UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF A MAILBOX NOTIFICATION SYSTEM WITH SOLAR BATTERY CHARGING BASED ON IOT
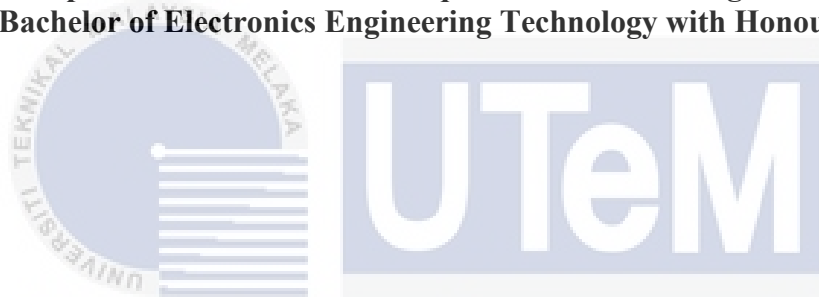
MUHAMAD ATHIR BIN MOHD SIDEK

Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

2022

DEVELOPMENT OF A MAILBOX NOTIFICATION SYSTEM WITH SOLAR BATTERY CHARGING BASED ON IOT

MUHAMAD ATHIR BIN MOHD SIDEK

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

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

DECLARATION

I declare that this project report entitled DEVELOPMENT OF A MAILBOX
NOTIFICATION SYSTEM WITH SOLAR BATTERY CHARGING BASED ON IOT is
the result of my own research except as cited in the references. The project report has not
been accepted for any degree and is not concurrently submitted in candidature of any other
degree.

Signature   :

Student Name   :   MUHAMAD ATHIR BIN MOHD SIDEK

Date   :   1/3/2023

APPROVAL

I approve that this Bachelor Degree Project 2 (PSM2) report entitled "Development of a Mailbox Notification system with Solar Battery Charging based on IOT" is sufficient for submission.

Signature   :

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Date   :   1/3/2023

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.

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Supervisor Name   :   ADAM BIN SAMSUDIN :

Date   :   1/3/2023

Signature

Co-Supervisor   :

Name   :   TS. DR. MOHD HATTA BIN JOPRI

Date   :   1/3/2023

DEDICATION

This project is devoted to me as an engineering student, and it is the first of my projects that I am studying and attempting to accomplish. It is also grateful to my beloved mother and father, Hazizian bt Mohd Zain and Mohd Sidek bin Mohd Hassan who taught me that even the most difficult life, inshaALLAH can be accomplished if completed one step at a time and with patience.

ABSTRACT

The Smart Mailbox, which aims to make users more aware of the presence of critical alerts and messages in their current mailboxes, particularly the centralised mailbox, was designed and studied in this study. This project's problem statement is They have lost important letters, invoices, and documents, and have even missed key deadlines, as a result of their negligence and forgetfulness in checking their email. This occurs because the citizens lack a new remedy or updated technology to address the problem. The goal of this project is to create a smart mailbox notification system, develop solar battery charging, and evaluate the efficiency of the notification system and solar battery charging. The main components used in this project are an IR sensor and a blynk application. The IR sensor detects mail or small parcels, and the blynk application function is to receive notification and a count from the blynk apps, which count how many letters are inside the mailbox. Based on the analysis data, this project will successfully achieve all of its objectives, and notifications from the Blynk apps will be received in less than 4 seconds.

ABSTRAK

Peti Mel Pintar, yang bertujuan untuk menjadikan pengguna lebih sedar tentang kehadiran makluman dan mesej kritikal dalam peti mel semasa mereka, khususnya peti mel berpusat, telah direka bentuk dan dikaji dalam kajian ini. Penyataan masalah projek ini ialah Mereka telah kehilangan surat penting, invois dan dokumen, malah telah terlepas tarikh akhir penting, akibat daripada kecuaian dan kealpaan mereka dalam menyemak e-mel mereka. Ini berlaku kerana rakyat kekurangan ubat baru atau teknologi terkini untuk menangani masalah tersebut. Matlamat projek ini adalah untuk mencipta sistem pemberitahuan peti mel pintar, membangunkan pengecasan bateri solar, dan menilai kecekapan sistem pemberitahuan dan pengecasan bateri solar. Komponen utama yang digunakan dalam projek ini ialah penderia IR dan aplikasi blynk. Penderia IR mengesan mel atau bungkusan kecil, dan fungsi aplikasi blynk adalah untuk menerima pemberitahuan dan kiraan daripada aplikasi blynk, yang mengira bilangan huruf di dalam peti mel. Berdasarkan data analisis, projek ini akan berjaya mencapai semua objektifnya dan pemberitahuan daripada aplikasi Blynk akan diterima dalam masa kurang daripada 4 saat.

ii

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Second, I'd want to thank my family members for supporting me throughout my four years of studies at Universiti Teknologi Malaysia Melaka (UTeM). Special thanks to the FTKEE staff for their invaluable assistance in completing this project.

Last but not least, I would like to thank all my classmates and all who have offered me their helping hand for millions of items.
Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

Pm	-	Maximum power in watt
G	-	Irradiance
Ac	-	Surface area of solar in meter square

LIST OF ABBREVIATIONS

V   -   Voltage
W   -   Power
A   -   Ampere

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1   Introduction

This study designed and studied the Smart Mailbox, which aims to make users more aware of the presence of vital alerts and messages in their current mailboxes, particularly the centralized mailbox. The project's goals are to produce, help users, and evaluate the project's success in resolving problems. The emergence of electronic mail has resulted in people forgetting to inspect their physical mailboxes owing to their busy schedules (e-mail). These conditions have been one of the key reasons of the loss of critical notifications or messages, as well as other concerns, due to their insensitivity to the existence of such warnings un the first place. Residents in residential areas near the city, notably in flats, condos, and shopping Centre lots, often lose mail and are unaware of its existence in the mailbox, according to the results of a study done on them [1]. The Smart Mailbox is fitted with a high-sensitivity sensor and an Esp 8266 to address these problems.

1.2 Background

As time passes, people get preoccupied with everyday issues because of their own distinct reasons and responsibilities, but some of them are unable to relax at all, resulting in stress. Stress has a higher impact on focus and attention than memory, according to the study. This, however, may hamper men's ability to recall new information. Other issues and thoughts will distract the mind, which it will then forget. As a result, people are badly impacted, with the risk of harmful side effects on other things. Males need regular reminders due to their penchant for forgetting, and most individuals require a lot of prodding at first, but gradually gain enough momentum that finishing what has to be done becomes a habit, not an exception.

People like simple things because technology has become so engrained in society that it is impossible to disconnect from it. According to Rescue Time, an iOS and Android app that tracks phone use, individuals spend an average of three hours and fifteen minutes on their phones every day, with the top 20% spending upwards of four and a half hours [1]. Every person checks their phone 58 times a day to send or receive text messages or to check email. Consumer productivity may be boosted by using applications on mobile phones (apps).

1.3 Problem Statement

According to surveys and research done mostly in targeted areas such as flats, condos, and shopping Centre lots, most inhabitants (80%) have encountered the same issue [1]. Due to their negligence and forgetfulness in checking their email, they have lost crucial letters, invoices, and documents, and have even missed key deadlines. This occurs because the citizens lack a fresh remedy or updated technology to address the issue they are experiencing.

2

Delivering mail door-to-door caused the postman to stand and wait for long periods of time, which exposed delivery companies' inefficiencies. Traditional mailboxes are prone to weather patterns that may cause mail damage or shredding, which is a problem with traditional mailboxes. Most notably in Malaysia, where the climate is tropical, hot, muggy, and wet all year round. When it comes to rainfall, it's hard to find a place with less than 2000 millimeters (79 inches) every year or fewer than 100 millimeters (mm) per month (4 inches). Postal deliveries have been halted because of the present situation.

Furthermore, conventional mailboxes were not built to accommodate today's delivery requirements. As e-commerce has grown in popularity, more pricey things are being delivered to your doorstep. It may be inconvenient if mail, papers, and other items go missing or are stolen. Couriers waste time and money on failed delivery efforts, and merchants must deal with irate customers or replace stolen items, as well as deal with extra delivery vehicles on the road, which adds to traffic congestion in the city. Some folks find that traditional mailboxes are sufficient for their purposes.

Regardless of the issue, it stimulates researchers to do study to build a Smart Mailbox or system. This mailbox is ideal for people who have a hectic work schedule that prevents them from being home during deliveries, who often forget to check their mailbox, and who are interested in high-tech gadgets.

1.4   Project Objective

The objective of conducting this project is to determine the difficulty that people in Malaysia are having with their present mailbox. After determining the source of the issues, strive to come up with a solution that will assist consumers increase their productivity throughout the day.

a) To design a smart mailbox notification system.

b) To develop solar battery charging system.

c) To analyze the efficiency of the notification system and solar battery charging.

1.5   Scope of Project

The primary target audience for this smart mailbox initiative is residents of apartment buildings and condominiums. It was picked because of its practicality in today's world.

This project was modelled after with the purpose of supporting and enabling users in recognizing which reduces the amount of mail lost. The scope of this projects is specified to put in each apartment or condominium that demands this smart mailbox, in addition to most of them avoid any ambiguity of this project owing to certain limits and restraints.

The proposed this project is not use electricity that much as this project will use renewable energy which is solar energy and can further save more cost in the future. Not only that this Smart mailbox can be monitored by an app called Blynk app from mobile phone. It will notify through the app if there any mail was inserted in the Smart Mailbox.

a) Design a smart mailbox system with combination of solar battery charging.

b) Renewable energy by solar (battery charging by solar)

c) Notification system by IOT (Blynk apps).

d) Battery 12 v 7 ah

e) Proteus 8.1

f) Arduino Ide

g) Polycrystalline solar panel

h) IR sensor (Normal version and Ky-032 version)

i) Solar charger controller

5

CHAPTER 2

LITERATURE REVIEW

2.1   Mailbox Revolution

Most letters were carried to the post office to be sent in the early 1800s, and recipients were required to pick up their mail at the post office. Mail was not carried to city inhabitants' homes at no additional cost until 1863. By 1890, hundreds of cities had started delivering mail to people's homes, requiring the usage of mailboxes [1].
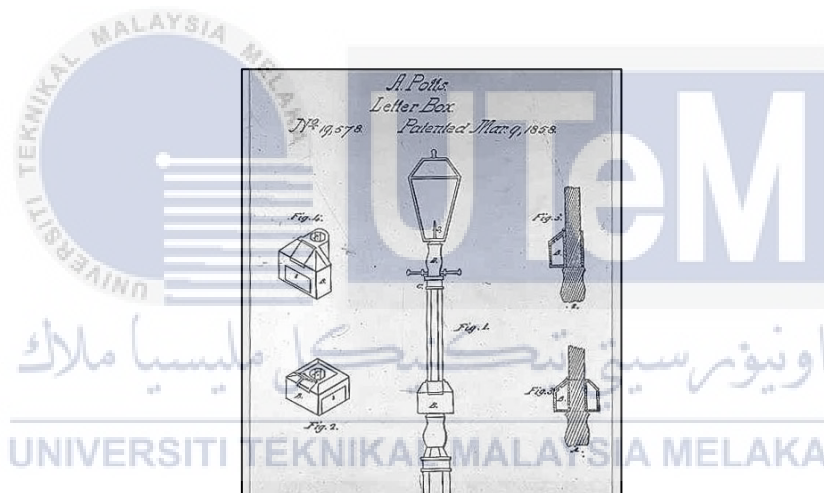
Figure 2.1 Albert Potts first letter box

On March 9, 1858, Albert Potts patented the first letter box sanctioned by the United States Postal Service. Lampposts with mailboxes were part of his idea, which his company constructed. His receptacle was little, and he had to empty it often.

Though it had existed in different forms before to 1923, the curbside contemporary mailbox sprang to prominence when the postal service mandated them for residential premises. These restrictions arose because of the postal service's increased reliance on such mailboxes for mail delivery.

Different sorts of models flourished at first. Plastic, aluminum, and other materials are used to make residential mailboxes. This was done to keep them safe from harm and the elements. However, as the twentieth century progressed, metal mailboxes became the most common form of residential mailbox owing to its durability and weather resistance. Different finishes and accessories have also grown in popularity.

Figure 2.2 Roadside mailbox

Since the turn of the century, apartment complexes and other multi-family homes have become increasingly widespread, especially in cities. This meant that the need for multi-family mail delivery expanded at that period. There was a need for new mail delivery systems that were both secure and simple.

Figure 2.3 apartment mailbox

Apartment mailboxes are designed for multi-tenant applications where the Postal Service will be delivering the mail. Choose from this group of products when the Postal Service will be delivering the mail. Usually, they install a master postal lock for safety feature.

2.2   Internet of Things (IoT)

Smart devices and high-speed networks have made the Internet of Things (IoT) a household name, thanks to the widespread use of low-power lossy systems (LLNs) with limited resources. A private or public network that links "things" and sensors is referred to as a "thingnet". IoT devices may be remotely controlled to achieve their objectives. The data is subsequently sent between the devices through the network using industry-standard communication protocols. Sensor chips may be found in a variety of smart, linked devices and objects, ranging from small wearables to massive machines.

In addition to serving personal needs, the Internet of Things also serves social requirements. Various smart technologies that monitor hospital operations, detect weather conditions, provide tracking and communication in autos, and identify animals using biochips are already serving community demands. Utilization of IoT in everyday life underlines its future importance. As a result of developments in hardware strategies, such as

improving capacity by merging cognitive radio-based networks to address frequency spectrum underutilization, it continues to expand rapidly [2].
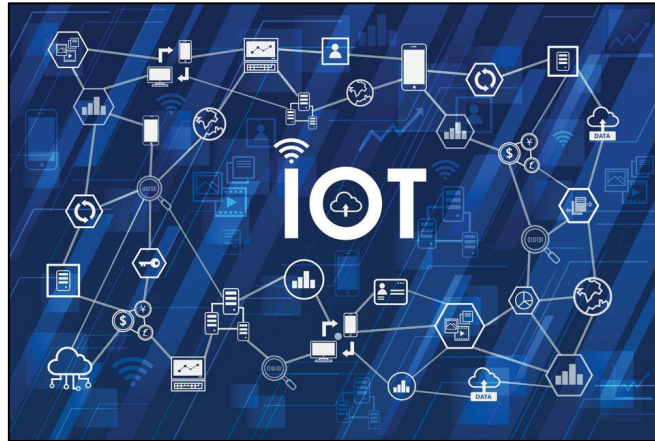
Figure 2.4 Internet of things (IoT)

2.2.1   Esp 8266

For connection between mobile apps, ESP8266, a low-cost 2.4 ghz (Wi-Fi) microchip connected with NodeMCU offers TCP/IP (complete transmission control protocol/internet protocol). This chip can keep an eye on and manage sensor systems linked to a platform for IoT. This research looked at, data from a platform-integrated temperature sensor was gathered and monitored using a Blynk application. The mobile phone-based smart mailbox notification system will receive notifications [3].
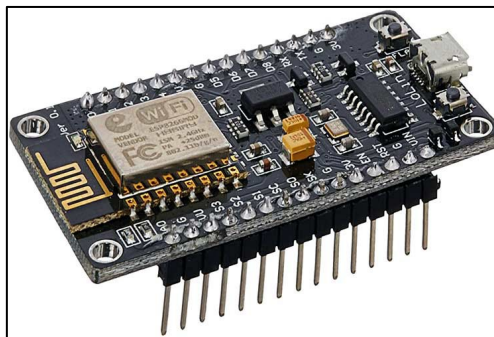
Figure 2.5 Esp 8266

2.2.2   Raspberry Pi

The Raspberry Pi is a powerful and inexpensive credit-card-sized single-board computer (SBC). In the $35 Raspberry Pi 3B Plus, for example, the central processing unit has four cores running at 1.4 GHz and 64 bits (CPU). With an increasing number of SBCs on the market, they are rapidly becoming a disruptive technology with widespread applications, particularly on the Internet of Things.

The 40-pin GPIO interface for communicating with external components on SBCs is easily modifiable using free, open-source software. Because of their mobility, versatility, affordability, and compact size, SBC-based systems are suited for step and point-of-need applications. Lin et al. used a microfluidic biosensor and a Raspberry Pi to do colorimetric analysis and found Salmonella with a LOD of 14 CFU mL.

Electrochemiluminescence (ECL) is a chemiluminescence technique that is electrochemically induced. The excited state of the luminophore may be created using either a co-reactant or the annihilation processwhere the luminophore's oxidised and reduced versions are generated electrochemically. The co-reactant approach is essential for aquatic sensing because it permits ECL to take place within the solvent's potential window [4].
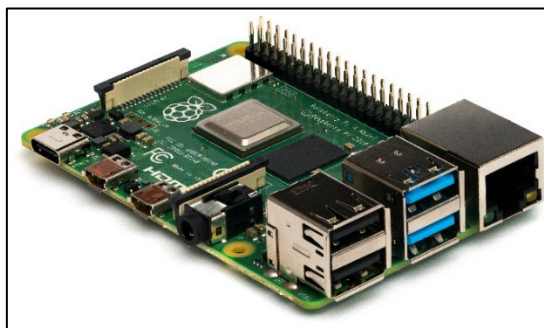
Figure 2.6 Raspberry Pi board

2.3 Blynk apps

BLYNK is an application platform for mobile OS (iOS and Android) devices for controlling Internet-connected modules such as Arduino, Raspberry Pi, ESP8266, WEMOS D1, and others. This widget may be moved by dragging it. It is easy to construct and takes around five minutes. Blynk is not confined to a particular board or module. Using this application platform, we can operate anything remotely from any location on the planet. The Internet of Things (IOT) system includes constantly Internet-connected records.

Figure 2.7 Blynk application

The Blynk application is simple to use on a smartphone. The purpose of the Blynk programmed is to get notifications when anything like a sensor contacts the app, and the app sends a notice. When anything contacts the sensor, the Blynk app sends a notice to the user. As a result, users will be aware that something has occurred [1].

2.3.1 Things speak application

Thing Speak is a simple-to-use cloud service that supports the Internet of Things as an open platform. It's one of the most popular cloud platforms for IoT, and it includes MATLAB as an integrated tool for analyzing data. In-depth analysis is possible with Thing Speak. For reading and writing data activities, the platform gives a unique channel ID and API keys. Remote monitoring and control are possible thanks to the API keys. Time limit: 5 minutes.

11

Figure 2.8 Flow of Thing speak

An IoT system allows for the simple but strong capability of interacting with a multitude of devices and applications by exchanging data. IoT services are in charge of communicating with the platform's users. Thing Speak is an Internet of Things (IoT) platform that allows you to gather and store sensor data in the cloud as well as create IoT apps. The Thing Speak IoT platform provides programmed that allow you to use MATLAB to analyze and display data before acting on it. Sensor data may be sent to Thing Speak using the Node MCU's ESP8266 Wi-Fi module [5].

2.4   Solar energy

Because solar energy creates no pollution, it is definitely more practical and ecologically beneficial than other kinds of energy. Furthermore, once it is installed, it has no influence on greenhouse gas emissions. It's also a clean, sustainable energy source that may be used at any time of year; even cloudy days can provide electricity.

12

Figure 2.9 sun to solar

Renewable energy sources (RE) are the greatest alternative for meeting power demand. Solar PV systems, wind power production systems, fuel cells (FC), micro-turbines, and other RE-based systems are the most common. Because of its advantages like as availability, dependability, and environmental friendliness, renewable energy sources are rising in favor for both home and industrial uses. Solar energy is seen as a stable, promising, and profitable energy source. It has various advantages, including the fact that it is pollution-free, has a long lifetime, and requires minimal maintenance [6].

The sun's energy, or solar radiation, comes in three forms: direct, diffuse, and reflected. Solar radiation that travels in a straight line from the sun to the earth's surface is referred to as beam radiation. Diffuse radiation is light that has been dispersed by particles and molecules in the atmosphere but still reaches the planet's surface. Unlike direct radiation, diffuse radiation has no obvious direction. Reflected radiation is sunlight reflected off non-atmospheric surfaces such as the earth.

2.4.1 Solar panel

Sun photovoltaic energy is produced by converting solar radiation directly into electricity. Due to its availability on Earth, low contamination rate, great durability, and

13

extensive expertise in the microelectronics sector, silicon is the most often utilized material for the fabrication of solar cells. Although many other alternative technologies have been developed and deployed, monocrystalline and polycrystalline silicon cells are the most extensively used.
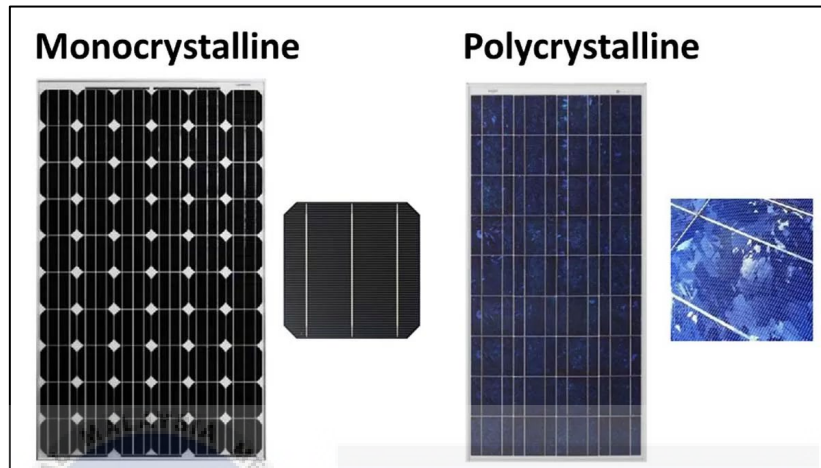
Figure 2.10 Monocrystalline and Polycrystalline solar panel

To generate monocrystalline silicon cells, cylinders of the same material are heated in special ovens. Create the pellets by cutting the bar into little pieces (300 mm thick). With a conversion rate of roughly 15%, these solar panels are a good alternative to fossil fuels. Polycrystalline silicon cells are made by melting single silicon particles in moulds and forming them into blocks. A single crystal is not formed during this process because the atoms do not interact with one other. They convert sunlight into energy with an efficiency of around 13%. The two most important parameters that govern the performance of a photovoltaic panel are the intensity of solar radiation and the temperature of the cell [7].
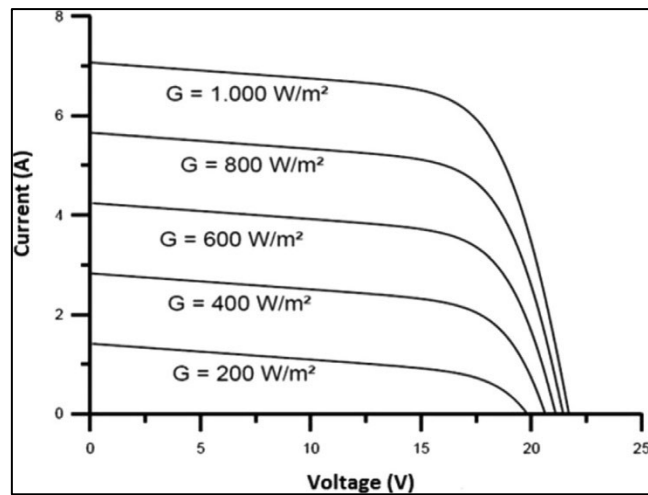
Figure 2.11 Variation in solar radiation has an effect on the characteristic curve of a PV
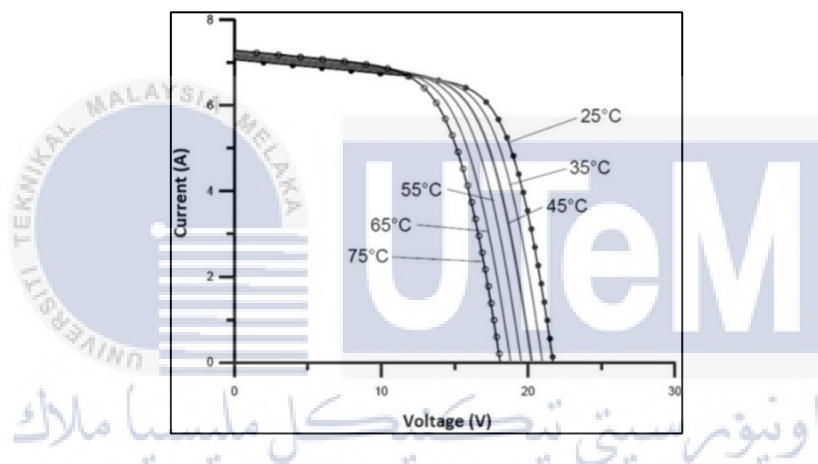
Figure 2.12 Show temperature has an effect on a PV system's characteristic curve.

15

2.4.2 Solar charger controller

Figure 2.13 of Charge controller for solar panels

The solar charge controller controls how much solar energy gets into the battery bank. By flowing backwards to the solar panels, Overcharging during the day and overnight draining of the deep cycle batteries are prevented by the use of this device. Although some charge controllers have other features like as lighting and load management, power management is their primary role.PWM and MPPT are the two most prevalent solar charge controllers (MPPT). Both monitor battery temperature to avoid overheating and vary charging rates based on battery capacity.

The battery voltage is greater than the solar charger controller, which is ideal for increased solar panel output. This solar charger controller can work at both low and high temperatures (below 45°C and over 75°C, respectively). Even when the irradiance is very low, it can work [8].

2.4.3   Solar Function to charging the battery

The Sun is a big source of energy that emits electromagnetic radiation. Depending on the wavelength of the created radiations, they may be classified as light, radio waves, or other forms of radiation. In the earth's atmosphere, just a minute fraction of the sun's rays is visible. Using this visible light, solar cells make electrons. Various solar cells use distinct light wavelengths.

Solar cells, which generate energy, are composed of semiconducting materials like silicon. A stream of tiny particles known as electrons transports electricity as an electric current. When sunlight hits a solar cell, silicon captures the electrons, which then flow through the n and p layers to generate electric current before departing the cell through the metal contact.

Figure 2.14 solar panel and battery

A solar charger circuit connects a rechargeable battery with a capacity of 2500 mAh to a solar panel. The battery will charge whenever sunshine is available. In the absence of solar charging, the device's battery life is roughly 2500 /0.78 = 3205.12 h or 133 days. There is no need for human charging or power supply wire near the mailbox since it features recharging circuitry to charge the battery from a solar panel [9].

17

2.4.4 Formula for efficiency solar

To compare a solar cell's functionality to that of another, the most used statistic is its efficiency. An efficient solar cell has a power-to-energy output ratio that is greater than or equal to one. Sunlight spectrum and intensity, as well as cell temperature, have an impact on the solar cell's efficiency. In order to evaluate the efficiency of different devices, the evaluation criteria must be standardized.

$$\eta = \frac{P_m}{(G * A_c)}$$

$Pm = maximum\ power\ in\ watt\ (10\ watt)$
$G = irradiance$
$(input\ light\ in\ watt/m2)\ (average\ Malaysia\ 1643\ kWh\ m{-}2)$
$Ac = surface\ area\ of\ solar\ cell\ in\ m2(0.350 * 0.24 * 0.017)$

Answer: 34.537 mW

The efficiency of a solar cell is affected by the temperature because of the inherent characteristics of the semiconductor material. Solar panels become more efficient when the temperature is lower and less efficient when the temperature is higher because the voltage between the cells lowers at high temperatures.

2.5 Battery

In a battery, chemical energy can only produce a certain amount of electrical energy per pack. Different voltages, shapes, sizes, and capacities exist. This little metal canister will begin to undergo chemical reactions that generate electricity for small gadgets such as a flashlight. It is made up of two independent electric conductors so that electrons from one conductor may travel farther and be received by the other. For this reason, the current will flow. As energy needs rise, battery life shortens. 6 to 48 months, although only 30% of

batteries reach 48 months. Expand during the off-season, charge your battery using a solar panel [10].

Figure 2.15 examples of batteries sizes
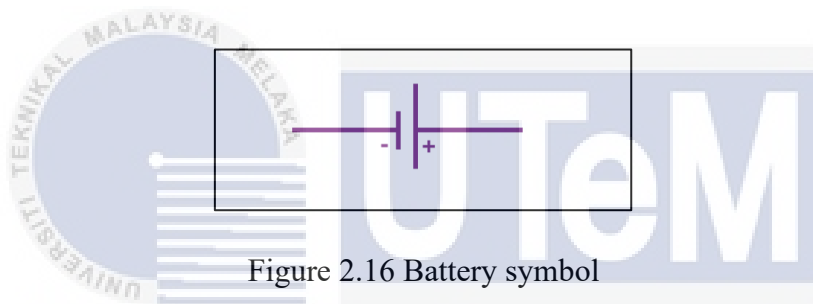
Figure 2.16 Battery symbol

2.5.1   Operation of battery

The positive and negative electrodos terminals are split into two distinct groups. Both electrodes in the cell are disconnected by chemical electrolite. Positive electrodes will always be within the canister, while negative electrodes will always be on the outside (American Chemical Society . 2013). The chemical will begin to react as soon as the load is connected, producing positive ions from the positive electrodes and electrons from the negative electrodes. Ions will transfer electrons throughout the circuit, which will activate the load. At the same time, the positive electrode will separate chemical processes. Electrons and ions will recombine, resulting in the discharge of the electrolyte. As a result, a completely operational circuit is created. Power tools, e-bikes, EV, medical applications, smart phones, computers, tablets, and cameras all require batteries nowadays [11].

19
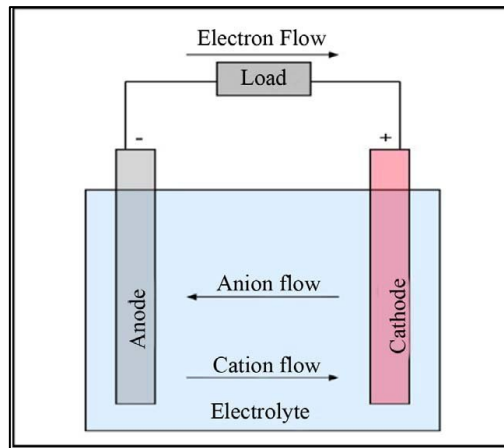
Figure 2.17 Working operation of a battery

2.5.2 Types of Battery

There are two kinds of batteries available. There are two cell types: primary and secondary. Primary batteries have a "single use" and cannot be recharged. Primary batteries include the vast majority of alkaline batteries and dry cells. The second kind of batteries, secondary batteries, are rechargeable.

Table 2.1 Comparative analysis of primary and secondary cell

Primary Cell	Secondary Cell
High-density energy, gradual release, and flexibility of application.	Their energy density is lower.
They are also called as dry cells since there is no liquid in them.	Water-filled cells and molten salt make up the structure (liquid cells with different composition)
Strong internal resistance	It's got a low resistance within it.
A chemical reaction has occurred that cannot be stopped.	It is possible to reverse the chemical process.

20

It has a smaller and lighter design.	It has a more complicated and heavier design.
It has a low startup cost.	It has a high upfront cost.

2.5.3   Battery 12v 7AH

Deep cycle and general-purpose 12V 7Ah batteries are widely used to power medical equipment, security systems, UPS and other emergency systems, toys, scooters, and fish finders. For a long time, Sealed Lead Acid (SLA) batteries were the sole option for 12V 7Ah batteries. Deep cycle Lithium Iron Phosphate (LiFePO4) batteries have recently become popular due to their weight savings, increased number of supported charging/discharging cycles, and other benefits. SLA AGM (Absorbent Glass Mat) batteries, on the other hand, are still going strong.

Figure 2.18 12v 7ah battery

As their name suggests, 12V 7Ah batteries feature a nominal voltage of 12V and a nominal (20h) capacity of 7Ah. Most 12V 7Ah batteries are sealed, maintenance-free Absorbent Glass Mat (AGM) although there are several Gel-Cell lead-acid batteries on the

market, most are lead-acid or Lithium Iron Phosphate (LiFePO4) batteries. Most cost-effective for high-power applications when weight is unimportant [12].

2.5.4 Lithium polymer battery

A new generation of electronics products (CE), including wearables and smartphones, is gaining in popularity at a pace never previously witnessed. This is because of how quickly technology is changing and how people's needs are changing. Most MPBs use lithium-based batteries because they have a high energy density, are light, last a long time, and drain themselves slowly. When it comes to MPBs, the most common battery types are lithium-ion and lithium-ion polymer.

Figure 2.19 Lithium polymer battery

LIPB is seen as a major step forward in the development of lithium-ion batteries because it is safer, has compared to LIB, it has superior electrochemical stability, a lower rate of deterioration over time, the capacity to create and be more flexible. Because these two kinds of batteries are seldom compared in terms of environmental impact, it's difficult to conclude whether LIPB is superior than LIB. Lastly, because to the high demand for CEs and electric vehicles, natural reserves of battery metals like lithium and cobalt are depleting at a pace never previously witnessed (EVs) [13]

2.6 Smart mailbox in Finland (Zohaib Hassan Year 2018)

Finland is a sparsely populated nation with a population that is dispersed over its territory. Postal service providers have been compelled to relocate mailboxes from home yards to street corners due to long distances and dwindling mail volumes. These communal boxes may be up to 200 metres distant from the residence. This is inconvenient for the elderly, particularly in severe weather. Furthermore, internet purchasing is becoming more popular in Finland, necessitating the development of smarter mailboxes.

A smart mailbox provides several benefits over a traditional mailbox. The main advantage is that clients will save time and be able to track their deliveries. It will also raise the value of the manufacturer's products.

Figure 2.20 of mailbox group [14]

Their battery technology is a serious constraint in their technology. The chemical processes within the battery cells are slowed by the low temperature. In the winter, the temperature in Finland may drop below -30 degrees Celsius, which can quickly deplete any chemical battery.

The smart mailbox should have at least a 200-meter range. The batteries should also last for at least two months. Furthermore, the gadget should be able to be retrofitted to a variety of mailboxes. There are five core items needed for this project.

a) Pir sensor (detect motion sensor)

b) Semtech LoRa 1276 (Wireless Transceiver Module)

c) Arduino Uno

d) GSM module (text messaging system)

e) Lithium battery

Its advantages exceed its disadvantages. The mailbox industry is very competitive, and manufacturers are always fighting for the best designs. According to them, the first firm to adopt a smart mailbox would have an advantage over other businesses. Consumers and contractors will choose for the smarter version of the box, resulting in increased sales for the individual brand. In addition, the retrofit device offers a lucrative commercial prospect [14].

2.6.1 The modern day mailbox by Jacob Turnberg and Jonatan Barriel (2020)

This project's goal is to develop a smart mailbox. The capacity to alert the receiver that mail has been received is characterised as "smart" in this sense. Second, the mailbox should be able to be opened using radio frequency identification technology (RFID), rather of using physical keys, as is the case with traditional mailboxes, especially in apartment complexes. The objective is to create a product that will demonstrate that the idea is both viable and useful in the future, and the solution was created with residential complexes and workplaces in mind.

Kevin Ashton created the term "internet of things" (IoT) in 1999 to describe a set of gadgets connected to a common network and capable of accessing information on their own. This enables the items to converse and exchange information with one another. Everyday things may be made "smart" using this method. Interconnected and communicative devices

offer a wide range of applications, from industrial production to assisted living, and may make things easier and more efficient.
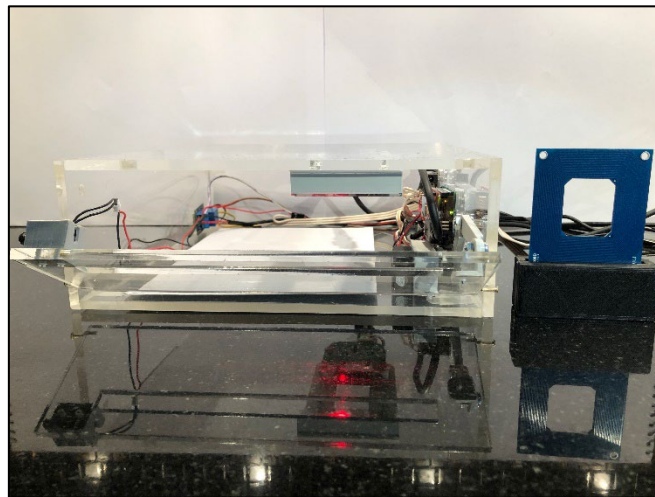
Figure 2.21 prototype smart mailbox

There is core items needed for this project.

a) Servo motor

b) Solenoid

c) Relay

d) Arduino

e) RFID-reader

f) Barcode-scanner

When a letter is put in the box, the scanner detects the barcode on the letter, determines who the receiver is, and alerts the recipient through e-mail over an internet gateway. To open the box, you must place a valid RFID-tag on the scanner, which will activate the solenoid and servo. The RFID programme uses a main/secondary system, in which a primary key may be used to store new secondary keys or remove all previously recorded secondary keys [15].

25

2.6.2 Smart postal mailbox concept by Stanislava Turskáa and Lucia Madleňákováa (2019)

There are three parts to the smart mailbox, the sensor, which the existence of material in a mailbox from a distant area, regardless of how far away, an assessment of the mailbox material, and a control unit that connects with the sensor and records mailbox status information, which is utilised for mailbox surveillance. Smart mailboxes are capable of detecting content in a mailbox from a distant location, independent of the distance between the mailbox and the user [16].

There are many intelligent postal mailbox options available on the global market, but none in Slovakia. The United States Postal Service, Australia Post, and La Poste are well-known for their mailbox research. This study's primary purpose is to optimise the delivery technique. The most essential aspect of these systems is the ability to determine whether an item is in the inbox or not. Wi-Fi, GSM, or Sigfox may be used to provide Internet connectivity, which is another common function.

Main component in this product is :

    a) IR sensor (detect motion sensor)

    b) Arduino Uno

    c) AM2320 is a sensor for both temperature and humidity.

    d) Button

    e) Printed Circuit Board (PCB)

Figure 2.22 Shows the smart postal mailbox design

The width, height, and depth of parcel boxes range between 250x175x100 mm and 500x300x200 mm (width, height, depth). In accordance with the parcel boxes offered by the Slovak universal postal service provider, the dimensions of the mailbox will have a width of 300 mm, a length of 300 mm, and a height of 400 mm. Both front and top access points are provided by a mailbox.

The Arduino Uno microcontroller board was used as the basis component to assure the mailbox's intelligent capabilities. Price, affordability, and quality were the most critical concerns. This kind of microcontroller board is gaining popularity. The Arduino Uno board utilises the ATMega 328P CPU from Atmel Corporation. The Arduino Uno now has a PIR sensor, a temperature and humidity sensor, and a button. The PIR sensor in the mailbox detects movement and alerts the user. When the item is placed in the mailbox, the PIR sensor senses motion and interprets it as "received mail." While envelope were sent to the mailbox and when it was taken from the mailbox, a button was needed. It's called "grabbing mail from the mailbox" when a button is pushed and the PIR sensor senses any movement of the mail. Repetition of pressing the button stops the mailbox's mail collection process [16].

2.6.3 Smart mailbox advantage and disadvantage

Table 2.2 Smart Mailbox advantage and disadvantage

Disadvantage	Advantage
-Need to maintain frequently if using the small capacity battery or do not use renewable energy. -Need wifi connection at the smart mailbox for the notification system if using blynk apps or raspberry pi.	Users may save time by not having to check their email every day and can save essential messages, invoices, documents, and even missed crucial deadlines owing to their carelessness and forgetful habit of monitoring their mailbox.

2.7 Summary

In summary smart mailbox in the business sector has a significant economic impact on utilities, making its assessment, appraisal, and reduction crucial. Improving the economic effectiveness of electric power systems, such as those that employ renewable energy by using solar panel as power source, would benefit from the accurate estimation of smart mailbox in our system. Next, our system using a rechargeable 12V battery for storage. Consequently, utilizing the IoT and the Blynk application, we can monitor our mailbox easily. In the case of the sensor Most electrical systems can accommodate the low power needs of an IR sensor, making it the ideal choice for mailbox detection.

CHAPTER 3

METHODOLOGY

3.1   Introduction

This chapter will detail the approaches and procedures used for this project. Methodology serves as a directive that must be followed to accomplish the project. This chapter will describe the whole project methodology from start to finish. This chapter will provide a thorough explanation of each procedural step to improve understanding. To guarantee the successful completion of the project, the strategy must be strictly followed. In addition, this chapter would outline the project's timetable and routine. The project plan and schedule will contain the time of each activity as well as the essential activities. This is necessary to guarantee the timely completion of the project.

29

3.2   Diagram of the project methodology
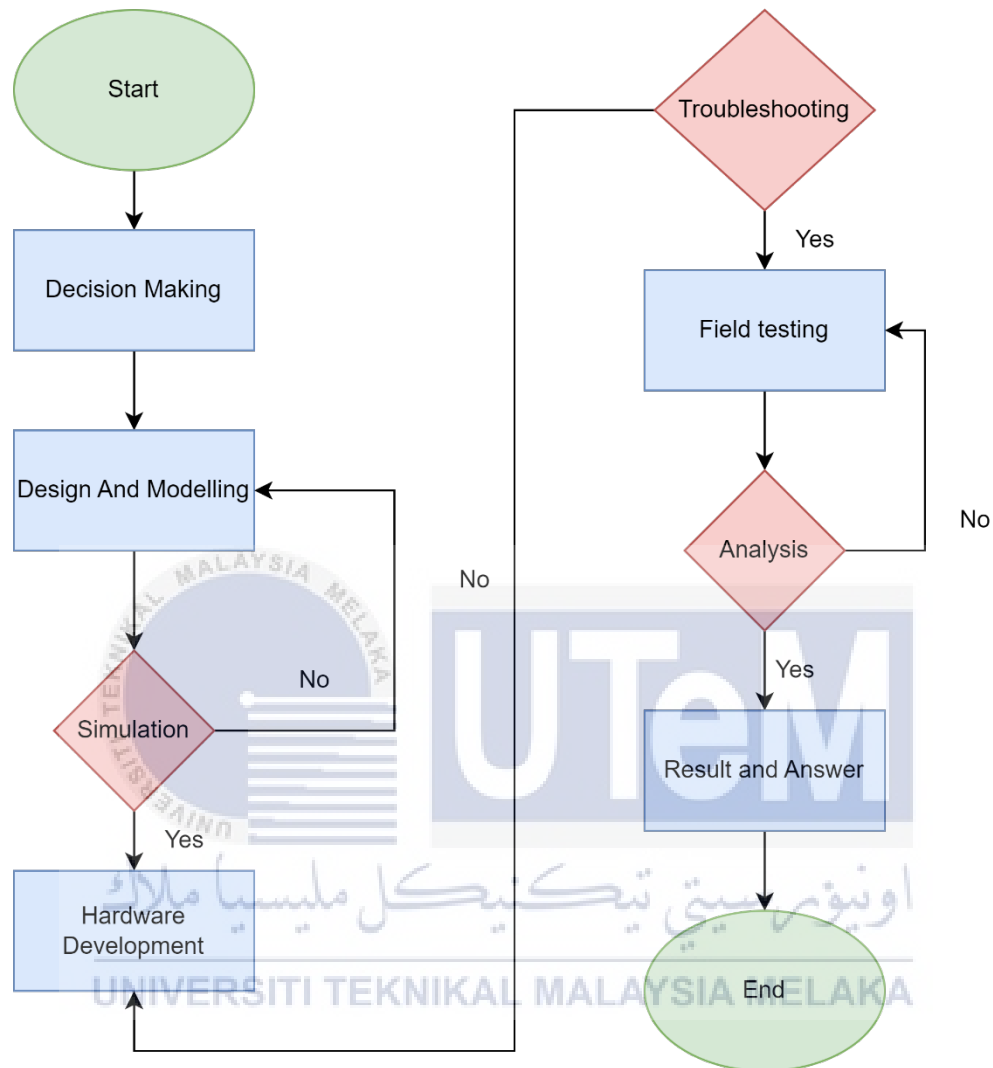
Figure 3.1 show the flowchart for the IOT-based Development of a Mailbox Notification system with Solar Battery Charging.

By referring the figure 3.1, It is organized into many segments to help with project development, the first of which is about project documentation. This section will go through the theoretical portion of the project, which is crucial in ensuring that the project is completed correctly.

The following step is to research the associated elements and software that will be employed in this project. In this section, appropriate components, and software for completing the project were picked. In terms of software, the Arduino Ide is used to code. The Arduino Ide is simpler to use than other programming packages. Because it can read input signals and convert them to output signals, it may be used in situations when the sensor detects an obstruction in the path.

Proteus Software is used for circuit design, and the code is uploaded to the Arduino in Proteus Software to check for flaws or functionality. This is because, before the hardware component is completed, it must be simulated to ensure that there will be no issues. Once these sections are error-free, the hardware design process will commence. This is the most important part since it must reflect the final shape and look of the project.

This hardware component was designed using AutoCAD. Following the completion of all of the other components, the project's last step is to conduct the final testing. With this component, you may check to see whether everything in the project is working properly, from hardware to software to troubleshooting to performance. If there are no issues, an analysis will be performed to record the project's success and the output data.

3.3   Project methodology

AutoCAD was used to produce the design for this hardware component. After all the elements have been finished, the project's checking component is the last step. It is in this stage that all of the hardware is connected together and that the coding, troubleshooting, and project operation are all checked to see whether they are working correctly or not. Analyses will be conducted out to document the project's success and thorough information from its inception to its final submission if there are no issues that develop.

31

3.3.1 Process flow development

3.4 Stage 1: Project research planning

On this stage, the element that needs to be to solve the problem indicated in the problem statement by designing a smart mailbox for users who have lost crucial messages, invoices, and documents, and have even missed key deadlines owing to their carelessness and forgetful habit of checking their email.

3.5 Stage 2: Development of the Project System Operation

It has now been determined that the general system functioning of the project consists of solar, charger controller, and battery. This charger controller will be placed between the solar panel and the battery to provide the electrical energy. A microcontroller, the Esp 8266, is also used in this project to manage the Smart Mailbox and the associated notification system.
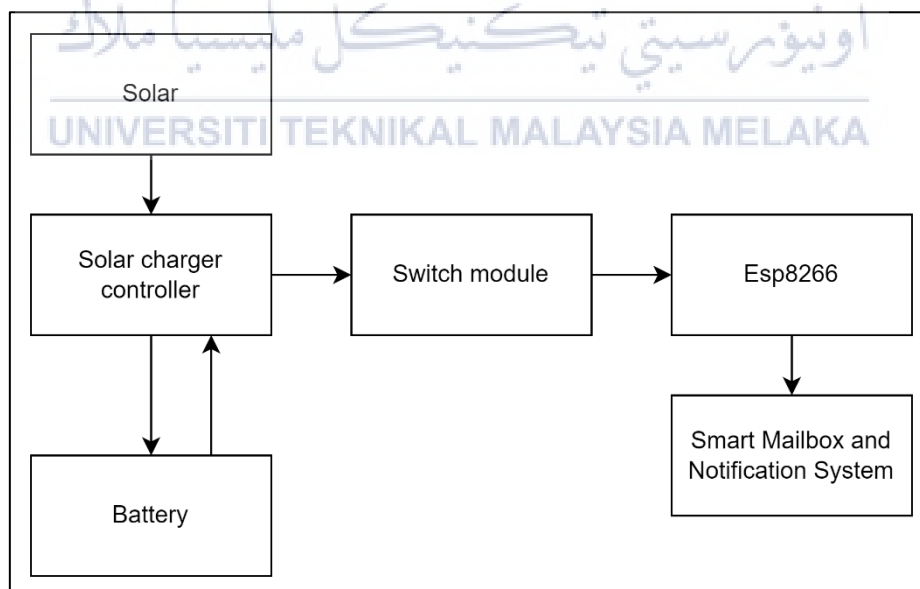
Figure 3.2 Block diagram for operation general system

3.6 Stage 3: Project determination

This stage is where the appropriate component, program coding, hardware, and mechanical design to be apply in this project prototype. This project consist of three section which is designing the mechanical part like the smart mailbox structure, electrical system and software design.

3.7 Stage 4: IR sensor performance analysis

This performance test was conducted using two IR sensors: the standard version IR sensor and the KY-032 version IR sensor. These results will indicate the best IR sensor for this smart mailbox. The test was conducted for 20 days at random, from 8 am to 6 pm, because the homeowners of this project usually only receive mail or small packages at that time. The owner will place around 15-20 letters per day as the highest record for this house owner receiving about 15 letters.

3.8 Electronic design

The electrical design incorporates the design simulations circuits and component type that have been chosen for use in the project. As part of the project's circuit design and programming, Proteus 8 software is used to create the circuit and simulate it for testing.

Figure 3.3 Proteus Simulation Circuit


```
#define BLYNK_TEMPLATE_ID "TMPLuR_4LLyb"              unsigned long debounceDelay2 = 50;
#define BLYNK_DEVICE_NAME "smart mailbox"            int irState2;
#define BLYNK_AUTH_TOKEN "ON4Bic201pmmLE4T12J7NCFzbDFuzR3t"   int lastIrState2 = HIGH;

#define BLYNK_PRINT Serial                            BLYNK_CONNECTED() {
                                                          Blynk.syncVirtual(V1);
#include <ESP8266WiFi.h>                              }
#include <BlynkSimpleEsp8266.h>
                                                      BLYNK_WRITE(V1) {
#define buzzerPin D1                                      int buttonState = param.asInt();
#define irPin D0                                          Serial.println("buttonState: " + String(buttonState));
#define irPin2 D2                                         if (buttonState == 1) {
                                                              count = 0;
char auth[] = BLYNK_AUTH_TOKEN;                            }
char ssid[] = "Yeke";                                 }
char pass[] = "athirsidek";
                                                      void myTimerEvent()
BlynkTimer timer;                                     {
                                                          Blynk.virtualWrite(V0, count);
unsigned long count = 0;                              }

unsigned long lastDebounceTime = 0;                   void setup()
unsigned long debounceDelay = 50;                     {
int irState;                                              Serial.begin(115200);
int lastIrState = HIGH;
                                                          pinMode(buzzerPin, OUTPUT);
unsigned long lastDebounceTime2 = 0;                     pinMode(irPin, INPUT);
unsigned long debounceDelay2 = 50;                       pinMode(irPin2, INPUT);
```

Figure 3.4 Arduino simulation program

34

3.9 Stage 5: Complete project integrations

Project integration commences once all the mechanical, electrical and software design phases for the Smart Mailbox Notification system are completed. Prototype components and program code will be used in order to ensure that this project works as expected. These tests and revisions will continue until the project's objectives are met.

3.9.1 Component list

3.9.2 Solar panel
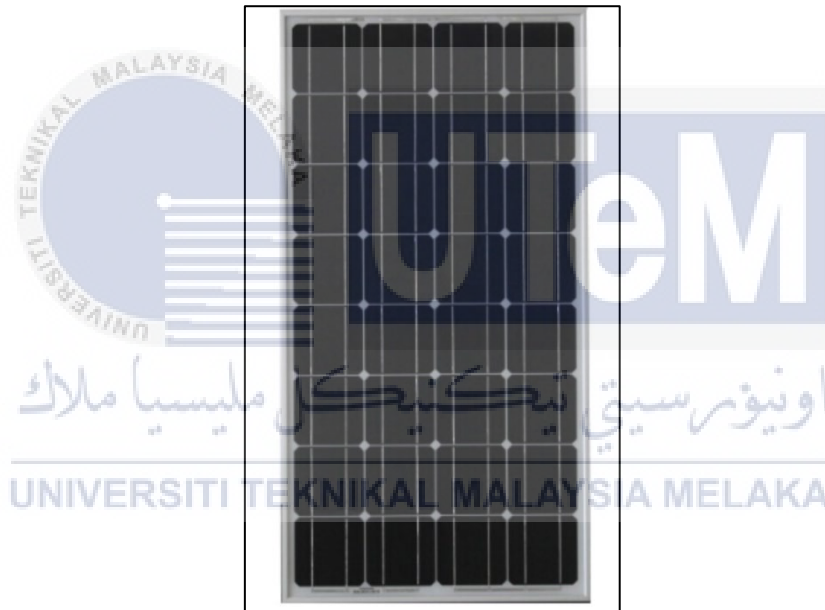
Figure 3.5 solar panel

Solar panels collect sunlight and convert it into electricity, which may then be used to power electrical loads. Each solar cell consists of layers of silicon, phosphorous (which imparts a negative charge), and boron. Solar panels are comprised of a number of solar cells (which provides the positive charge). Solar panels collect photons and convert them into an electric current.

Solar cells create an electric field that pulls electrons from various atomic orbits and into a directed current when they come in contact with photons on their surface.

3.9.3   Solar charger controller

Figure 3.6 solar charger controller

Using a solar charge controller will keep your 12-volt GEL or Flooded battery from being overcharged. A reverse battery connection might potentially pose a risk. This controller displays the charging current or battery voltage on the LCD metre. This charge controller is built to endure a long time and save money on electricity costs.. Over-discharge voltage is constantly changing due to the exact regulation of the battery discharge rate.

3.9.4 Battery 12v 7ah

Figure 3.7 Battery 12v 7Ah

A common 12-volt battery seen in cable boxes and home security systems, the 12v 7Ah is a high-capacity 12-volt battery. Security and backup power systems may both benefit from its modest size and portability. ABS plastic is used for the outside shell to prevent spills and leaks. With Absorbent Glass Mat Technology, the battery has a long service life and can provide powerful currents on demand when needed. It takes just four hours for this battery to fully recharge if we apply the correct solar charging technique, and it may be used for more than three years.

3.9.5 IR sensor
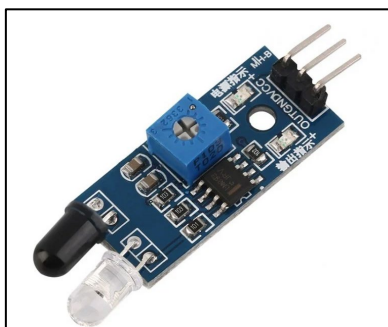
Figure 3.8 IR sensor

This project detects the letter in the mailbox using an IR sensor. An infrared sensor is an electronic device that produces light and detects environmental objects. For instance, an infrared sensor can detect motion and estimate the temperature of an item. Practically every object emits infrared heat radiation. Around the year 1800, astronomer William Herchel discovered infrared light by accident.

3.9.6 Basic component

Table 3.1 Basic component list

No	Component	Function
1.	Jumper	An electric line known as a jumper wire is used to connect distant electric circuits on printed circuit boards.
2.	1.5mm Electric cable	To connect between solar to battery and solar charger controller.
3.	Usb to micro usb cable	To connect between solar charger controller to the microcontroller.

3.10 Software part

In this section, there are some component that will use in this project.

3.10.1 Esp8266
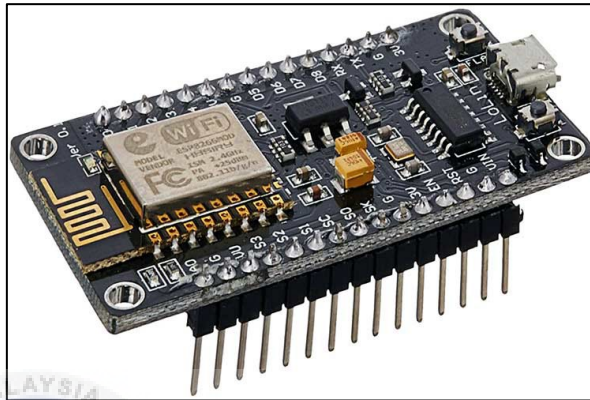
Figure 3.9 Esp8266

Esp8266 may be useful in industrial environments. As a result of the chip's reduced external component count and its tightly integrated on-chip capabilities, it is dependable, compact, and long-lasting. Standard digital peripheral interfaces, antenna switches, RF baluns, a power amplifier and a low-noise receiver amplifier are all included in the esp8266. Filters and power management modules are also included.

Low-power, 160 MHz, ten-silica-core RISC microcontroller (ESP8266EX) with a low-power, 32-bit architecture Around 80% of the processing power is made accessible to application developers via the Real-Time Operating System (RTOS) and the Wi-Fi stack.

3.10.2 Blynk apps

Figure 3.10 Blynk application

If you have an iOS or Android smartphone, you can use Blynk to create interfaces that may be used to manage and monitor hardware projects. You may construct a project dashboard by installing the Blynk app on your smartphone and then filling the screen with buttons, sliders, graphs, and other widgets. Pins may be activated and deactivated using widgets, and sensor data can be shown with them. As of this writing, Blynk is supported by the great majority of Arduino boards, as well as some Raspberry Pi boards as well as the Particle Core and the ESP8266. Support for other boards is expected to be added in the future. Arduino shields for Wi-Fi and Ethernet are supported, and you may also use the USB connection on a computer to control the devices you use with Arduino.

3.10.3 Arduino Ide
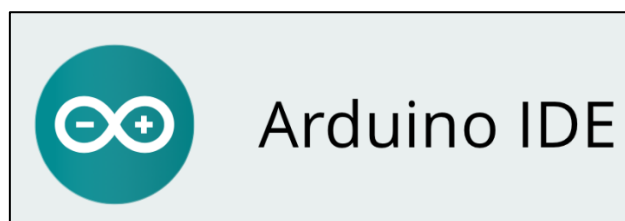
Figure 3.11 Arduino Ide

The Arduino IDE is an open-source software platform for developing and uploading code to Arduino boards. The IDE developed may be useful to users of Windows, Mac OS X, and Linux. Programming languages C and C++ are supported. The abbreviation IDE stands for an Integrated Development Environment in this instance.

3.10.4 AutoCAD

Figure 3.12 AutoCAD

AutoCAD will be used to create the blueprints for this project. The design's scale, size, and form may differ from the real prototype.

3.10.5 Sketchup

Figure 3.13 Sketch Up

SketchUp will also be used to create the design for this project. The design's scale, size, and form may differ from the real prototype.

3.11 Conclusion

Finally, it's safe to say that people are sometimes susceptible to forgetfulness. They must constantly be reminded so that crucial information does not slip their minds. Users of this mailbox will experience less mail or package loss because to the smart mailbox initiative that this mailbox has proposed. Users will be more aware of the existence of bills or letters. A reminder will be sent to the user's mobile application reminding them of their package or letter. Wi-Fi connectivity is required for the intelligent mailbox to work, and alerts will be sent via 'Blynk' applications.

CHAPTER 4

RESULT AND DISCUSSIONS

4.1   Introduction

This chapter goes into greater detail about the research and the project as a whole. All project testing, data analysis, and operational status are all included. To determine if the project's goal has been achieved, several checks and evaluations are conducted. This chapter is broken up into subchapters with the final or expected results.

4.2   Hardware Design

This project is based on a real mailbox structure design. The size dimension of this mailbox is 30cm L x 15cm W x 40cm H and for the battery box the size dimension is 30cm L x 21cm W x 15cm H and for the solar panel size dimension 37cm L x 24cm W. Figure 4.1 show mailbox, 4.2 show battery box and 4.3 show solar panel.

Figure 4.1 Front View mailbox
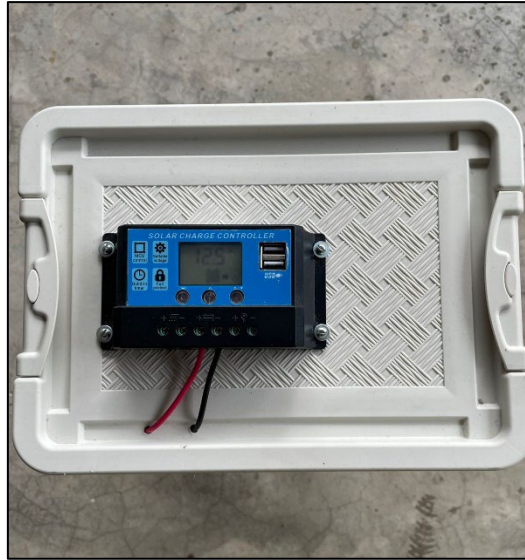
Figure 4.2 Front View battery box

Figure 4.3 Front View solar panel

The hardware part is the development of the smart mailbox made up of, a microcontroller, and a sensor. Hardware development includes circuit design and the operation of the IR sensor. The circuit is made up of an ESP8266 Wi-Fi module, and a power supply. While the IR sensor is the most important component in this project for detecting the incoming mail or small parcel.
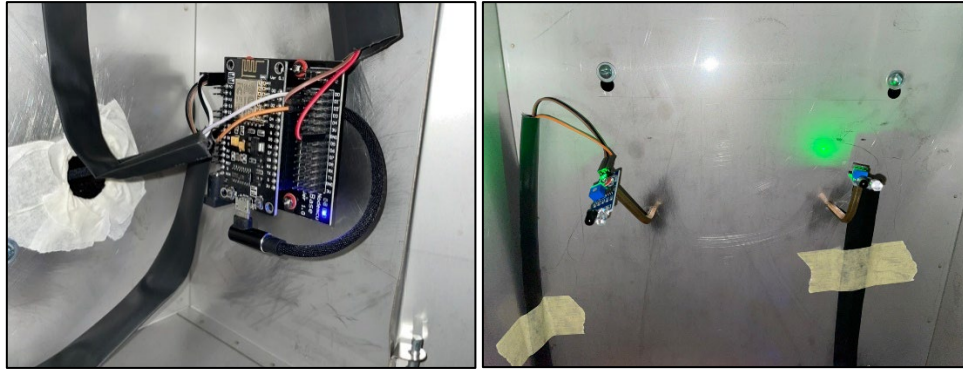
Figure 4.4 Inside of smart notification mailbox

Turning on the configured Wi-Fi and input hardware devices such as IR sensor and buzzer is required to active and put smart mailbox into operation. The IR sensor will turn on the green light when the ESP8266 connect to Wi-Fi modem that is suitable for ESP8266 which can connect to 2.4 GHz WIFI. The IR sensor will turn on the green light. After the ESP8266 connected to the Wi-Fi the operation will be process. First the IR sensor will detect the mail or small parcel that go through the sensor and then the buzzer will make the sound and the phone that have been download the Blynk apps and log in to the same user as the smart mailbox will get the notification from the Blynk apps. Figure 4.5 below shown the fully hardware development of Smart Mailbox Notification System with Solar Battery Charging.

Figure 4.5 Hardware Development of Mailbox Notification System with Solar Battery
Charging

4.3 Software design

The smart mailbox designed for this project consists mainly of NodeMcu ESP8266, two IR sensor, buzzer and ESP8266 Wi-Fi module. The coding and program are uploaded to NodeMcu Esp8266 via usb cable from Arduino IDE. Besides, The ESP8266 WIFI Module acts as wireless connectivity between the smart mailbox and the clouds.
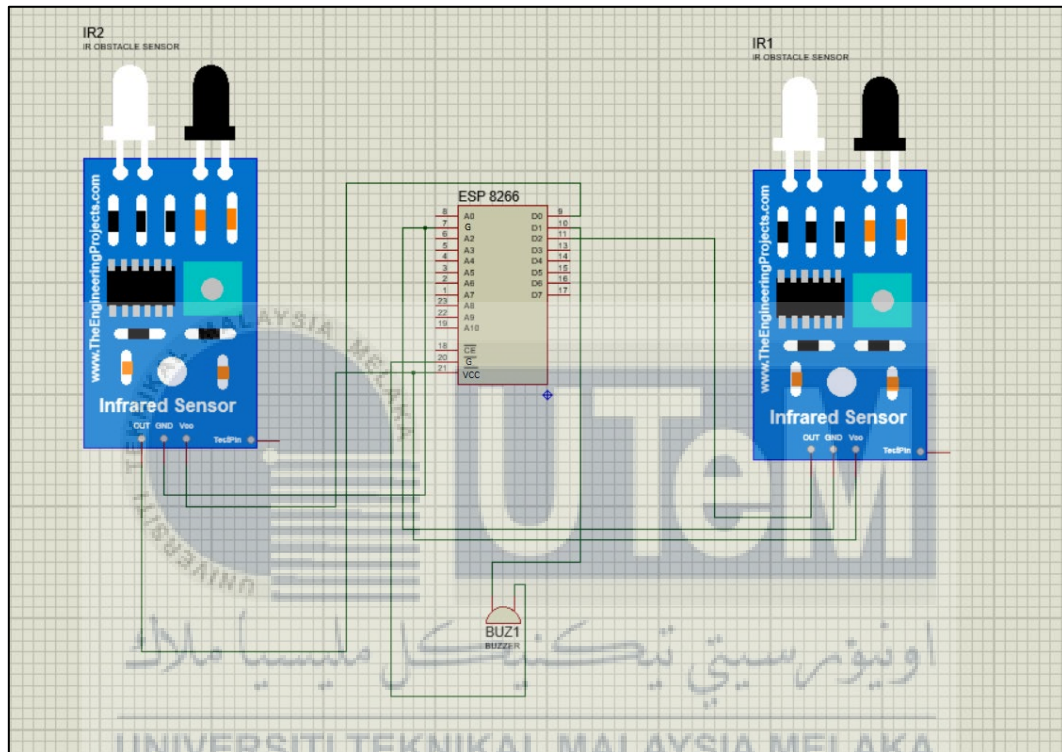
Figure 4.6 Schematic Diagram

4.3.1 Arduino Instructions Programming

This project made use of the Arduino IDE software. In general, the Arduino IDE software is an open source, C and C++ based programming language that is available in most operating systems. Understanding a C++-based language is essential to modify programming instruction. An Esp8266 is used as the system microcontroller in this project.

46

```
#define BLYNK_TEMPLATE_ID "TMPLuR_4LLyb"
#define BLYNK_DEVICE_NAME "smart mailbox"
#define BLYNK_AUTH_TOKEN "ON4Bic20lpmmLE4Tl2J7NCFzbDFuzR3t"

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

#define buzzerPin D1
#define irPin D0
#define irPin2 D2
```

Figure 4.7 List of Libraries

4.3.2 Arduino Instructions Programming for Esp8266 connected to WIFI

```
#define BLYNK_TEMPLATE_ID "TMPLuR_4LLyb"
#define BLYNK_DEVICE_NAME "smart mailbox"
#define BLYNK_AUTH_TOKEN "ON4Bic20lpmmLE4Tl2J7NCFzbDFuzR3t"

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Yeke";
char pass[] = "athirsidek";

BlynkTimer timer;

void myTimerEvent()
{
  Blynk.virtualWrite(V0, millis() / 1000);
}

void setup()
{
  Serial.begin(115200);

  Blynk.begin(auth, ssid, pass);
  timer.setInterval(1000L, myTimerEvent);
}

void loop()
{
  Blynk.run();
  timer.run(); // Initiates BlynkTimer
}
```

Figure 4.8 Program for ESP8266 Module

Figure 4.8 above shows the Wi-Fi connection setup for Esp8266. After turning on the Esp8266 to the supply it will automatically connect to the Wi-Fi because the password and the username of the Wi-Fi have already been added to the program.

47

4.3.3 Arduino Instructions Programming for Notify Warning on Blynk

```
{
  Blynk.run();
  timer.run(); // Initiates BlynkTimer

  int reading = digitalRead(irPin);
  int reading2 = digitalRead(irPin2);

  // ---------------------------------------

  if (reading != lastIrState) {
    lastDebounceTime = millis();
  }

  if ((millis() - lastDebounceTime) > debounceDelay) {
    if (reading != irState) {
      irState = reading;

      if (irState == LOW) {
        count++;
        Blynk.logEvent("mail_alert","Incoming Mail!");
      }
    }
  }

  lastIrState = reading;

  // ---------------------------------------
```

Figure 4.9 Program for Notify Warning

Figure 4.9 above show the coding for notify warning on the Blynk app. If the mail hit the area IR sensor that covered, it will get a warning notification from the Blynk app. So, the user of this smart mailbox will be alert that they have a new mail in their mailbox.

4.3.4 Blynk Application

In this project, the data and notifications can be monitored from the smart mailbox with the Blynk application. This smartphone app displays all the data notifications as shown Figure 4.10.
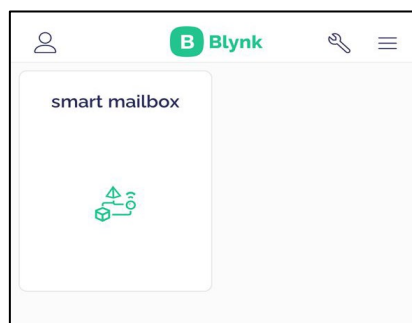
Figure 4.10 Blynk Application

To begin, install the Blynk apps for Android or iOS from the Google Play store or the Apple store. To communicate with the Esp8266, the user must install the Blynk library for the Arduino IDE. Then, on the smartphone, open the apps and create an account to login and build a new project. The hardware chosen for this project is the Esp8266, and the communication method is Wi-Fi ESP8266.
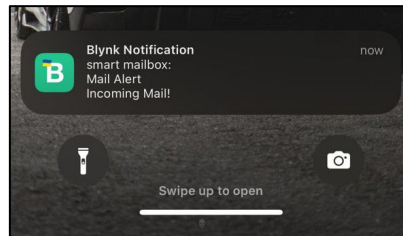
Figure 4.11 Blynk Notification

4.4 Steps and Procedures of this project

When the smart mailbox connects to the power supply which is at the solar charger controller the Smart mailbox will turn on. After that the Wi-Fi adapter must been turn on the adapter username and password must be same with the program that we setup in the Arduino Ide.

Figure 4.12 Esp8266 ON

```
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Yeke";
char pass[] = "athirsidek";
```

Figure 4.13 Username and Password in Arduino IDE

Next, connect the ESP8266 Module in the smart mailbox with adapter WIFI and wait to connect to the WIFI which is shown in Figure 4.14.

Figure 4.14 WIFI Connection from program and adapter WIFI

After smart mailbox connected to the supply from the battery box and the Wi-Fi adapter turn on and the two IR sensor will show the light the Esp8266 will automatically connected to the adapter Wi-Fi because the username and the password of the Wi-Fi has already been set in the program and the smart mailbox will be ready to use.
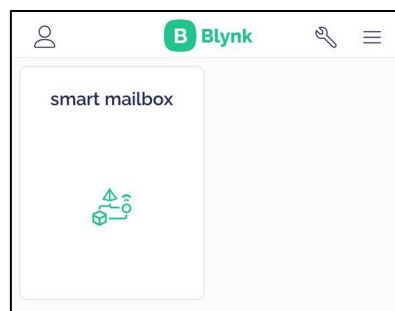
Figure 4.15 Smart mailbox in online Condition
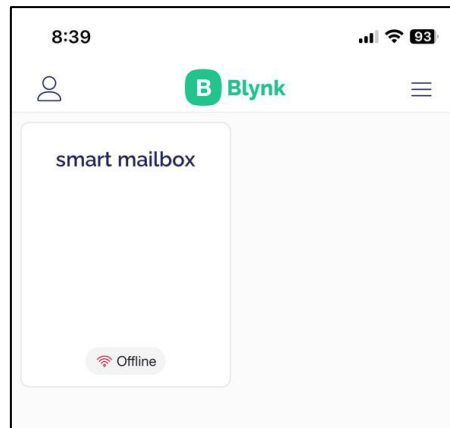
Figure 4.16 Smart mailbox in offline Condition

The next step will prepare the IR sensor to detect any mail or small packages that have passed past the sensor. Esp8266 will send a notification to the cloud when an IR sensor detects any mail or a small package, and the owner of the smart mailbox will receive the Blynk notification on their phone.
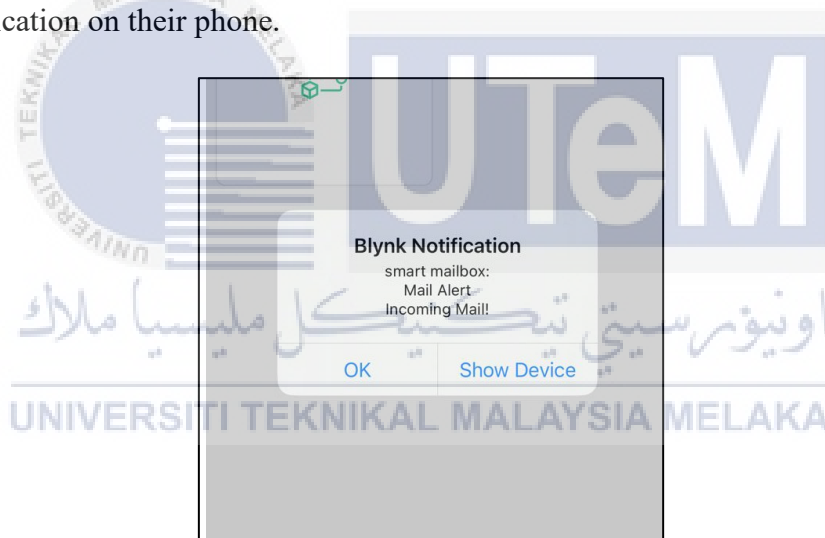
Figure 4.17 Notification from Blynk apps

The Blynk apps also keep track of the number of packages that smart mailbox owners have received in their mailboxes. This count can also be reset at any moment, all it takes is a quick click of the reset button to make the counting clear. Once the owner has placed all the mail and small packages in the smart mailbox.

51
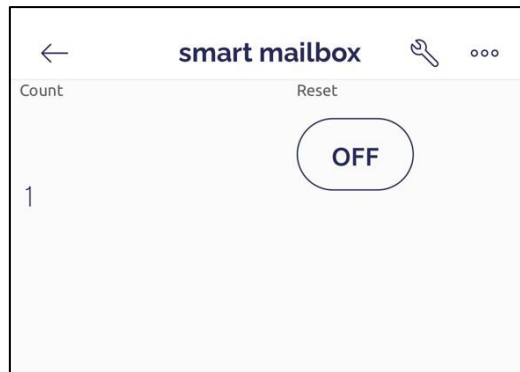
Figure 4.18 Smart mailbox show that has one mail in mailbox.
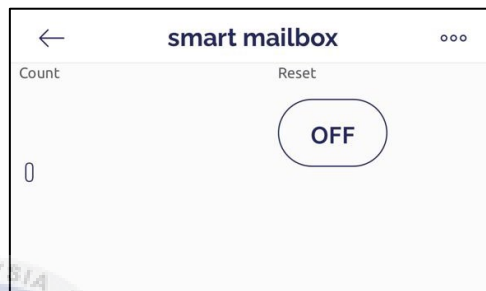
Figure 4.19 Reset has been do

4.5   Discussion

4.5.1   Effectiveness between two different IR sensor brands

The smart mailbox notification based on IOT has been installed with two different types of IR sensors which are IR sensor normal version and IR sensor KY-032 version. Several testing have been conducted in order to determine which brand has the best performance in terms of distance covered to detect mails and parcels inserted into the mailbox. Table 4.1 shows the distances between 0 cm to 9 cm, the detection of IR sensor and the Blynk notification that been receive or not.

52

Table 4.1 Data effectiveness between two different IR sensor

Distance(cm)	Detection (IR sensor Normal Version)	Blynk notification	Detection (IR sensor KY-032 Version)	Blynk notification
0	Yes	Receive	Yes	Receive
0.5	Yes	Receive	Yes	Receive
1	Yes	Receive	Yes	Receive
1.5	Yes	Receive	Yes	Receive
2	Yes	Receive	Yes	Receive
2.5	Yes	Receive	Yes	Receive
3	Yes	Receive	Yes	Receive
3.5	Yes	Receive	Yes	Receive
4	Yes	Receive	Yes	Receive
4.5	Yes	Receive	No	Not Receive
5	Yes	Receive	No	Not Receive
5.5	Yes	Receive	No	Not Receive
6	Yes	Receive	No	Not Receive
6.5	Yes	Receive	No	Not Receive
7	Yes	Receive	No	Not Receive
7.5	Yes	Receive	No	Not Receive
8	Yes	Receive	No	Not Receive
8.5	Yes	Receive	No	Not Receive
9	No	Not Receive	No	Not Receive
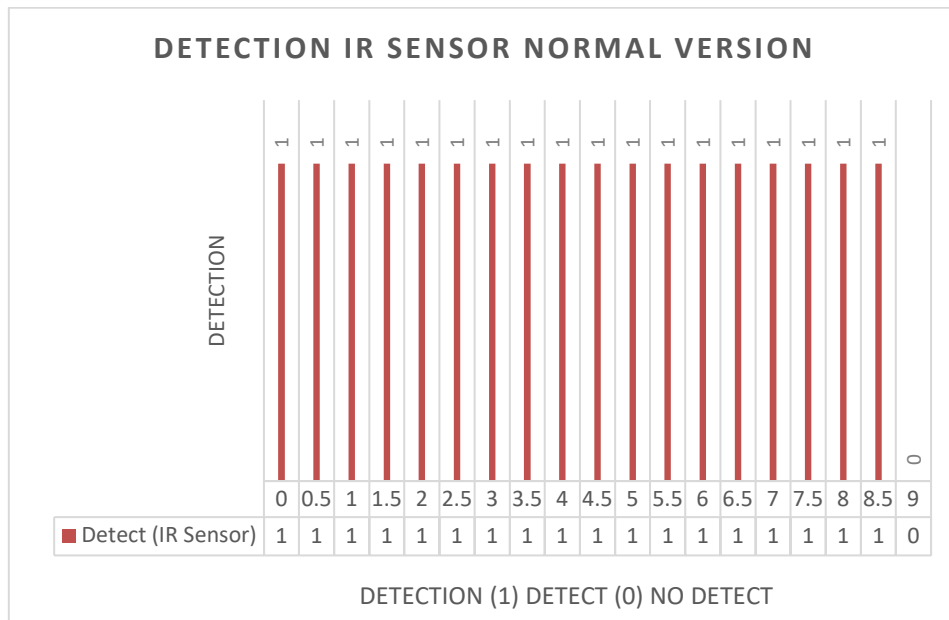
Figure 4.20 Detection normal Ir sensor data
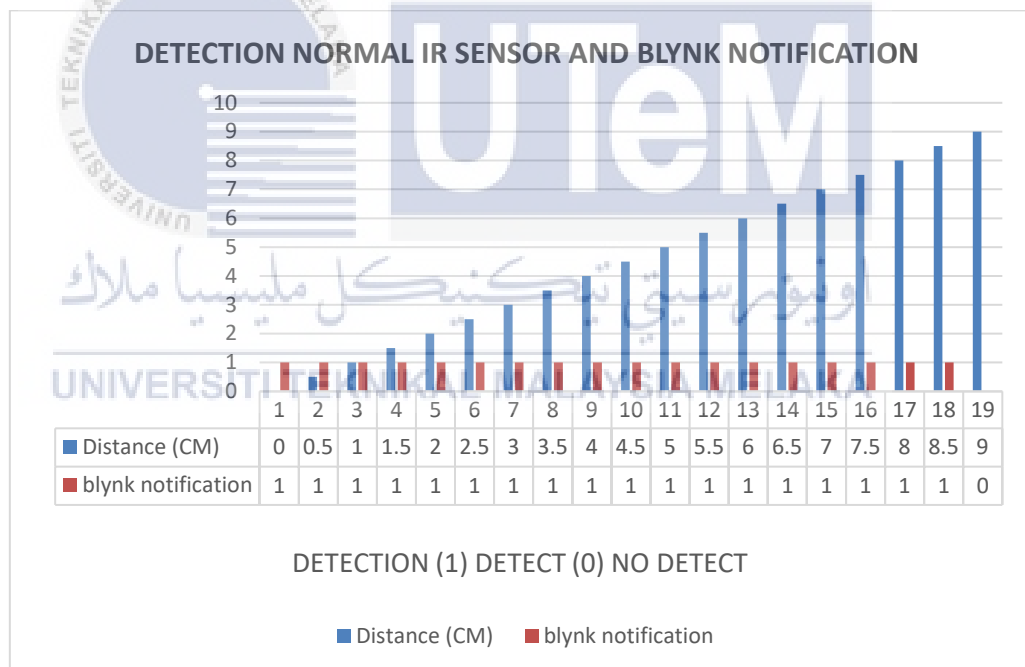
Figure 4.21 Detection normal IR sensor and receiving Blynk notification
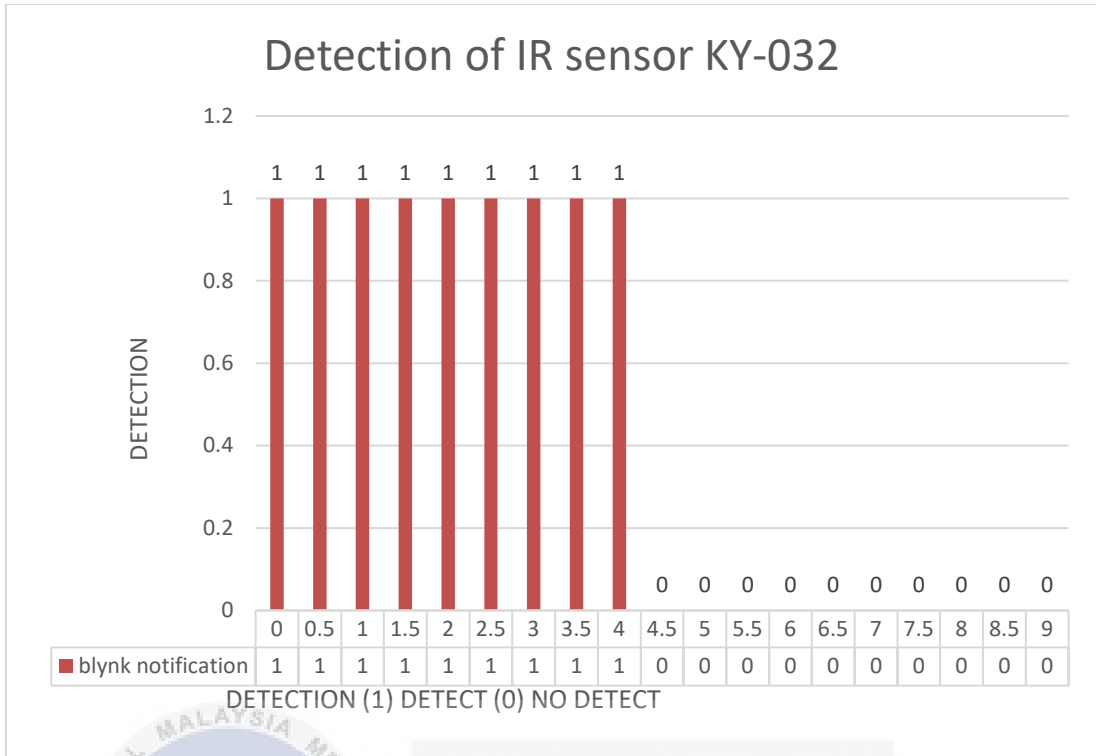
Figure 4.22 Detection KY-302 IR sensor and receiving Blynk notification
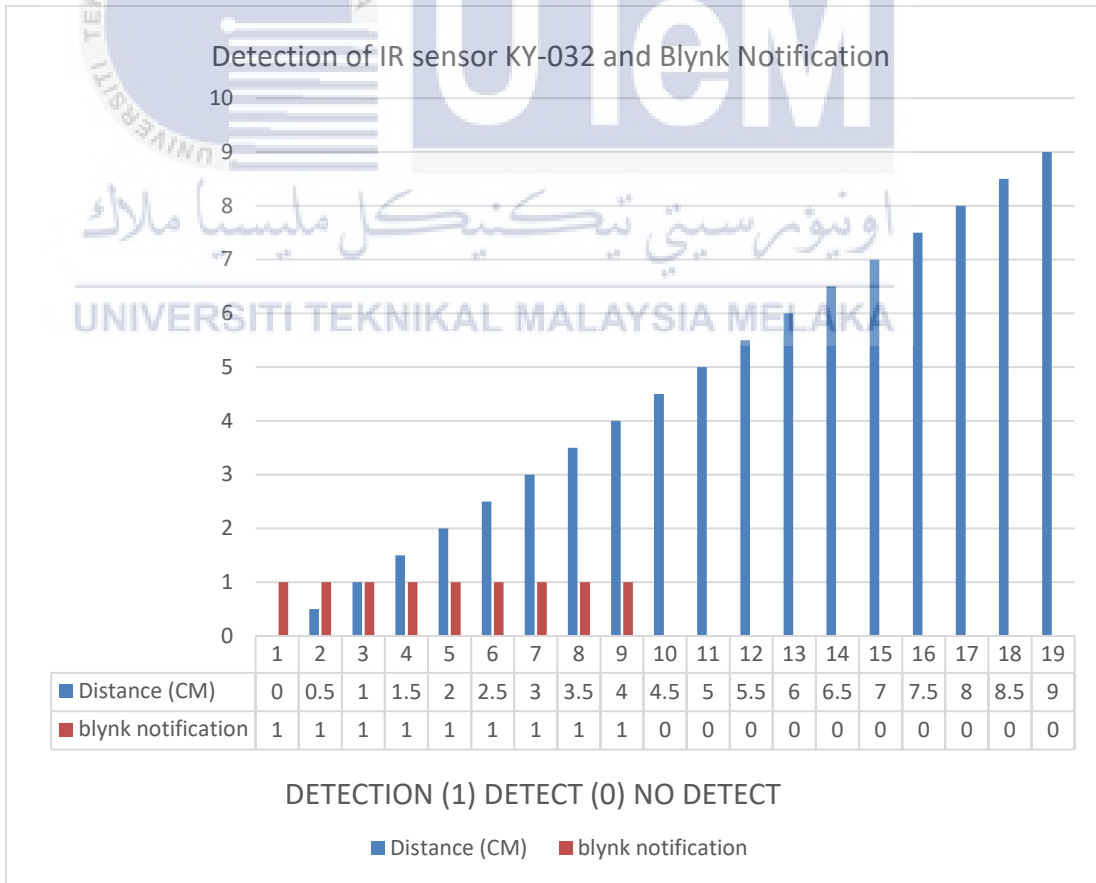
Figure 4.23 Detection KY-302 IR sensor and receiving Blynk notification

55

The data from the graph in Figures 4.20,4.21,4.22,4,23 show the effectiveness of the IR sensor between the normal IR sensor and the KY-032 IR sensor. The legend for the graphs above is that the number 1 displayed for Blynk notification represents the detection of mails or parcels while the number 0 represents no detection of mails or parcels. This data shows that the normal IR sensor can detect mails or small parcels in 8.5 cm max distance and cannot detect over 9 cm while the KY-032 IR sensor can only detect mails and small parcels not more than 4cm. This result confirms that the best sensor that can be implemented for this smart mailbox is a normal sensor due to the coverage distance to detect mails and parcels is better than the KY-032 IR sensor.

4.5.2 Analysis of Blynk to send the notification in time.

The notification time was tested by doing 30 attempts on 3 different set. Every time the mail was inserted the buzzer will make sound to confirm the mail was detected and the notification will be received. The test recorded the attempt and the time Blynk notification will arrive to the phone by using a stopwatch.

Table 4.2 Data Blynk to send the notification in time

Attempt	Response time (Second)			Average response time
	Set 1	Set 2	Set 3	
1	1.45	2.33	3.30	2.36
2	1.71	1.44	1.54	1.56
3	1.65	1.53	2.20	1.79
4	1.88	1.68	1.54	1.70
5	1.65	2.31	2.33	2.09
6	1.81	3.32	1.52	2.22
7	1.55	2.15	2.10	1.93
8	2.00	1.62	1.33	1.65

| 9 | 2.30 | 1.77 | 1.45 | 1.84 |
| 10 | 1.83 | 1.43 | 2.44 | 1.9 |
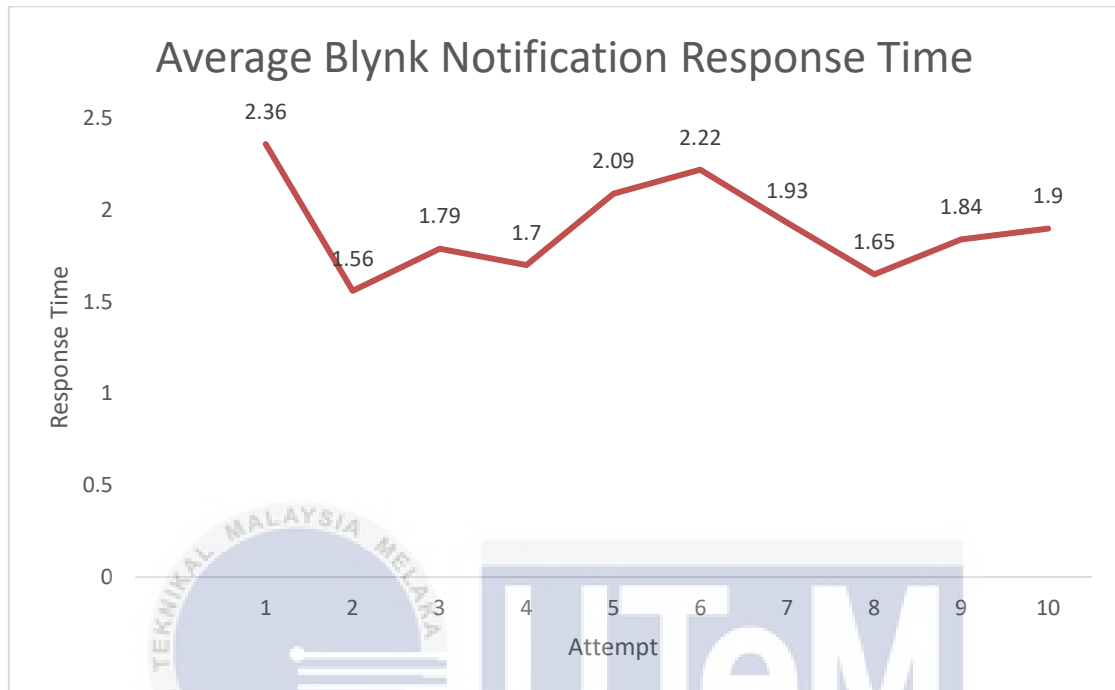
Figure 4.24 Average Blynk Notification Response Time

The data from the graph in figure 4.24 shows how much time that need the notification received to the owner phone its only need less than 4 second.

4.5.3   Solar efficiency result

The solar system is checked at various hours of the day in the presence of different sun orientations, so that the incident light can be detected in different circumstances.

Table 4.3 Data obtained for solar efficiency

| SOLAR PANEL POSITION : 45° |
| PLACE :Taman tasik Utama, Melaka |
| DATE :23/12/2022 |
| MEASUREMENT DATA |

TIME	IRRADIANCE (kwh)	TEMPERATURE (° C)	VOLTAGE (V)	CURRENT (A)	POWER (W)
8.00 a.m.	112	25	14.6	0.03	0.438
9.00 a.m.	184	25	15.1	0.04	0.604
10.00 a.m.	279	26	15.2	0.06	0.912
11.00 a.m.	554	29	15.0	0.35	5.250
12.00 a.m.	561	29	15.0	0.36	5.400
1.00 p.m.	723	31	17.6	0.41	7.210
2.00 p.m.	891	31	16.5	0.43	7.095
3.00 p.m.	898	31	16.2	0.42	6.804
4.00 p.m.	713	30	15.6	0.35	5.460
5.00 p.m.	699	30	14.9	0.20	2.980
6.00 p.m.	472	29	15.0	0.04	0.600

To calculate the solar efficiency, the maximum power can be obtained by calculating using the formula in Step 1 below. Then the surface area of solar cell must be calculated by using the formula Length*Height *Width and to calculate the overall value for solar efficiency, the formula in Step 3 can be used to finalize the answer.

1)STEP 1: Calculate the maximum power
Maximum power, Pm in watt $= (10wh)$

2)STEP 2: STEP 2: Calculate the surface area of solar cell in m2

Length × Height × Width = Surface Area
$0.350 \times 0.24 \times 0.017 = 0.001428$

3)STEP 3: Calculate the solar efficiency

Formula Solar Efficiency $= Efficiency = \dfrac{\text{Maximum power}}{\text{Irradiance} \times \text{Surface area of solar}}$

$n = \dfrac{10}{1643 \times 0.001428}$

Answer = 5.4 %

According to the calculation above, employing solar energy is advised since it works well with the system and might also consume less energy when a battery is used as the power source. As a result, solar power may be used to replenish batteries. The highest Figure recorded throughout the experiment, according to Table 4.3, was an irradiation of 914 kwh. However, according to study, Malaysia's average irradiance value is 1647 kwh, which is high by comparison to the measurement. This is because the measured irradiance value was decreased owing to the current gloomy and wet weather.
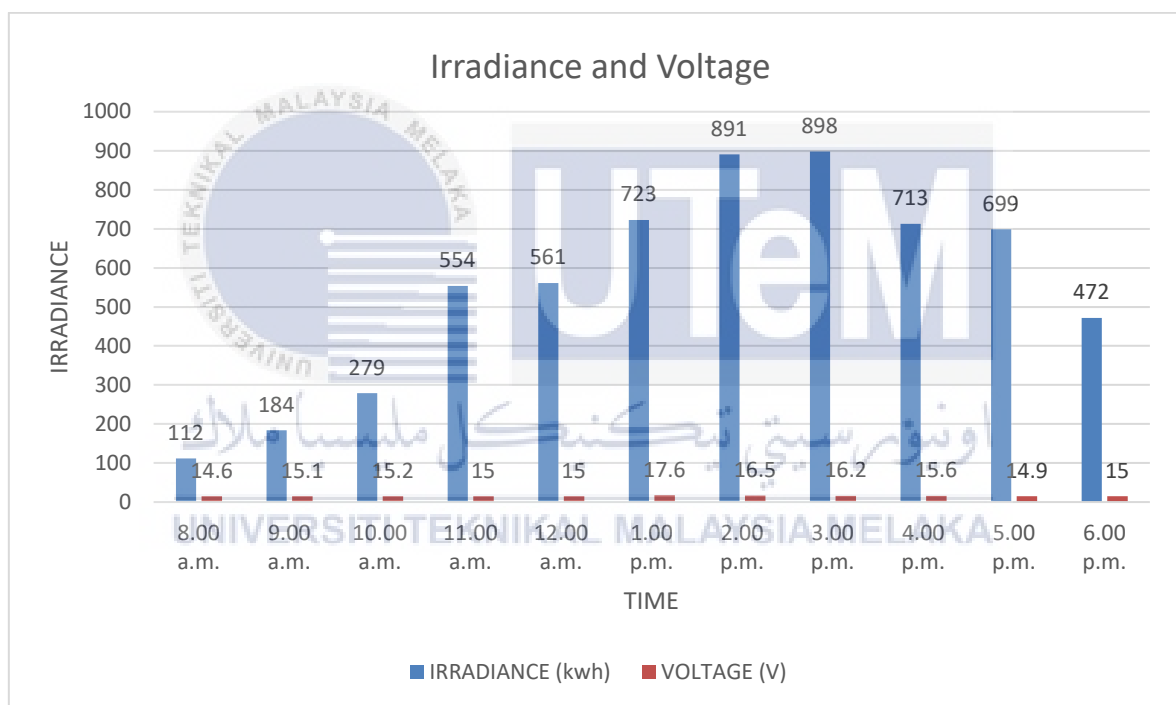
Figure 4.25 Irradiance and voltage
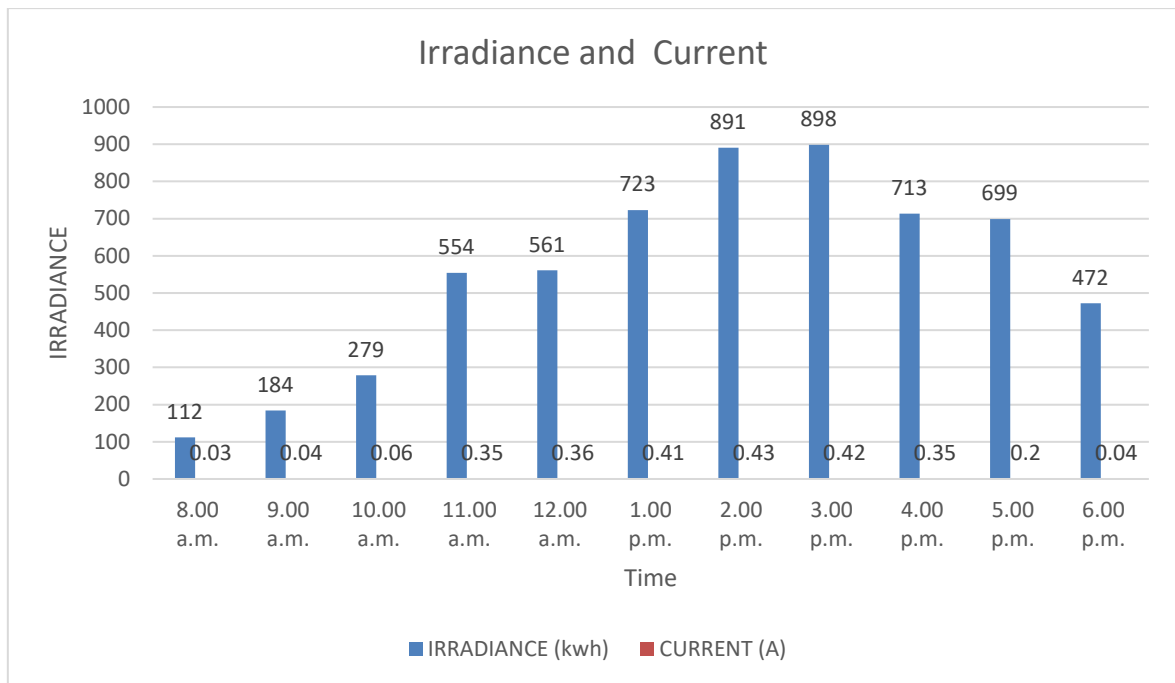
Figure 4.26 Irradiance and current
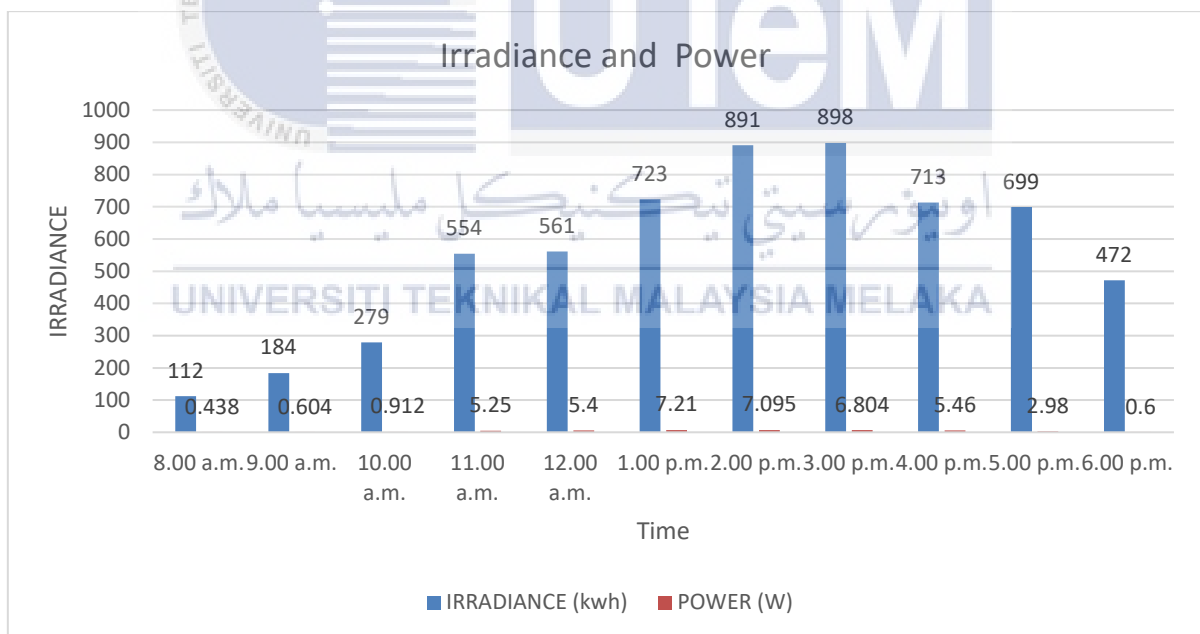
Figure 4.27 Irradiance and power

The solar battery charging has been installed and the system ran for 8am to 6pm at my house Taman Tasik Utama. Based on the result from the graph the highest improvement occurs when solar panel at the sun orientation at 3.00pm at the hour. This is when the solar panel received the maximum incident of light.

CHAPTER 5

CONCLUSION

5.0   Introduction

This chapter will briefly describe about the conclusion. The conclusion is basically summary of the whole project. On the other hand, recommendation and idea will be presented in this part for improvement in the future.

5.1   Conclusion

In conclusion, Finally, people are sometimes prone to forgetfulness. They must constantly be reminded in order to prevent them from forgetting anything crucial. This mailbox will assist users in minimizing the loss of critical packages or letters by offering the Smart Mailbox Project. Users of the smart mailbox will benefit from being more aware of the letter thanks to the sensor assembly. This is so that the user of the mobile application will be reminded of their package or letter by the mailbox's message that it has arrived. The smart mailbox will operate with a strong Wi-Fi connection and then deliver alerts through "Blynk" applications.

Additionally, the testing that was done had a favorable outcome, with alerts appearing on the "Blynk" applications when the sensor picks up motion from an arriving package in the mailbox. The objectives mentioned demonstrate that this project yields a favorable outcome, and thanks to the analysis's findings, it is clear that all of the project's goals have been well met.

61

Knowing more about the Internet of Things will help people realise how crucial it is to our everyday lives. The information era has advanced to the next stage with IoT. The Internet of Things has the potential to alter our daily routines, our jobs, and our communities. IoT aims to give you back your day by consolidating all of your control into one place.

Your smartphone will serve as the primary hub for the rest of your world, putting everything of your life at your fingertips. IoT is currently a significant aspect of our lives and is not simply a basic concept. With the help of this technology, the sector will soar to new heights and provide everyone in the globe fair and equal access. Therefore, we are all aware of how significant IoT is to us, and based on this initiative, it will eventually assist us in the future.

5.2 Recommendation

When creating a new product, it is necessary to come up with a better solution that can be used with the Smart Mailbox to address the issues of insensitivity and being unaware of the existence of mail. As a consequence of the conversation, several fresh suggestions are made to enhance the project moving forward.

Close circuit television (CCTV) is a need for the Smart mailbox in order to monitor activity, mostly for security and surveillance reasons. CCTV is dependent on well positioned cameras and viewing on-camera input remote displays. Closed-circuit describes the exclusive wireless communication networks or coaxial cable lines that the cameras use indicating that access to its content is intended to be restricted to individuals who have access to monitors and/or video recorders suggesting that they have access to material is meant to be limited to those capable to watch it.

Last but not least, the smart mailbox should be concerned with delivering information regarding battery health and percentage, as well as the state of the other

62

components, in addition to sending messages if there are mails present. When there is damage, taking immediate action may save more severe difficulties from occurring and can always guarantee that the components are in excellent shape.

In the future, perhaps, these suggestions will be able to increase the Smart mailbox's productivity and convenience.

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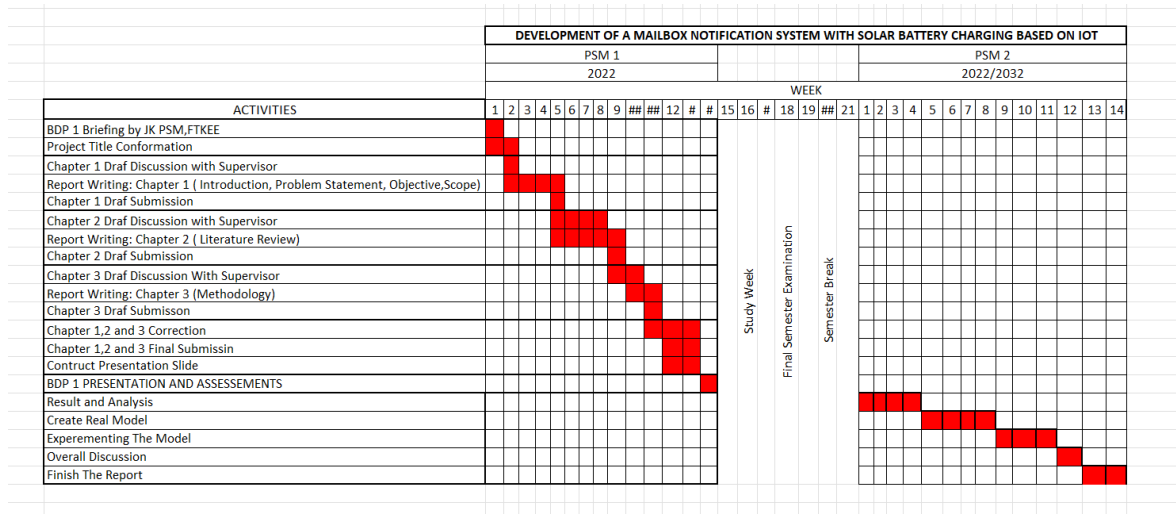
APPENDICES

Appendix A   Mesuring Item

Irradiance meter and Multimeter

Appendix B   : Gantt chart

ACTIVITIES	DEVELOPMENT OF A MAILBOX NOTIFICATION SYSTEM WITH SOLAR BATTERY CHARGING BASED ON IOT																																				
	PSM 1																							PSM 2													
	2022																							2022/2032													
	WEEK																																				
	1	2	3	4	5	6	7	8	9	##	##	12	#	#	15	16	#	18	19	##	21	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BDP 1 Briefing by JK PSM,FTKEE	█																																		
Project Title Conformation		█																																	
Chapter 1 Draf Discussion with Supervisor			█																																
Report Writing: Chapter 1 (Introduction, Problem Statement, Objective,Scope)			█	█																															
Chapter 1 Draf Submission																																			
Chapter 2 Draf Discussion with Supervisor					█	█	█																												
Report Writing: Chapter 2 (Literature Review)							█	█																											
Chapter 2 Draf Submission									█																										
Chapter 3 Draf Discussion With Supervisor										█	█																								
Report Writing: Chapter 3 (Methodology)											█	█																							
Chapter 3 Draf Submisson												█																							
Chapter 1,2 and 3 Correction												█	█																						
Chapter 1,2 and 3 Final Submissin													█																						
Contruct Presentation Slide													█																						
BDP 1 PRESENTATION AND ASSESSEMENTS														█																					
Result and Analysis																						█	█	█											
Create Real Model																									█	█	█								
Experementing The Model																												█	█						
Overall Discussion																														█	█				
Finish The Report																																	█	█	

Study Week — Final Semester Examination — Semester Break (columns 15–21)

Appendix C : Program

```
#define BLYNK_TEMPLATE_ID "TMPLuR_4LLyb"
#define BLYNK_DEVICE_NAME "smart mailbox"
#define BLYNK_AUTH_TOKEN "ON4Bic201pmmLE4Tl2J7NCFzbDFuzR3t"

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

#define buzzerPin D1
#define irPin D0
#define irPin2 D2

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Yeke";
char pass[] = "athirsidek";

BlynkTimer timer;

unsigned long count = 0;

unsigned long lastDebounceTime = 0;
unsigned long debounceDelay = 50;
int irState;
int lastIrState = HIGH;

unsigned long lastDebounceTime2 = 0;
unsigned long debounceDelay2 = 50;
int irState2;
int lastIrState2 = HIGH;

BLYNK_CONNECTED() {
  Blynk.syncVirtual(V1);
}

BLYNK_WRITE(V1) {
  int buttonState = param.asInt();
  Serial.println("buttonState: " + String(buttonState));
  if (buttonState == 1) {
    count = 0;
  }
}

void myTimerEvent()
{
  Blynk.virtualWrite(V0, count);
}
```

68

```
void setup()
{
  Serial.begin(115200);

  pinMode(buzzerPin, OUTPUT);
  pinMode(irPin, INPUT);
  pinMode(irPin2, INPUT);

  noTone(buzzerPin);

  Blynk.begin(auth, ssid, pass);
  timer.setInterval(1000L, myTimerEvent);
}

void loop()
{
  Blynk.run();
  timer.run(); // Initiates BlynkTimer

  int reading = digitalRead(irPin);
  int reading2 = digitalRead(irPin2);

  // -------------------------------------

  if (reading != lastIrState) {
    lastDebounceTime = millis();
  }
  if ((millis() - lastDebounceTime) > debounceDelay) {
    if (reading != irState) {
      irState = reading;

      if (irState == LOW) {
        count++;
        Blynk.logEvent("mail_alert","Incoming Mail!");
      }
    }
  }

  lastIrState = reading;

  // -------------------------------------

  if (reading2 != lastIrState2) {
    lastDebounceTime2 = millis();
  }

  if ((millis() - lastDebounceTime2) > debounceDelay) {
    if (reading2 != irState2) {
```

```
    irState2 = reading2;

    if (irState2 == LOW) {
      count++;
      Blynk.logEvent("mail_alert","Incoming Mail!");
    }
  }
}

lastIrState2 = reading2;

// --------------------------------------

if (irState == 0 || irState2 == 0) {
  tone(buzzerPin, 1000);
} else {
  noTone(buzzerPin);
}


Serial.println("count: " + String(count) + " | irState: " + String(irState));
}
```