Italy [8]. Arduino is an electronic platform comprising hardware and software components. The Arduino has programmable microprocessors that can be easily programmed using a simplified version of C++ called the Arduino IDE [8]. Various types and models of Arduino are available, including the Arduino Uno, Arduino Mega, Arduino Nano, Leonardo, Arduino Due, and Arduino Mega ADK [8]. To meet the different project requirements, these boards provide a variety of features and capabilities. Figure 2.11 below shows a various model of Arduino board.

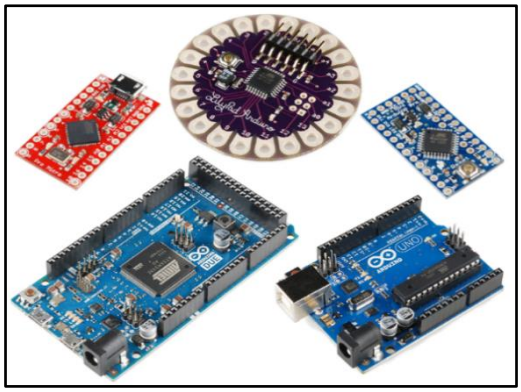

Figure 2.11 Various Arduino Model

2.3.2.3 Raspberry Pi

The Raspberry Pi is an open-source computer built in the United Kingdom by a foundation named Raspberry Pi. Raspberry Pi consists of a series of small-board computers that were developed as a learning aid for basic computer skills for students [9]. It's equipped with a processor, memory, storage, and a few input and output options. And it's the GPIO which enables him to interact with electronics components, sensors, or actuators, that differentiate this Raspberry Pi from others. There are a variety of Raspberry Pi models that are available as 2.12 figure shown below.

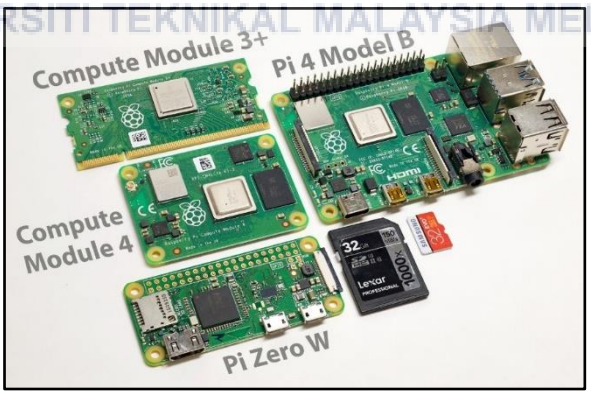

Figure 2.12 Raspberry Pi Model

2.3.2.4 Comparison of Microcontroller

In summary, while all three platforms are used in IoT projects, they have different strengths and purposes. Simple wireless communication and basic sensing and control tasks

are suited to the ESP8266. The Raspberry Pi is well-suited for applications demanding high complexity, as it possesses enhanced processing power, flexibility, and expanded communication options. On the other hand, the Arduino excels in the domain of physical computing and prototyping, prioritizing seamless interactions with external sensors and actuators. Its dedicated focus on this aspect makes it particularly suitable for such purposes. Specific requirements and the complexity of the project in question determine whether to choose between these platforms. Table 2.3 below shows microcontroller comparison.

Table 2.3 Microcontroller Comparison

Feature	**ESP8266**	**Arduino**	**Raspberry pi**
Microcontroller vs. Computer	Microcontroller with Wi-Fi capabilities.	Microcontroller board designed for embedded systems.	Functions as a single-board computer, capable of running a full operating system.
Processing Power	Moderate processing power with 32-bit RISC microcontroller.	Limited processing power with AVR microcontrollers.	Offers a higher processing power with ARM-based processors.
Connectivity	Equipped with built-in Wi-Fi capabilities.	Limited connectivity options, primarily relying on USB, UART, I2C, and SPI.	Provides a wide range of connectivity options, including Ethernet, Wi-Fi, Bluetooth, and USB.
GPIO Pins	Provides 17 digital GPIO pins for basic hardware integration.	Offers a range of digital and analog pins, but with fewer options compared to Raspberry Pi.	Features a varying number of GPIO pins (26 to 40 pins), allowing for versatile hardware interfacing.
Programming	Programmed using the Arduino IDE based on C/C++.	Programmed using the Arduino IDE based on C/C++.	Supports various programming languages, including Python, C/C++, Java, Scratch, and more.
Application	IoT projects, home automation,	Robotics, IoT projects,	Robotics, home automation,

2.3.3 Computer Aid Design Software

The utilization of CAD software is considered a fundamental aspect in the creation, alteration, assessment, and enhancement of designs across diverse sectors. CAD software is crucial for designing, modifying, evaluating, and improving designs in different industries. Common CAD software includes SolidWorks, Autodesk Inventor, and Autodesk Fusion. Selecting appropriate CAD software depends on factors such as requirements, industry preferences, and individual operational methods. Table 2.4 show CAD comparison.

Table 2.4 Comparison CAD Software

	SolidWorks	**Autodesk Inventor**	**Autodesk Fusion 360**
User-Friendliness	User-friendly interface	Complexity for beginners	Cloud-based collaboration
Modeling	Advanced 3D modeling capabilities	Robust feature set	Parametric and direct modelling
Integration	Integration with other software	Integration within Autodesk ecosystem	Extensive file format compatibility
Learning Curve	Steeper learning curve for complex designs	Complexity for beginners	-
Collaboration	-	-	Cloud-based collaboration

2.3.4 Smartphone Software Development

Smartphone software is one of the main factors in enhancing data to be monitored and controlled. The IoT ecosystem relies on smartphone software for monitoring and controlling data. The app acts as a controller, ensuring security, accessibility, and user

experience. Smartphones currently use iOS and Android operating systems, with software integrating to facilitate communication between IoT devices and smartphones.

2.3.4.1 Blynk Application

Blynk is an IoT platform that enables remote control of electronic devices through iOS and Android apps. For devices such as Arduino, ESP8266, Raspberry Pi and SparkFun he provides a dashboard where you can create Graphical Interactions with Widgets, Sensor's, or Library [10]. The Platform is made up of three main components: applications, servers, and libraries [10]. However, Blynk's performance may be affected by unstable internet connections and its dependence on cloud infrastructure, potentially affecting reliability and performance during server outages or technical issues. Figure 2.13 shows the Blynk working diagram.

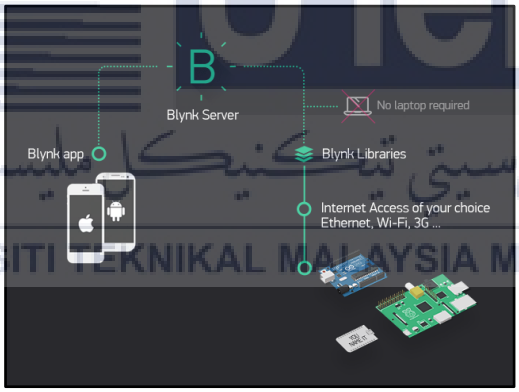

Figure 2.13 Blynk Working Diagram

2.3.4.2 MIT App Inventor

MIT App Inventor is an open-source platform for building mobile apps. Users can create Android and OS applications using a drag-and-drop interface for visual objects [11]. The platform seeks to democratize mobile app development. MIT App Inventor simplifies mobile app development with a visual programming interface. Users can create app functionality by utilizing prebuilt code blocks that can be easily dragged and dropped instead

of manually writing code (Fig. 2.14). The system's success as a creation tool can be attributed to its user-friendly interface. Over 10 million people worldwide have used MIT App Inventor, creating 43 million projects [11]. In summary, MIT App Inventor offers a beginner-friendly approach to mobile app development using a graphical programming interface. This technology offers benefits such as accessibility, rapid prototyping, educational value, and compatibility with multiple devices. However, this approach has limitations in terms of complexity, platform dependence, and customization restrictions. MIT App Inventor is a useful tool for learning and creating Android apps of varying complexity, despite its limitations.

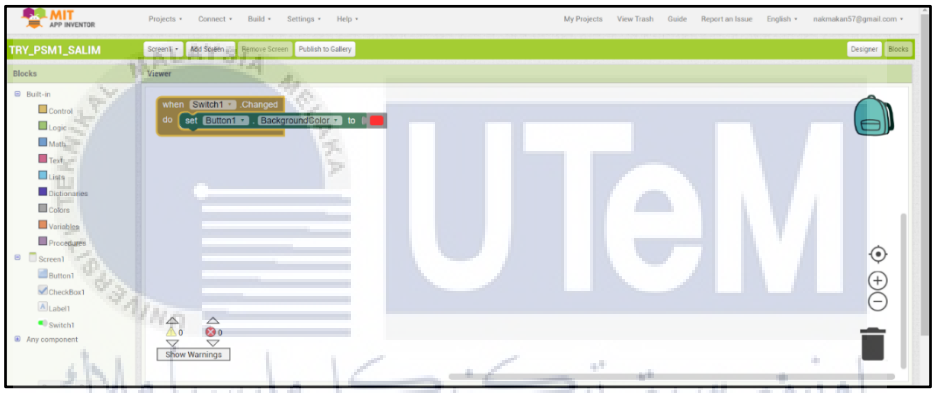

Figure 2.14 Drag-and-Drop Code block

2.3.4.3 Tuya Developer App

The Tuya Developer App is a software tool designed by Tuya to facilitate the development and administration of smart home devices and applications that operate within the Tuya ecosystem. The simplification of the development process is achieved through the provision of intuitive tools and templates for device configuration, cloud integration, and user management. The technology presents numerous benefits to developers who aim to design personalized IoT solutions. The integration of devices with the Tuya cloud platform can be achieved by developers through the utilization of Tuya's APIs and SDKs. The

implementation of remote control, real-time data monitoring, and synchronization across multiple devices has the potential to improve the user experience.

The technology presents various benefits to developers who aim to design personalized IoT solutions. The Tuya Developer app facilitates the integration of Arduino and Raspberry Pi devices with the Tuya cloud, allowing for streamlined administration and manipulation via the Tuya app. The Tuya Developer app facilitates the customization of the user interface and functionalities within the Tuya app. This allows for the tailoring of the app experience to meet specific requirements or branding needs. It is crucial to consider possible constraints when utilizing the Tuya development platform, including the learning curve, hardware compatibility, reliance on the Tuya ecosystem, and potential limitations on development flexibility within the Tuya framework. Figure 2.15 below show Tuya application interference.

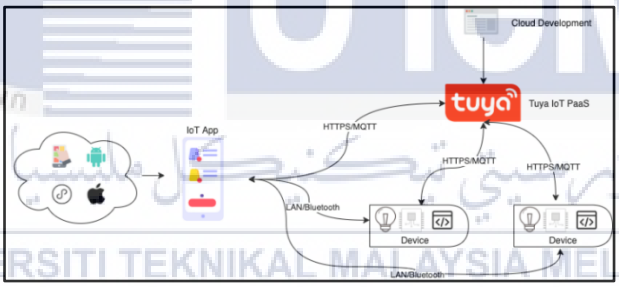

Figure 2.15 Tuya Application Interference

2.3.4.4 Comparison of Smartphone Software

MIT App Inventor, Blynk, and Tuya are three different platforms that cater to distinct areas of application development. MIT App Inventor focuses on mobile app development, while Blynk is specifically designed for IoT development. Tuya targets the automation and control of various smart devices within a home environment. The choice among these platforms depends on the specific requirements and objectives of the project at hand.

2.4 Related Journal Research

In This subtopic will establish a correlation with prior or analogous project goals. The objective of this process is to examine the proposed research idea and concept that will be further developed in the project. The purpose of this journal is to provide an understanding of the benefits and drawbacks of prior research. A selection of journals has been chosen based on their alignment with the objectives and concepts of the similarity.

2.4.1 IoT enabled Smart Switch With user-friendly Electrical Interfacing [12]

In their study, G. Manikannan, P. Prabakaran, and M. Selvaganapathy presented a novel approach for the creation and implementation of an Internet of Things (IoT)-enabled intelligent switch. The proposed system was designed to incorporate a user-friendly electrical interface and provide power on/off notifications via an Android application.

The present system has been developed to function in two modes, namely manual and internet-enabled, thereby facilitating users to regulate their household equipment through a singular touch. The objective of this research is to develop a system that can efficiently incorporate novel technologies into pre-existing infrastructure, while minimizing the need for substantial monetary resources. Figure 2.16 below represents mobile applications and figure 2. 17 project flowcharts that have been designed by this research.

Figure 2.16 Mobile App Home

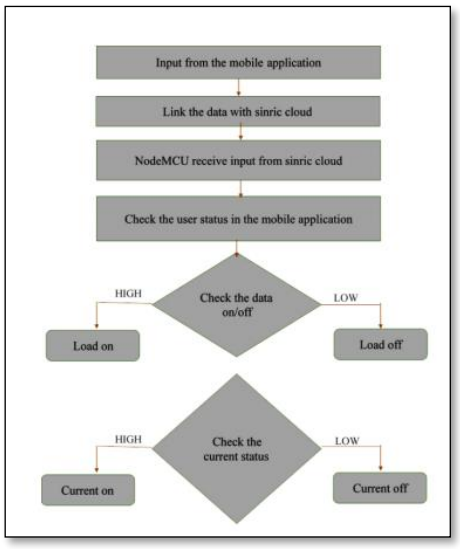

Figure 2.17 Project Flowchart

2.4.2 IoT Smart Plug based on ESP8266 Wi-Fi Chip [13]

In their study, Rohan Garg and Dr. B Dastagiri Reddy proposed a smart plug that is intended to enable users to remotely manage connected devices by providing functionalities such as on/off toggling, device status monitoring, scheduling of device activation or deactivation at user-defined intervals, usage history tracking, physical switch-based device control, and security measures to prevent unauthorized access. The plug exhibits a range of functionalities, including the capacity to activate and deactivate connected devices, remotely monitor the status of the device, schedule the device to power on or off at a user-designated time, track the device's usage history over a 24-hour period, manipulate the device through a physical switch on the plug, and implement a security layer to forestall unauthorized usage.

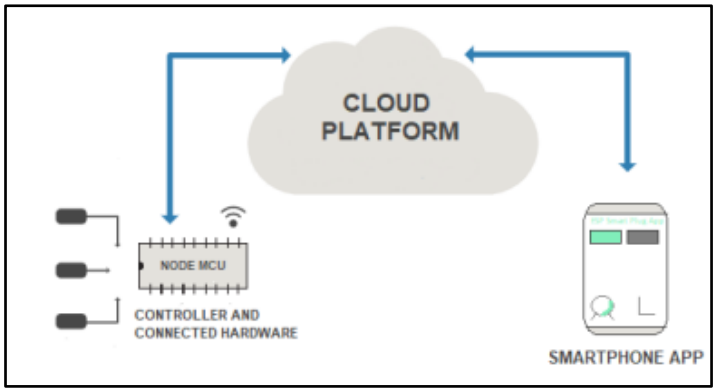

Figure 2.18 Cloud for NodeMCU

ThingSpeak is an open-source platform that enables Internet of Things (IoT) applications and APIs. It provides users with the ability to collect, display, and evaluate real-time data streams in the cloud. The present study demonstrates that the app and NodeMCU establish communication solely through cloud-based mechanisms (figure 2.18), thereby enabling users to remotely operate the plug from any location worldwide, contingent upon the device's internet connectivity. Using MIT Inventor App in smartphone as shown in figure 2.19.

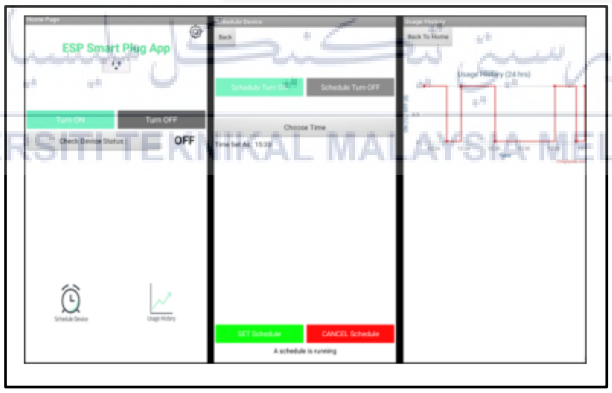

Figure 2.19 MIT App Inventor

2.4.3 IoT Based Smart Home Automation Enabled with Manual Mode Switch Control [14]

This project was presented by Anand Pratap Singh, Arghya Biswas, and Brahmjit Singh. The proposed system has two modes for controlling appliances: one from the web and one from the manual switch. In web mode, a signal is received via Wi-Fi and processed

by a Raspberry Pi. The microcontroller (Attiny88) then updates the connected appliances via SSR and sends an acknowledgment to the Raspberry Pi to update the database. The microcontroller executes data signal processing in the manual switch mode and transmits a command to the appliances through SSR to activate or deactivate them based on the switch status. Subsequently, the microcontroller transmits an acknowledgement signal to the Raspberry Pi for the purpose of updating the database.

The proposed system combines wireless and manual modes to control home appliances remotely and locally. The website is a GUI with a proper database, and the Raspberry Pi can connect to the database via Wi-Fi connectivity. In the first mode, the Raspberry Pi processes the data and sends it to the microcontroller Attiny88 via an I2C communication protocol. In the second mode, the microcontroller modulates the data and sends it to the SSR to control the appliances. Finally, the Raspberry Pi sends the data to the webserver to update the website database. Figure 2.20 shows a block diagram for smart switch system.

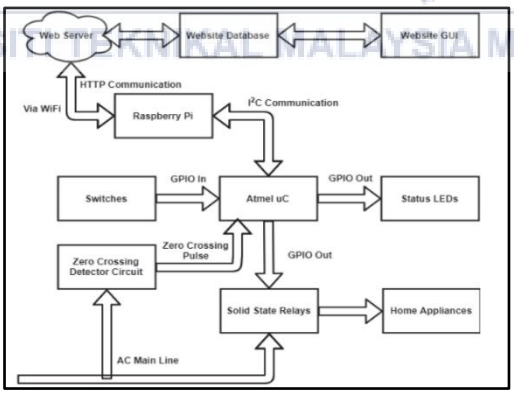

Figure 2.20 Block Diagram for system

2.5 Previous Research Comparison

Table 2.5 Previous Research

No.	Author	Year	Tittle	Method	Advantage	Limitation
1	G. Manikannan, P. Prabakaran, M.Selvaganapathy	2016	IoT enabled Smart Switch With user-friendly Electrical Interfacing [12]	Sinric Pro, Google Home and Amazon Alexa App with ESP8266, NodeMCU, or ESP32	- User-friendly App - Increases efficiency - Real-time monitoring section	- Dependency to internet speed - Dependency on cloud -Hard to first setup - Range
2	Rohan Garg, Dr. B Dastagiri Reddy	2022	IoT Smart Plug based on ESP8266 Wi-Fi Chip [13]	Use ESP8266, ThinkSpead Cloud, rudimentary method, and MIT App Inventor	- Android application - Can be controlled from everywhere - Has control timer - Physical and Software control - Compact size	- Not support IOS - Cannot control high load - Limited app function
3	Anand Pratap Singh, Arghya Biswas, Brahmjit Singh	2019	IoT Based Smart Home Automation Enabled with Manual Mode Switch Control [14]	Using Raspberry Pi, Two-mode operation, Linux Operation System, Attint88 (Microcontroller), Solid State Relay circuit.	- Can operate in two modes (Web & Manual) - Flexibility and Reliability to the home appliances - Real-time domain	- Complex Phyton server - Old piano type switch - Web Mode cannot update physical switch status - Replacement phyical switch problem
4	Ms. S. Premalatha, Mr. T. Sathies Kumar, Ms. K. Srividya, Mr. B. Rajapandian, H.Maadhavan,	2019	Multi-Way Switching System Using Iot [15]	Using ESP32, 8 channel Relay, RFID Module, Wi-Fi & Bluetooth, MIT App Inventor, Blynk App	- Low-cost - Easy-installation - Multiple control option - support Android & IOS operating system	- Less app functionality - Less load capability - Not compact

No.	Author	Year	Tittle	Method	Advantage	Limitation
					- Maximizing home security - end users experience great convenience	
5	Jain-Shing Wu1, Ming-Shen Jian	2018	Smart Local Area Services based on IOT Identification with Adaptive Cloud Intelligent Switch [16]	Sytem three layers: Physical Layer, Intelligent Layer, and Command Layer	- Customized services - Easily controlled and managed by the remote cloud virtual machine - Real implementation environment.	- Dependency on cloud - Short range
6	Yung-Chung Tsao, Chia-Chun Wu, Yaw-Wen Kuo, Yin-Te Tsai, Chihcheng Hsu, Renjie Wang, Polun Chou, Liulin Ho, Chiyang Li, Chihsheng Ko	2021	An Implementation and Design of a Digital Light Switch of Smart-Home Based on MQTT Broker [17]	Using Message Queue Telemetry Transport (MQTT), NodeMCU-32 Lua WiFi, MIT App Inventor	- Android & IOS compatibility - Map Accessibility - Good internet security	- dependency of Internet Access - dependency on cloud
7	Bharath S.	2021	IoT Based Smart Switch With Bluetooth Speaker Using MQTT Protocol: Node-red Framework [18]	Using nodeMCU, Bluetooth speaker, Kodular software tool, MySQL Database, MQQT,	- Low-cost - Easy to connect to home network - Efficient and easy to install and operate	- Limited app functionality - Not Compatible to IOS - Cannot use at bigger scale
8	Imran Hussain S, Deepalakshmi S, Benilla R J, Charu Nivetha V,	2023	Automation of Smart Home using Smart Phone via Google Assistant [19]	Using Google Assistant, ESP32, IFTTT App,	- Control by using Google Assistant - Affordable cost	- Dependency of Internet Access - Dependency of Google Assistant

No.	Author	Year	Tittle	Method	Advantage	Limitation
						- Limit functionality
9	M. Arunkumar. V. Archana. S. Anjana Devi, S. Nithya Sri	2023	Advanced Smart Home and Office Automation using IoT [20]	Dual mode Smart home and Office Automation, IFTTT, NodeMCU, Mongo DB, Blynk App	- Control by Blynk - Monitoring Air Quality, Temperature and Humidifier - Camera assist function	- Dependency of Wi-Fi
10	Md. Ibne Joha, Md. Shafiul Islam	2021	IoT-Based Smart Home Automation Using NodeMCU: A Smart Multi-Plug with Overload and Over Temperature Protection [21]	ESP8266, Blynk App	- Overload Protection - Good security - Monitoring temperature and Power	- Dependency on speed internet (delay) - Dependency of Wi-Fi

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2.6 Summary

In conclusion, this literature review chapter has been focused on research and journal from previous or similar project conceptual. In this chapter, the comparison in subtopic to investigate the advantages and limitations of every aspect that be used to this project development. All aspects have been considered to ensure that the project that will be developed gives more advantages regarding project limitations. This development of Smart Switch will encourage people to go inside IoT ecosystems and became accelerated to Industry Revolution 4.0 that has IoT ecosystems. The project focus of this project is to develop smart switch wiring and casing that are optimized for ease of use by end-users.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses a series of stages of development until this project is completed. The purpose of this chapter is to provide details on components and project concepts. This development of smart switches will ensure the simplicity and efficiency of the technology applied. All the factors of the development of a smart switch, such as hardware and software, have been emphasized as being designed and assembled as a project. The ideas-based project objective and research in this chapter are implemented to design and develop smart switches with user-friendly wiring and casing that endure climate environments.

3.2 Smart Switch Installation Problem

Existing smart switch installation process there are commonly problems that will occurs to consumer. The installation is not user-friendly for first user installation and to consumers that do not have electrical experience and knowledge. The wrong step and wiring during installation can lead to electrical hazard such as electrical shock. Proper equipment for electrical work also will be needed such a test pen, multimeter, and screwdriver that usually consumer does not have. Without any knowledge of electrical it will be the most challenging during installation. Furthermore, another option that consumers have was hiring an electrical expertise to install the device, but it cost higher than device price. Figure 3.1 below installation process that needs to be done by consumer.

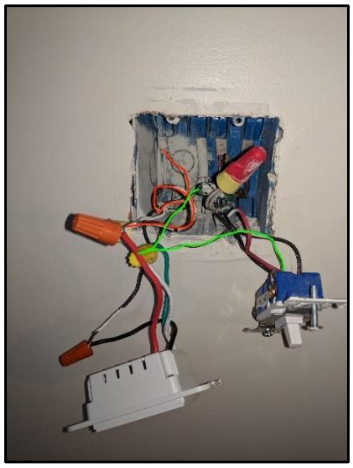

Figure 3.1 Wiring Installation

3.3 Design to overcome wiring issue

The design and development of smart switch user-friendly wiring and case to overcome that installation issue. This design has considered all the aspects of smart switch in term to implementing a PnP conceptual to ensure problem can be solved according to project objectives. This subtopic will content design process and component that be use for this project. The figure 3.2 below shows flowchart designing and assembly process.

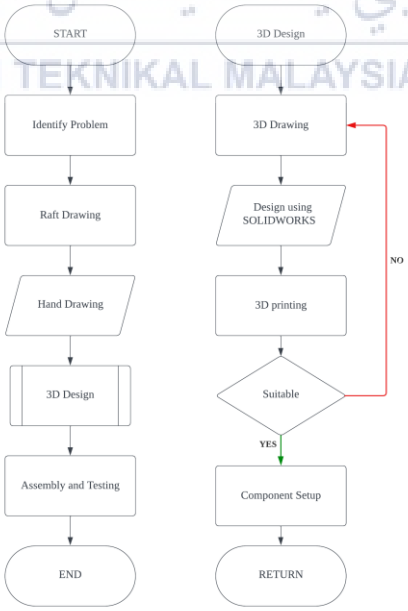

Figure 3.2 Flowchart Design and Assembly

3.3.1 Component of Smart Switch

Before the design process, this part will focus on component that be used on the main part of project which main part. Smart Switch component will be the main priority to ensure to achieve project aims. Figure 3.3 below shows the component development process.

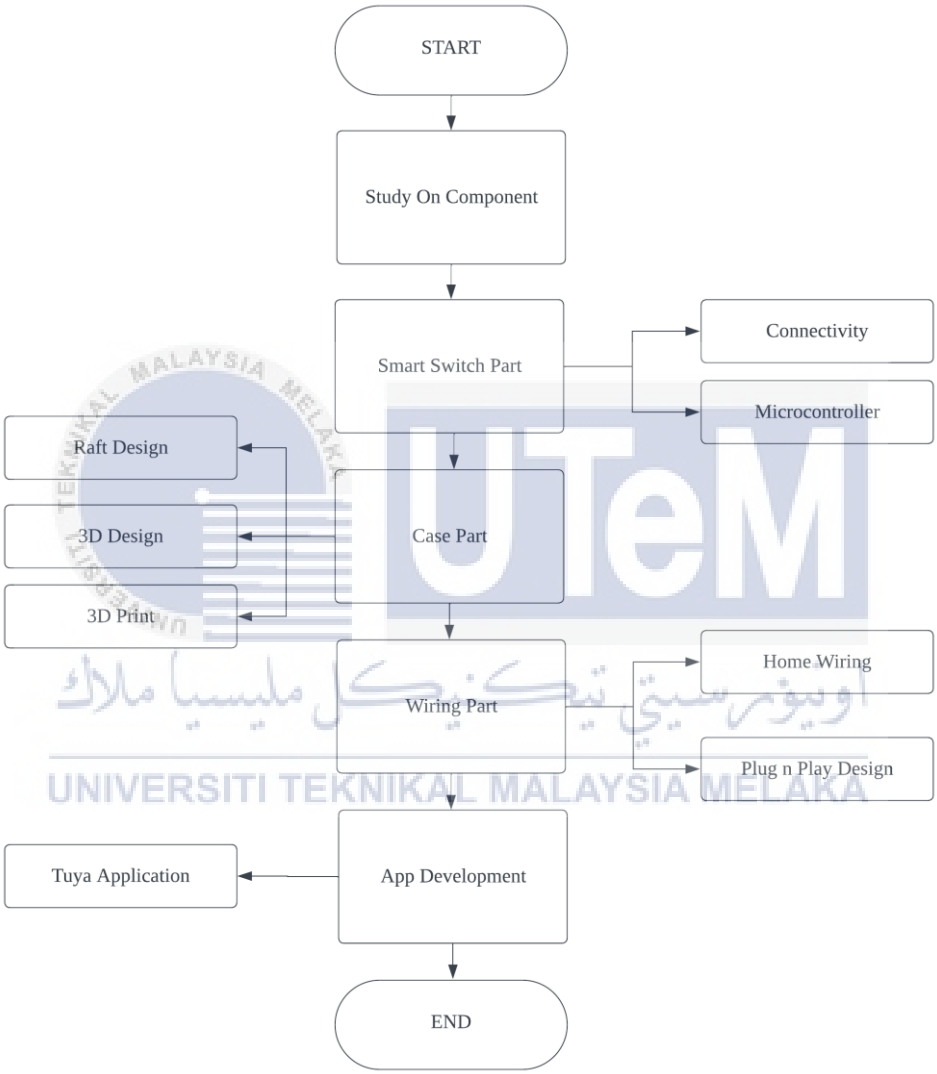

Figure 3.3 Flowchart of Component Development

3.3.1.1 Smart Switch Component

This subtopic will brief on component that be used in this project. There is an electrical component that be used to make a connection between home wiring and smart switch device. This component that use:-

a) TYWE3S

Fi module TYWE3S, which is compatible with Tuya's platform, is widely used in Internet of Things devices. It enables the integration of Wi-Fi and microcontrollers in one module allowing manufacturers to include them on their products, which will enable them to make connections with Tuya's cloud. The TYWE3S modules are based on the ESP8266 microcontroller by Espressif, which also has a Tensilica L106 32-bit RISC processor running at 80 MHz. The ESP8266 is known to be the least expensive, lowest energy consumption and it has built-in wireless networking capabilities that make it a good choice for Internet of Things applications. By coupling Wi-Fi connectivity and the software components needed, the TYWE3S module will facilitate manufacturers' fast development and deployment of Tuya compatible devices. It enables devices to be connected to the Tuya cloud allowing remote control, monitoring and integration with a variety of Smart Home systems. Figure 3.4 below shows labelled pins for TYWE3S.

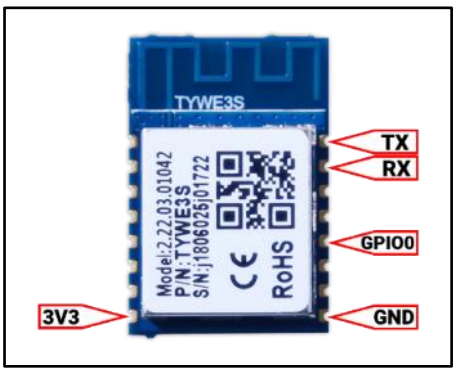

Figure 3.4 Labelled TYWE3S pins

b) Brass Plug Pin

A brass plug pin is a component used in electrical systems, typically found in plugs, connectors, and sockets. The brass plug pin serves as a conductor, allowing the flow of electric current from one point to another. The material is frequently composed of brass owing to its favorable characteristics of electrical conductivity and resistance to corrosion. When a plug pin is inserted into a socket or connector, it establishes contact with the corresponding terminals or pins in the receptacle. The establishment of this connection facilitates the passage of electrically charged particles, thereby enabling the functioning of diverse apparatus or the conveyance of signals. The specific function of a brass plug pin can vary depending on the application. In some cases, it may carry power for the smart switch's operation. This will be used in smart switch main part that to connect the base part terminal channel to connect residential electrical to the smart switch for power supply. Figure 3.5 below shows brass plug pin.

Figure 3.5 Brass Plug Pin

c) Electrical Terminal

Terminal contacts are metal parts that directly contact the smart switch pins when put into an electrical socket or outlet. Between the socket and the object being powered, these contacts create an electrical connection. The quantity and configuration of terminal contacts may vary depending on the electrical standard. A socket generally comprises two or three terminal contacts, namely the live contact and the neutral contact. The live contact

is responsible for transmitting electricity from the power source to the connected device, while the neutral contact acts as a channel for returning electricity to the power source. The secure interconnection ensures a dependable electrical linkage and enables the apparatus to obtain electrical power from the energy source.

Even when the smart switch pin is subjected to tiny movements or vibrations, terminal connections are made to maintain a stable and dependable connection. To ensure secure and dependable electrical connections, the design must comply with national electrical standards. Figure 3.6 below shows material of electrical terminal.

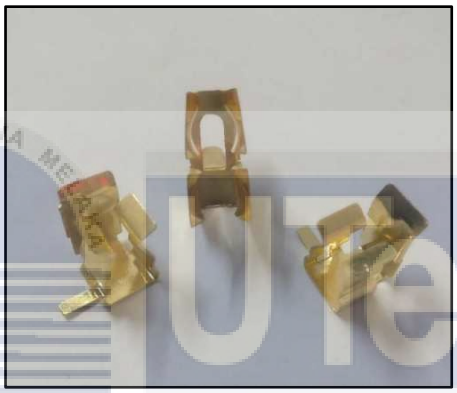

Figure 3.6 Electrical Terminal

3.3.2 Design Process

This subtopic will focus on designing a model for this project. This project has taken component as aspect to design a smart switch casing. This design will start with raft drawing to get earlier idea before proceeding in 3D modelling design then 3D printing model. The process to ensure the design process structured well.

3.3.2.1 Sketch Drawing

The initial phase of the casing design process involved the creation of a raft drawing. The process of creating a raft design for implementation in a smart switch involves using hand-drawn sketches to generate appropriate design concepts. The process of drawing a raft

is typically segmented into three distinct parts, namely the base component, the port slot component, and the smart switch component. The objective of this subtopic is to conceptualize an appropriate and simplicity design for the smart switch in advance of commencing the 3D rendering phase.

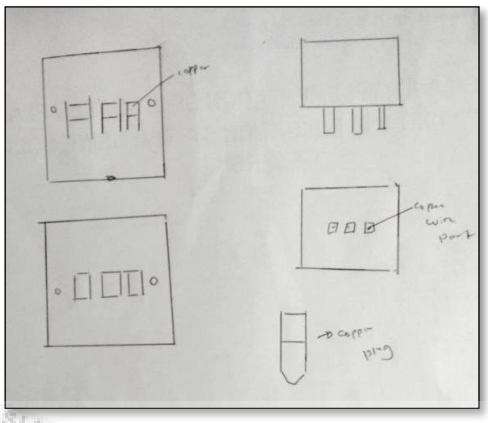

Figure 3.7 Sketch Drawing

3.3.2.2 3D Design

To design a 3D drawing for this project. has been chosen as software for designing 3D Model. SolidWorks is reliable computer-aided design (CAD) software that facilitates the creation of three-dimensional (3D) designs and models. The software enables users to generate intricate and precise models using diverse tools and features. Individuals have the capability to generate a component file, opt for a pre-designed format, and employ drafting instruments to produce a two-dimensional outline. Upon converting the initial sketch into a three-dimensional representation, individuals have the capability to implement various characteristics such as extrusion, revolve, and fillet. In addition to its basic features, SOLIDWORKS provides users with a range of advanced capabilities, including constraint options, material selection, and appearance customization. The software additionally enables the creation of intricate illustrations and records, affording its users the ability to preserve

and transfer data for diverse objectives, such as 3D printing. The figure below 3.8 shows a 3D model designing process by using SOLIDWORKS.

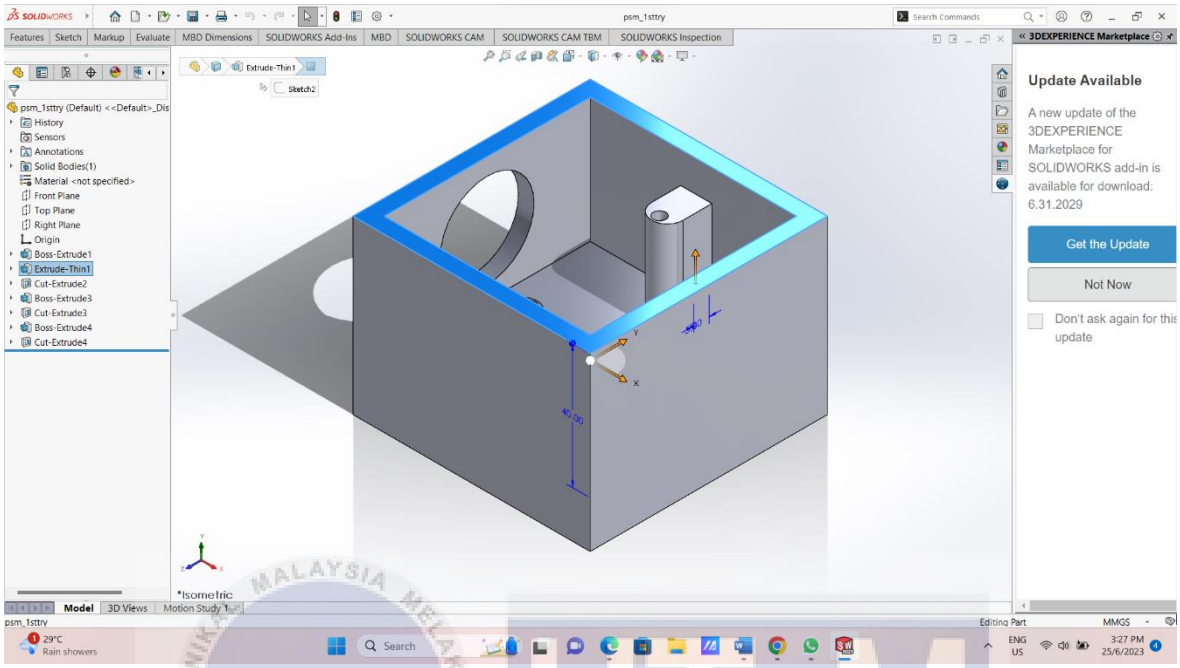

Figure 3.8 Designing 3D case by SolidWork

3.3.2.3 3D Print

After designing a 3D model on SolidWorks, the model will print by using a 3D printer machine. The process of 3D printing entails the production of tangible objects through the sequential layering of material by a 3D printer. All parts of the project body will be printed using 3D printer is due flexible to create model. With the presence of this 3D printer, it will allow us to create a model suitable for smart switch applications. Figure 3.9 below shows 3D printed case. Figure 3.10 shows flowchart of design and printing case until get final case.

Figure 3.9 3D Printed Case

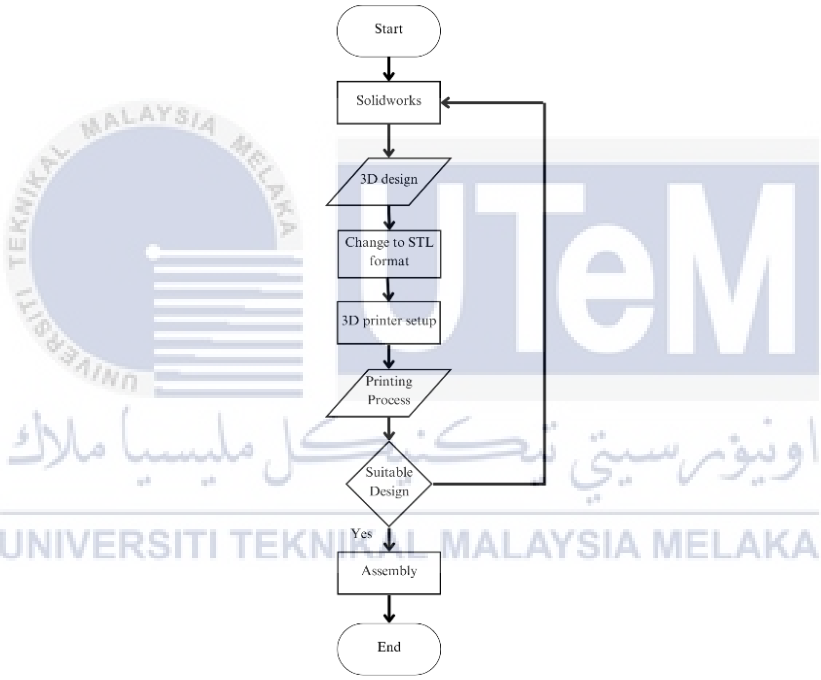

Figure 3.10 Design and 3D Printing Flowchart

3.4 Software Development

This subtopic will focus on device and software development to be used for control and monitoring smart switches. Smartphone applications will be used as interference devices to control and monitor smart switch via wireless network. Figure 3.11 below shows flowchart of controlling smart switch using smartphone applications.

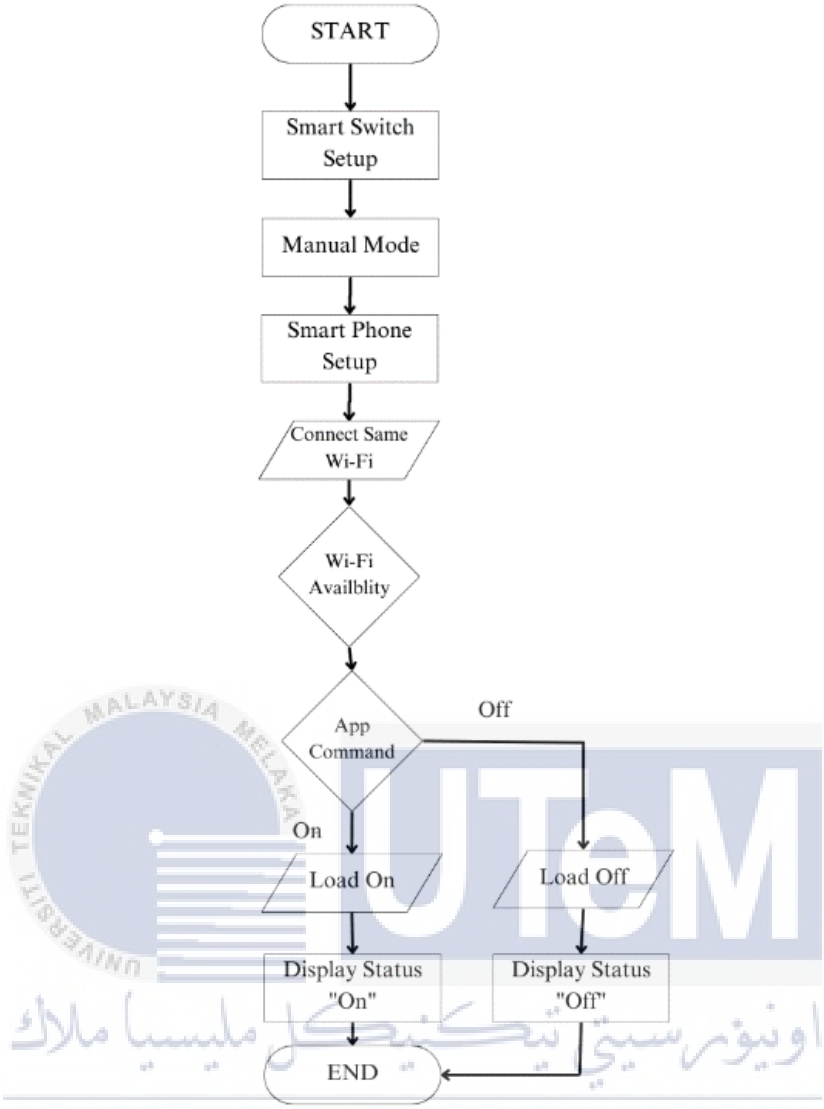

Figure 3.11 Controlled Smart Switch Flowchart

3.4.1 Tuya Developer Application

The Tuya Developer App is a mobile software application developed by Tuya Inc. to help developers create and manage intelligent devices. It offers features such as identifying and organizing connected devices, remote management, testing, and debugging. The Tuya IoT cloud platform integrates cloud development capabilities, enabling remote control, scheduling, and automation. Data analytics enable developers to monitor device performance and user behavior. The application also offers customization options for user

interfaces and experiences, allowing developers to create personalized experiences for their clients. Figure 3.12 below shows mobile app configurations to controlling the devices.

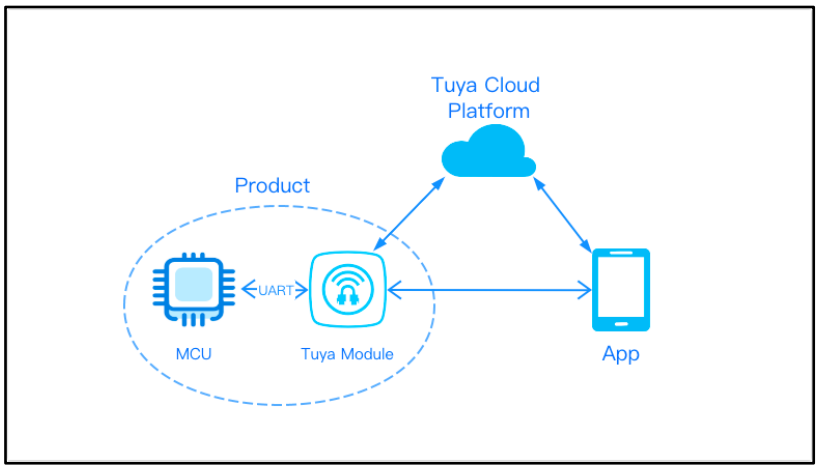

Figure 3.12 Tuya App configuration

The Tuya Developer App provides access to resources like documentation and APIs, aiding in understanding the platform and facilitating integration. Overall, the Tuya Developer App streamlines the process of developing, testing, and managing smart devices, easing the burden on developers. The figure below 3.13 shows app creation in Tuya developer website.

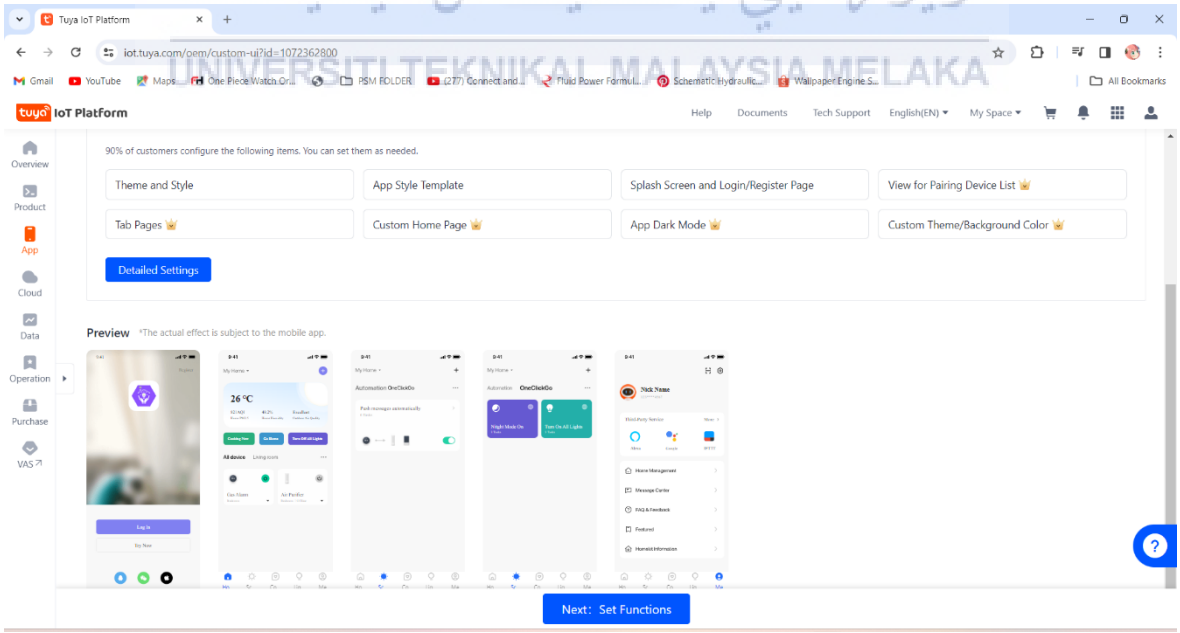

Figure 3.13 App Creation on Tuya Developer Website

3.5 Home Circuit Wiring Design

This subtopic is explaining the component and wiring part on home wiring. These wiring designs are represented of wiring that implemented on Malaysia standard. There are a few components that are used such as distribution board and single line diagram. This subtopic is explaining the component and wiring part on home wiring. These wiring designs are represented of wiring that implemented on Malaysia standard. There are a few components that are used such as distribution board and single line diagram. The component that is used is suitable for 240 V supply. This figure 3.14 below shows Home Wiring Diagram.

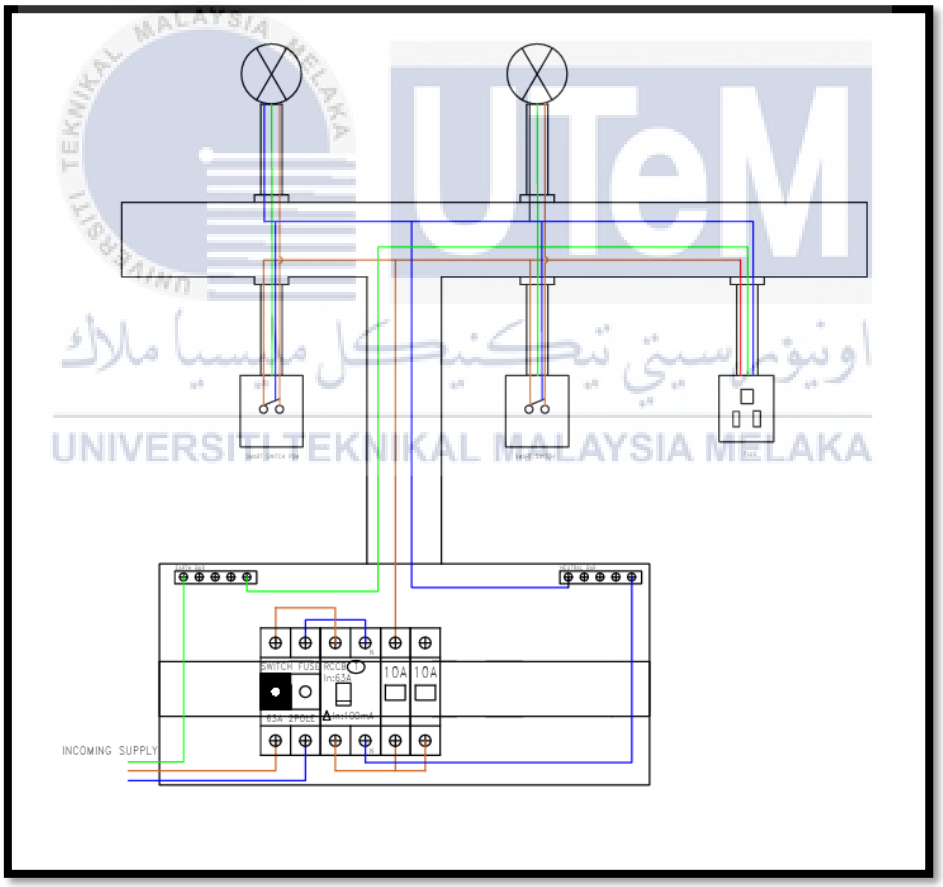

Figure 3.14 Home wiring diagram

3.6 Summary

This chapter presents the proposed methodology the focus is on outlining the proposed methodology for the development of a user-friendly smart switch, emphasizing both simplified wiring and intuitive control methods. The objective is to improve the overall user experience by simplifying the installation process and ensuring an intuitive control interface that is easy to use.This chapter provides a thorough examination of the methodology, offering insights into key design principles and practical steps for creating an efficient and user-centric smart switch.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis on the design and development of smart switch user friendly wiring and casing that can endure local climate. The 3D printed case of has designed has applied to implement Plug and Play concept to smart switch. These design improvements are on 3D design prototype to achieve the project objectives. Result and data have been taken to ensure circuit function as designed.

4.2 Case Prototype

This project requires a few designs and a 3D printing stage to acquire the final version. During this design process there was required a specific dimension to be built that need suitable for copper plate placement that use to transfer voltage and current from supply. This design has been drawn on SolidWorks software to generate the 3D design before executed to printing object process.

Figure 4.1 3D Base Model Prototype 1

The initial prototype, depicted in Figure 4.1 above, served as the first iteration of the base component but was rejected due to its excessive thickness and a terminal holder that proved smaller than the copper dimensions. Subsequently, the revised 3D base prototype, illustrated in Figure 4.2 below, was developed to address these concerns and refine the design.

Figure 4.2 3D Base Prototype 2

The illustrated figure represents the second iteration of the base prototype, characterized by an optimal thickness level. Notably, it features a well-designed holder suitable for accommodating the copper plate terminal. Subsequently, final design has been designed and printed.

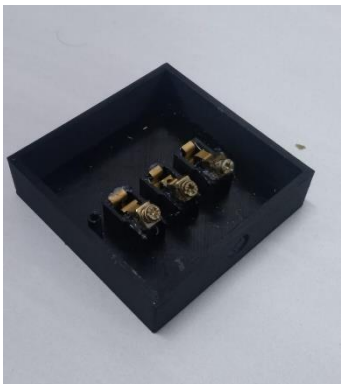

Figure 4.3 Final version of Base Case

Figure above 4.3 show the final version that final version printed case has been obtained. The copper plate terminal has a place on the holder. Additionally, the design incorporates a cover case element intended for locking the circuit, enhancing safety measures. Subsequently, Figure 4.4 below showcases the cover, serving as a safeguard against physical contact, thus mitigating potential electrical hazards.

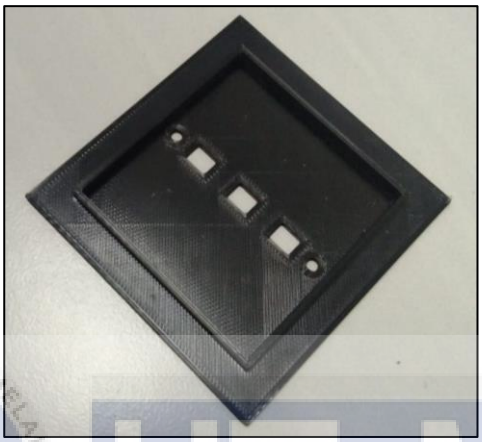

Figure 4.4 Base Cover part

The socket for stored home wiring will be in based part. There are three copper terminals that will be connected with live wire from supply, live wire that is going to load and neutral wire. After that, smart switch case has been design and printed on figure 4.5 below. This case will combine with smart switch component . This 3D design has dimension of 90 mm X 90 mm that will consist of smart switch wiring part on smart switch to cover case that consists of copper plug pin that use to connect load wiring to the smart switch.

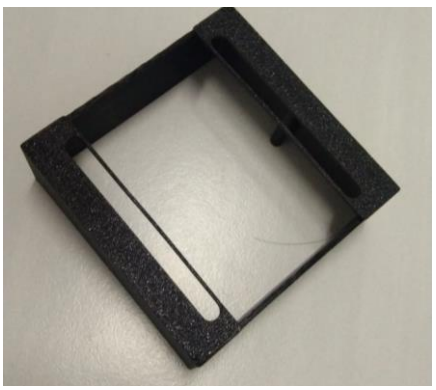

Figure 4.5 Smart Switch Case

The cover for the smart switch has been meticulously printed to seamlessly fit with the dimensions of the smart switch. This specific design is intended to serve as an enclosure for the smart switch case, effectively closing and securing the entire assembly. The primary objective is to safeguard the wiring connections from external factors that could potentially result in electrical shock. This design consideration aligns with safety standards and ensures the robust protection of the internal components, thereby enhancing the overall safety and reliability of the smart switch

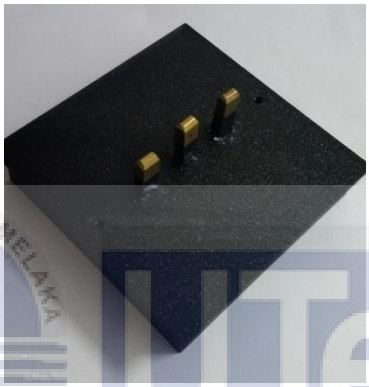

Figure 4.6 Smart Switch case cover

Figure 4.6 above is the integrated cover for the smart switch case, featuring a synergistic combination with a copper plug pin. This innovative design element serves as a conduit for the transfer of voltage and current between the smart switch module and the load wiring. The research emphasizes the strategic integration of the copper plug pin to optimize the efficiency and reliability of electrical connections, ensuring a secure and effective transmission of power within the smart switch assembly. This integration is a significant contribution to the overall advancements in smart switch technology.

4.3 Software Development

sThe implemented software empowers users to remotely control and automate electrical switches via mobile applications. This user-friendly software, designed only

forAndroid phones, provides a seamless interface for users to set on/off states or establish schedules for their smart switches. Developed using the Tuya developer website, the application configuration enables convenient and efficient management of smart switch. The application's has Wi-Fi connectivity feature, allowing users to establish a connection with and control their smart switch remotely.

The application follows a user-friendly pairing process, typically taking 1-3 minutes, wherein it detects nearby smart switches from the smartphone and configures them to connect to Wi-Fi. This streamlined setup ensures that users can quickly and easily integrate their smart switches into the home automation system. Figure 4.6 below illustrates the interface of the smart switch application, providing users with a visual representation of the controls and features available for managing their connected devices.

Figure 4.7 Application Interface

4.4 Wiring Diagram and Installation

This subtopic brief wiring diagram of all component in this project. Installation of wiring to present home standard wiring.

4.4.1 Smart Switch Wiring

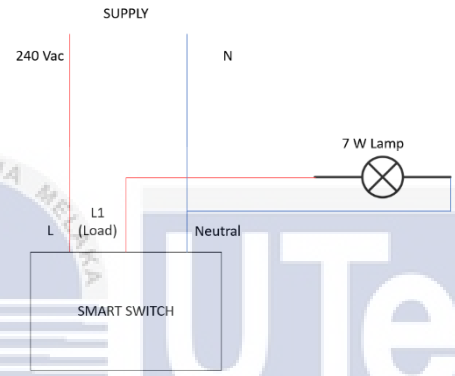

Figure 4.8 Smart Switch Wiring

The representative of figure 4.8 above shows wiring diagram of smart switch component. Smart switch wires to the corresponding wires as figure abow , mount the smart switch.

4.4.2 Base Wiring Part

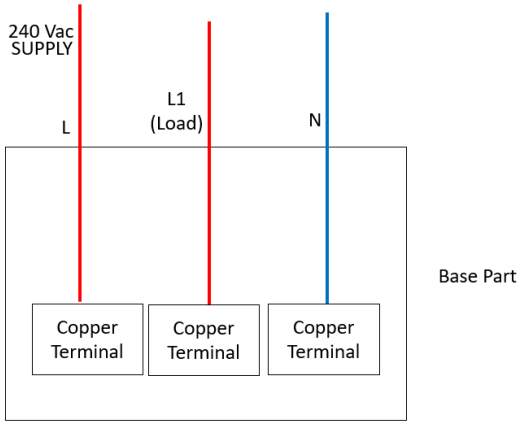

Figure 4.9 Wiring Diagram on Base part

Figure 4.9 shows the wiring diagram in the base part. There are 3 cable that used L1 (Supply Live Wire), L1 (Load Live Wire) and Neutral wire. The main Live supply is 240V and Neutral wire will connect on copper terminals on mounted that has been design. L1 been connected to the mounting in the middle part. This part will contact smart case part that applied Plug n Play concept and stored the supply power. Figure 4.10 shows wiring installation on base part.

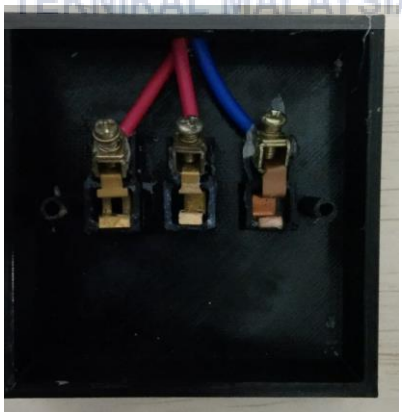

Figure 4.10 Wiring Base Installation

4.4.3 Smart Switch Case

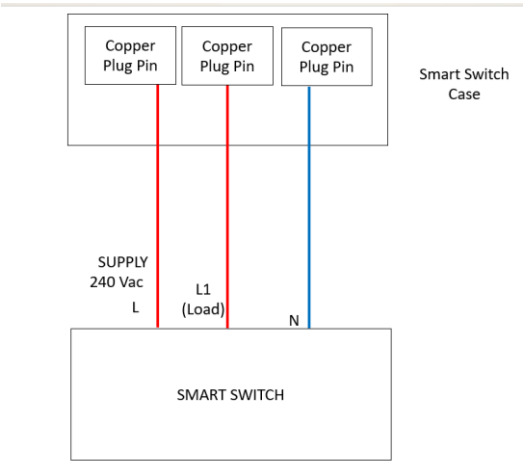

Figure 4.11 Wiring Smart Switch to Case Holder

Figure 4.11 shows the wiring diagram in the smart switch case. The Smart Switch will connect to copper plug pin. The main Live supply is 240V and Neutral wire will connect on copper terminals on mounted that has been design. L1 been connected to the mounting in the middle part. This part will make a contact to copper terminal on base part to transfer voltage, current and power that has been stored supply voltage. When smart switches case plug-in on base part the copper terminal and copper plug will connected to transfer voltage from supply to load via smart switch.

4.4.4 Home wiring

Figure 4.12 below shows the wiring diagram home wiring diagram that used. These wiring diagrams will be constructed to express the actual home wiring diagram. Distribution Box used will be supplied by 240V from plug that connected to dual pole Miniature Circuit Breaker (MCB) that rated 63A to protect an electrical circuit from damage caused by overload or short circuit. The primary function of an MCB is to interrupt the flow of electric current in the event of a fault, preventing overheating and potential fire hazards.. The two

smart switches will have a live wire that connects from same MCB 10 A and plug will be connected with other MCB 10A. Residual Current Circuit Breaker (RCCB) rated 40A, is protect against electric shock and prevent electrical fires. Its primary function is to quickly disconnect the power supply when it detects a leakage 100mA current in the electrical circuit.

Figure 4.12 Home Wiring

4.5 Results and Analysis

4.5.1 Smart Switch Measurement value

In the pursuit of evaluating the electrical component wiring connections and the efficacy of the smart switch in controlling a load, a series of measurements were conducted using a 7W lamp load. The obtained data, as summarized in Table 4.1, delineates the recorded values for voltage, current, and power under both "Off" and "On" conditions.

Table 4.1 Measurement Value

Smart Switch Condition	**Voltage (V)**		**Current (A)**	**Power (W)**
	L	L1		
Off	240	6	0	0
On	240	232	0.029	6.7

Figure 4.13 Voltage Measurement (L1 During Load)

This comprehensive dataset provides critical insights into the electrical parameters governing the smart switch's functionality in the context of load control, with a focus on a 7W lamp load. These findings contribute substantively to the assessment of the smart switch's performance and its impact on power consumption management.

4.5.2 Touch Control

On the smart switch there are touch button there can be used for turning on/off switch. The data has been taken to check the response time touch win. The table 4.2 below shows data on the touch button of smart switch. Based on data, the touch button shows a high response time that can trigger on/off the load under 1 second. Recorded time for response time as show as figure 4.14.

The recorded times for the three trials consistently demonstrate a rapid response, affirming the efficacy of the touch button in facilitating prompt and reliable control over the load. These findings underscore the tactile efficiency of the touch button interface, contributing positively to the user experience and enhancing the overall responsiveness of the smart switch.

Table 4.2 Data on Touch Button

Touch Button	Time Taken / Condition	
Sensitivity	Yes	
Response Time	Trial 1	0.16s
	Trial 2	0.20s
	Trial 3	0.14s

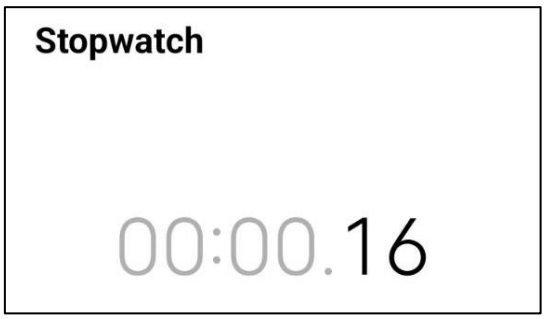

Figure 4.14 Touch button response time

4.5.3 Smartphone Control (MyPSM Application)

The smart switch offers an additional control option through the MyPSM mobile application, developed using Tuya developer mode. Table 4.3 outlines key performance metrics related to the application's functionality. The pairing time for the application falls within the 0 to 2-minute range, indicative of an expeditious and efficient connection process. The application exhibits high responsiveness, executing commands within 1 second. With a connectivity range extending up to 50 meter. The data was taken in optimal Wi-Fi condition.

Table 4.3 MyPSM App Performance

MyPSM App Performance	**Data**
Pairing Time	0 – 2 Minutes
App Responsive	<1 Second
Connectivity range	50 Meters
Compatibility	Android Only

4.5.4 3D Printed Case

A case has been design through SolidWorks for the purpose of housing the smart switch component and base part to secure electrical wiring that use to connect both case part . This design has been realized through 3D printing technology. The following tables present the data associated with the 3D-printed part.

Table 4.4 3D Printed Case Data Analysis

3D Printed Case	Value / Type
Material Used	PLA +
Case Durability	Can hold 20Kg
Temperature Resistance	120 ºC
Recommended Temperature for case placement	60 ºC - 70 ºC

4.6 Summary

This project has applied the concept of plug n play concept. This concept make easier installation and placement process. The data on voltage and current of smart switch is shows electrical wiring is reliable. This wiring circuit supplied by house plug that 240V. Project installation consist of distribution box to suppy wiring diagram to represent house wiring diagram. Load that connected to smart switch can be controlled by two method which is physically touch panel button and control using MyPSM application that been build using Tuya developer website. Response time of phyhical touch button is very responsive that only taken 0.16 second to on/off switch after button has been touch and also response time by using smartphone application is taking less 1 second. This data has been taken by using Wi-Fi in good condition. The application may has lower response time according Wi-Fi speed and distance between smart switch and smart phone. This application also can set up the schedule for controlling load by time that can be setup on this application. The pairing time is taking within 2 minute to connect smart switch to application configuration.

The PLA+ material that use in this project is suitable regarding temperature resistance, durability of the material. 3D printed case will stored electricity connection and was insulator material that can prevent electrical flow to the case object. On the case, copper plug and terminal has been place to transfer voltage from supply to load via smart switch. By having this casing the smart switch has plug n play concept that can lower electric shock probability.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This report outlines the process of the design and development of user-friendly smart switch wiring and casing to endure local climate environment. This project was developed to overcome the problem statement and encouragement of using IoT ecosystems such as smart switches, smart plug, etc. to escalate automation in private building and conventional to make easier controlling and monitoring electrical peripherals by using smart devices. To finish this project, a lot of research on 3D modelling and circuits has been required to fulfil the project desired.

Referring to project objectives, the smart switch that has been designed and developed has been achieved. The assembled of smart switch has obtained user friendly wiring with casing that can endure local climate. By this project also the replacement of smart switch can be easier and more low risk during installation process because this project was plug-n-play concept. Hopefully, this project will encourage more people to install smart switches on their private and conventional buildings that can enhance daily life productivity and make it easier to control and monitor peripheral devices from everywhere and anywhere.

5.2 Potential for Commercialization

This project has potential commercialized because of implementation of PnP concept to the smart switch that easier installation and replacement process. This idea can lead to the invention of existing smart switch available. The smart switch would require minimal setup, allowing users to simply plug it into the based part. No complex wiring or

installation would be necessary, making it accessible to a wide range of users. By using Wi-Fi as connectivity and smart phone applications. This would provide convenience and flexibility. Even in case eventually Wi-Fi turned down user can still control the smart switch by physically contacting it. The smartphone app would have an intuitive and user-friendly interface, enabling easy setup, device management, and customization of settings. It would provide a seamless and enjoyable user experience.

To significantly enhance the assurance of consumer safety associated with this project, it is imperative to secure a SIRIM certificate. This certification serves as a robust indicator of the project's unwavering commitment to safety standards, affirming its suitability for implementation in both residential and office environments. The acquisition of a SIRIM certificate not only instills confidence in consumers but also acts as a compelling factor to attract their trust, thereby fostering a greater inclination to incorporate the project into their respective ecosystems.

5.3 Future Works

For future improvements smart switch on effecieny app :-

i) Applied Plug n Play concept to other smart home device.

ii) Adding a monitoring system to power consumtion on home system.

iii) Improve casing material.

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APPENDICES

Appendix A Gantt Chartt BDP1

No.	Task Description	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	PSM 1 Briefing														
2	Title Selection & Submission														
3	Report Introduction														
4	Software Development														
5	Literature Study														
6	Report Writing														
7	Design 3D model														
8	Report Adjustment														
9	Final Report Submission														
10	PSM 1 Presentation														

Appendix B Gantt Chartt BDP2

No.	Task Description	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	PSM 2 Briefing														
2	Design Prototype														
3	Development 3D printing														
4	Smart Switch Testing														
5	Model Wiring Installation														
6	Report Adjustment														
7	Final Report Submission														
8	PSM 2 Presentation														