
## Faculty of Electrical Technology and Engineering

# THE DEVELOPMENT OF A SMART PACKAGE PICKUP SYSTEMFOR HIGH-RISE RESIDENTIAL BUILDINGS (SPPS)



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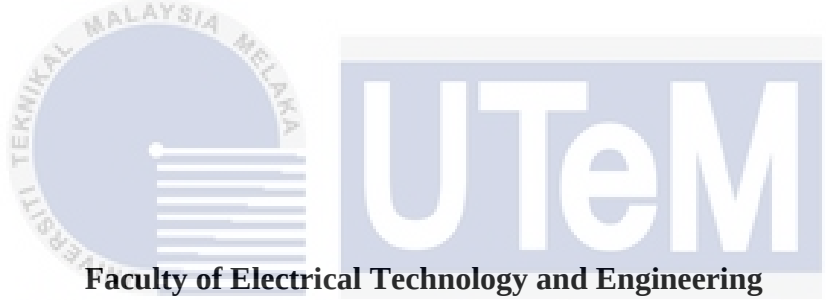
**Bachelor of Electrical Engineering Technology with Honours**

**2023**

**THE DEVELOPMENT OF A SMART PACKAGE PICKUP SYSTEM FOR HIGH-RISE RESIDENTIAL BUILDINGS (SPPS)**

**MUHAMMAD AFIQ BIN NORNIZAM**

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




**Faculty of Electrical Technology and Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2023**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

**BORANG PENGESAHAN STATUS LAPORAN**
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Tajuk Projek: Smart Package Pickup System for High Rise Residential Building (SPPS)

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Supervisor Name : MOHAMAD NA'IM BIN MOHD NASIR

Date : 12/1/2024

# DEDICATION

*To my beloved family,*

*Your constant support, love, and understanding have served as the cornerstones upon which this senior project has been constructed. Your encouragement kept me going during the difficult moments and motivated me to pursue greatness. I appreciate your unwavering belief in me..*

*To my exceptional supervisor,*

*Along this journey, your advice, knowledge, and mentoring have been extremely helpful. This project has evolved into what it is now because to your perseverance, helpful criticism, and commitment to my academic development. I sincerely appreciate your guidance and support.*

*To my incredible friends,*

*Your constant friendship, late-night brainstorming sessions, and continuously support made this project entertaining and rewarding. Your confidence in me and your support were a continual source of inspiration. I am grateful that you are my sources of support.*

*To my esteemed university,*

*I thank the university that gave me the means, the encouraging atmosphere, and the chance to broaden my ideas and focus on my studies. The variety of learning opportunities and academic support have greatly shaped my talents.*

*This project is proof of the combined help and advice I got from my friends, family, supervisor, and university. Your help has been invaluable, and I sincerely thank each and every one of you for your contributions to this effort.*



*With deepest appreciation,*

*[Muhammad Afiq Bin Nornizam]*

## ABSTRACT

The Smart Package and Parcel System (SPPS) project aims to develop programmable store parcels that provide secure storage for items. Its primary objective is to design and develop a smart package pickup system (SSPS) for high-rise residential buildings using a solar power system and to investigate the performance of the SSPS system. This application serves the purpose of securely storing packages and enabling customers to retrieve them when needed. To ensure the correct functioning of the hardware components, the software part of the SPPS is designed to run the appropriate program. The project utilizes an Arduino Uno microcontroller as the central component for controlling the system. Furthermore, a solar system has been integrated. Additionally, GSM is used for the sender to send a code number and password to the receiver. The SPPS has been successfully developed and has shown promising results after a series of conducted experiments.

## *ABSTRAK*

Projek Sistem Pakej Pintar dan Bungkusan (SPPS) bertujuan untuk membangunkan peti stor pintar yang boleh diprogram untuk menyediakan penyimpanan yang selamat bagi barang. Objektif utamanya adalah untuk merekabentuk dan membangunkan sistem pengambilan pakej pintar (SSPS) untuk bangunan kediaman tinggi menggunakan sistem kuasa solar dan menyiasat prestasi sistem SSPS. Aplikasi ini berfungsi untuk menyimpan pakej dengan selamat dan membolehkan pelanggan mengambilnya apabila diperlukan. Bagi memastikan fungsi yang betul bagi komponen perkakasan, bahagian perisian SPPS direka untuk menjalankan program yang sesuai. Projek menggunakan mikropengawal Arduino Uno sebagai komponen pusat untuk mengawal sistem. Selain itu, sistem solar telah ditambah. Tambahan pula, GSM digunakan untuk pengirim menghantar nombor kod dan kata laluan kepada penerima. SPPS telah berjaya dibangunkan dan telah menunjukkan hasil yang menggalakkan selepas siri eksperimen yang dijalankan.

## ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Mohamad Na'im Bin Mohd Nasir, for his precious guidance, words of wisdom, and patience throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support that enables me to accomplish the project. I want to thank all my fellow friends for their willingness to share their thoughts and ideas regarding the project.

My highest appreciation goes to my parents and family members for their love and prayers during the period of my study. An honourable mention also goes to Encik Mohd Na'im Bin Mohd Nasir as my supervisor for all the motivation and understanding to finish bachelor degree project 2.

Finally, I hope this project will give consumers more benefits and be helpful in implementing the smart package parcel system, especially in industry technology.

**DECLARATION**

**APPROVAL**

**DEDICATIONS**

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| | | |
|---|---|---|
| LED | - | Light-Emitting-Diode |
| GSM | - | Global System for Mobile Communication |
| ADC | - | Analog Digital Converter |
| USB | - | Universal Serial Bus |
| SMS | - | Short Message Service |
| LCD | - | Liquid-Crystal Display |
| IoT | - | Internet of Things |
| I/O | - | Input / Output |
| IDE | - | Integrated Development Environment |
| Wi-Fi | - | Wireless Fidelity |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

With the rapid development of the smart package pick-up system, the popularisation of delivery systems is becoming a major concern. Due to the sudden growth of e-commerce, shipping and parcel distribution will soon see an important increase. As far as high-rise residential buildings are concerned.

Over the span of years, delivery of packages or parcels has not been allowed directly to the units of residents in high-rise buildings. Instead, such packages must be left at the mailbox, which is a place authorised by management for self-pickup. Some building managers have given postal and courier workers permission to deliver packages up to a certain apartment. Courier service has also received numerous complaints about parcels going missing or being damaged, which requires courier service to accept responsibility for what happened even if it was not their fault.



Arduino serves as a foundation for the hardware and software to communicate in this creative package pickup operation (programming words). Circuit boards, such as the Arduino UNO, which is typically used to refer to Arduino boards, and the IDE, which is the development component, make up Arduino platforms. Using the IDE, Arduino boards maybe programmed in C++.

Furthermore, with the hardware, which is a barcode scanner, the delivery person needs to scan the parcel before leaving it in the store room, and the receiver needs to scan the parcel back to make sure the serial number of the parcel is the same in the system. The receiver must enter the code number that they received.

## 1.2 Project relation to the current issue

Nowadays, Intelligent package delivery systems face several challenges that affect their effectiveness and reliability. System failures, connectivity problems, or software bugs are examples of technical issues that might cause delays or mistakes in the parcel retrieval and drop-off procedures. Strong precautions must be taken to avoid theft or unauthorised access to packages kept in these systems, since security is still a major problem. Another important factor is user experience; some people may find it frustrating to struggle with interface navigation or usability problems. The efficacy of these systems as a whole can be impacted by compatibility problems that interrupt operations, making seamless integration with a variety of delivery providers imperative. Furthermore, a limited amount of storage space at pickup locations limits the system's capacity to effectively manage a high volume of packages. Regular maintenance is essential to ensure smooth operations, as breakdowns can disrupt service and affect user satisfaction. Lastly, meeting regulatory compliance, especially concerning data privacy laws, is a persistent challenge, requiring adherence to local regulations for the collection and storage of user data. Addressing these multifaceted challenges is essential for enhancing the functionality and reliability of smart parcel pickup systems in the logistics industry.

## 1.3 Problem Statement

The area has seen an increase in delivery businesses, which has caused a variety of issues, such as the potential for product damage from wind and rain, product loss during delivery due to theft incidents, and product placement issues. The number of deliveries will increase in the next few years, which will provide a significant challenge to our delivery management. The study will utilise GSM modules, and keypads to achieve this objective. An Arduino-based prototype will be developed and integrated into the system to facilitate its functioning.

## 1.4 Project Objective

The project major purpose is to develop a security smart package pick up system, the effectiveness of the developing smart package system by using Arduino uno. The project will show advantage and disadvantage of the system. Specifically, the objectives are as follows:

a) To design and develop smart package pickup system (SSPS) for high rise residental building using solar power system.

b) To investigate performance of SSPS system.

## 1.2 Scope of Project

The scope of this project are as follows:

i) Circuit design

- The system is made up of a barcode scanner, a GSM module, and a keypad to enter the code number.

ii) Program development

- To use the Arduino IDE software to write a programme for an Arduino Uno to run the system and hardware.

iii) Software development

- Using PROTEUS software, which can display the output for this design circuit, to build and connect the circuits.

iv) Hardware

- A supply is needed to deliver power to the Arduino board and make sure the GPS module, keypad, and barcode scanner are functional. A GPS module is used to send notification and a code number to the receiver.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

In this era, high rise residental buildings are overrun with deliveries every day. The number of package deliveries has skyrocketed, even more so during the past few years. Buildings are overrun with single-item boxes as a result of one-click checkout convenience and impulsive shopping. The issues high-rise dwellers deal with are numerous.Packages are left unattended in unprotected lobbies or, worse, outside the front door without staff assigned to receiving and processing them. It's quite challenging to determine exactly when a package theft from an apartment complex occurred. Systems for security and video cameras are obsolete and challenging to operate without technical knowledge. With the smart package pick-up system, it’s the way to solve problemsat high residency.

## 2.1 Type of Parcel delivery system

As of yet, there is research indicating that the flexible parcel delivery (FPD) problem is a type of vehicle routing problem (VRP). It is essential for both local transportation inside a manufacturing or warehouse structure and for cost-effective delivery of goods [1]. Also, vehicle routing offers the delivery company a number of benefits, such as shorter routes for vehicles with a higher carrying capacity, which limits traffic problems and helps to reduce negative externalities associated with transportation [2]

Another way to refer to this is as the "walking time to drop off" (WTD). WTD is the period of time that the delivery person walks to the customer to deliver or drop off a package before returning to the delivery vehicle. If the delivery person wants to deliver to multiple workplaces in the same building, he or she may take a few packages out of the vehicle to drop off. In this scenario, we can consider these few delivery locations to be a single delivery point with a longer WTD than a single delivery point like a typical residence [1].

Next, the phrase "Internet of Things," or "IoT," refers to the countless numbers of physical items that are currently connected to the internet and actively collecting and sharing data. By linking all of these different devices and giving them sensors, digital intelligence is given to previously dumb technology, enabling it to communicate real-time data without the assistance of a person. The logistics system, especially for point-to-point distribution, is one of the applications. The current parcel delivery technique is provided through the logistics hub, despite hidden economic penalties in terms of delivery time and distance. IoT platforms are services that can simply connect each component to other components to boost utility value. This enhances the economic viability and decreases the overall delivery distance using IoT technology. It demonstrated the creation and use of an experimental IoT platform. And besides, IoT devices can partition processing by utilising Bluetooth and Wi-Fi features. Since then, the data has been processed without using servers thanks to a variety of IoT device features. Also, the equivalent module may be seen as being of great value by switching it to the delivery system or the tracking system [3].

Another is that many robots have recently been used in a wide range of industrial settings. Also, it would be ideal if transportation-related operations were automated. The construction of an automated parcel delivery system using image processing techniques has been developed. The benefit of this system is that it delivers things quickly and affordably, not just packages. This system is composed of a table unit and a transport robot. The work of the table unit is pushing out a parcel to the transport robot, and the transport robot moves the parcel to the truck. Creating a robot that can transport packages to a truck that delivers packages will benefit workers. The table unit uses a camera to gather exterior data. The parcel and a bar that protrudes from the parcel are both recognised by the visual system. After the package is placed on the table unit, this unit can extrude the package to the transport robot and then reposition the extruding bar. The creation of a transport robot will automate the delivery process. The cost of developing this robot will be inexpensive [4].

The device that they use is a motion camera device, "Xtion PRO LIVE, as a device that acquires external information. This gadget features both a distant image sensor and a colour camera. Seen in Figure 2.1 is "Xtion PRO LIVE. By using an "Arduino UNO" microcomputer board to manage the table unit's bar. As seen in Figure 2.1, "Arduino UNO" [4].



**Figure 2. 1Xtion Pro LIve**

Moreover, one of the concepts is using drones for transmissions from rooftops in the city. Drones and other small unmanned aerial vehicles (UAVs), among other emerging technologies, can be crucial for parcel delivery in the context of smart cities. Smaller packages can be transported using drones rather than being stopped in traffic, which would

cause delivery to be delayed and customer service to decline. Several companies, including Amazon, DHL, UPS, and Google, have earlier reported ideas for using drones to transport packages directly to end users in large cities from their depots (warehouses). Drones were used by Domino's Pizza to deliver pizza to genuine consumers in the New Zealand town of Whangaparaoa. Other successful uses include UPS's hybrid truck-drone delivery in Florida, the United States, and Alibaba's drone-based package delivery to islands in China [5].

Drones, on the other hand, are driven by electric batteries, making them more environmentally friendly. Additionally, since they are not hindered by bad road conditions or high traffic, they move faster and more efficiently. In order to conduct drone-based parcel delivery, proper locations for unloading the packages need to be provided. Building rooftops may be an appropriate option. In this research, on the concept that parcel delivery by drones from building rooftops will soon become a reality, they suggested the MILP model for drone operation planning to maximise the number of deliveries[5]

Finally, electric bicycles are the new technology in transport that has become popular now a days, and in some countries, E-bikes have become an important way for people to go anywhere [6], in order to show that light-electric vehicles may replace those with traditional combustion engines, helping to reduce the effects of logistics on metropolitan areas[6].

This research is primarily concerned with developing a truck-bike mixing model to reduce operating costs for a current truck-only service by replacing part of the vehicles with bicycles. It also looks at the implications for a decrease in carbon emissions as a whole. Many locations prevent delivery trucks from entering specific prohibited zones, which makes it challenging for the courier service to deliver the package. Customers who care about the environment would be more likely to stick with a business if it combined a truck with a bike. Last but not least, deploying cargo bikes would help reduce road congestion and other

issues, such as delays caused by many delivery vehicles being forced to park outside of residential complexes and retail establishments [7].

## 2.2 Type of Mail box pickup system

In terms of the campus environment, more delivery services have recently entered the campus, which has led to a number of inconveniences. These include the inconvenient reception of goods by students and teachers during class hours, the potential for damage to goods from wind and rain, the loss of goods during delivery, the impact on the aesthetics and environment of the campus, and the management of public security. The Multi-functional Parcel Delivery Locker (MFPDL), a new device, employs the C51 MCU and GSM/GPRS modules to send clients SMS with passwords so they may be verified before receiving their packages. The system's core aspect is the smart access system, which carries out SMS sending, password generation, and password authentication operations [8].

The advantage of the system is analysed: smart mailbox Based on radio frequency technology the indicator will turn on when the system finds a package in the mailbox. A proximity switch sends a detection signal to the controller when the user locks the mailbox, and the controller tells an electronic lock module to lock as a result. The user needs a password or RFID card to unlock the mailbox. Moreover, GSM-based messaging technology is used to lock the package in the mailbox to prevent unauthorised unlocking. Automatic receiving of the unlock test message by the owner, who then forwards it to GSM to complete the identification and verification of the phone number. Another is a bar code-based postal delivery system. With this system, you pick the box size, open a box at random, scan the bar code of the packages on the LCD screen, and the created password is transmitted right away to the recipient's phone. Using the password, shipments can be taken by receivers [8].

This technology can boost productivity, expedite fast delivery, and save operational expenses for express companies. The device is modular, consumes little power, and is simple to maintain [8].

Another type is the concept of a smart postal mailbox. They focus on the problem of smart mailboxes that are used to deliver mail without the addressees being there in person. The application's primary purpose is to find out whether a package is in the mailbox. The hardware programme includes the postal mailbox's layout and the essential parts that are thought to have the most modern characteristics. The smart postal mailbox's software component makes sure that its hardware devices operate properly [9].

To run this prototype, they used a PIR sensor, a button, wires, and an Arduino as hardware. The application concept of smart postal mailboxes is that sensors are used to analyse mailbox contents while they are located within the mailbox and can detect the existence of content there. A control unit that communicates with the mailbox sensor and maintains records about the mailbox's status so it can be used to monitor whether the mailbox is filled with items, and a remote access device that enables a user to contact the mailbox management unit from a distance and inquire about the mailbox's status [9]. Figure 2.2 show flowchart of application of smart postal mailbox.

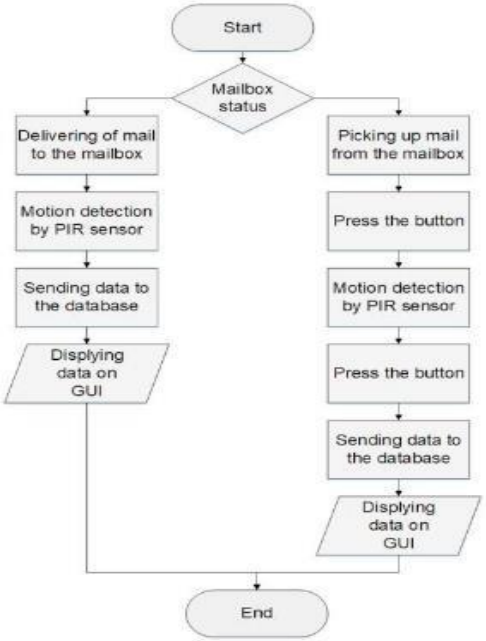


**Figure 2. 2 Concept Of Application Of Smart Postal Mailbox [9]**

The procedure for getting mail to the mailbox is the main topic of this software. The signal is taken as "received mail" if a letter is delivered to the mailbox and the PIR sensor senses motion [9].

Moreover, a smart box has been developed to overcome that courier service and receiver problem nowadays. Combining solar and IoT is the best development of smart boxes now[10].

With a total score of 96% after 50 parcels were tested, the smart box performed admirably. Running the smart box reveals one issue, namely that it is unable to recognise small packages [10]IoT, which is linked to the smart box, is the key software that is required. The application is used to notify the owner when new mail or packages are delivered and placed inside the smart box. If the owner's smartphone is ever online, the owner will receive a notification [11]. Also, owners utilise a smartphone application called LINE to receive notifications when a package is deposited. Solar energy is used to reduce electricity costs and as a backup in the event of a power outage [11].

A microcontroller, infrared sensors, and a solar panel were used to create a smart box prototype for mail and package delivery services. This system also has Wi-Fi capability, which allows a recipient to be alerted when mail or package posts arrive at their delivery address. In the end smart box prototype is the way to secure our parcel and mail[10], [11].

## 2.3 High-Rise Pick Up System Mailbox

The smart mailbox with security system has been developed so that both tenants and delivery services can benefit from a more effective and secure parcel delivery system. Moreover, the current mailbox at the high residence is not safe, lacks a security system, and can cause a missing parcel [12]. This product will use smart IOT technology, a camera, and a servomotor to offer users a secure system. The smart mailbox's door will be locked or opened by the servomotor via a Blynk app on a mobile device, while the camera can be watched by receivers and will function as CCTV. The courier service must push the button mailbox, and the receiver will receive a notification on their phone to open the lock mailbox, allowing the delivery man to place the parcel inside the smart mailbox [12].

The purpose of this project was to find a solution to the issues of an unreachable receiver, lost or damaged objects, and courier delivery issues. The team has concentrated on how to create a product with an overall function and perfect features that meet the demands of the market all through the product design stage. Eventually, this product will be suitable, as advances in technology[12].

Next, e-commerce has recently developed into a significant part of global retail. The purchasing and selling of commodities changed significantly with the advent of the internet, much like many other industries. Several courier companies hire part-time delivery personnel and pay them on a commission basis based on the volume of packages they send, but lately many receivers complain that parcels are damaged because of rain, and in many

cases, their parcel is missing because some of the couriers just left the parcel at the mailbox if the receiver didn't notice their parcel had already arrived [13].

In this article, the project is a smart mailbox system prototype using Arduino Uno as the microcontroller and barcode scanner, and the smart mailbox will be fabricated using aluminium and acrylic. This project application shows that when the parcel is already in the smart mailbox, the delivery guy will scan the parcel, and the receiver will get a notification by email to show the parcel has already arrived and is safe in the smart mailbox [13].

## 2.4 Backgrounds and Related Works

### 2.4.1 TYPE OF ARDUINO

Arduino acts like a brain that can control hardware, for example, an RFID reader, a camera, a motion sensor, etc. Arduino has many types, such as Arduino Yun, as seen in Figure 2.3, with an ATmega32u4 for its microcontroller and an Atheros AR9331 for its microprocessor.



**Figure 2. 3 ARDUINO YUN**

Moreover, the board has a Micro USB connector for hard-wired programming and a Micro SD card slot for additional on-board storage. The board also features a typical USB-type A connection, which enables the system to connect a camera [14] .

Another microcontroller board based on the ATmega2560 is called the Arduino Mega 2560. It contains 16 analogue inputs, 4 hardware serial ports (UARTs), a 16 MHz crystal oscillator, 54 digital input and output pins (of which 15 can be used as PWM outputs),

a USB connector, a power jack, an ICSP header, and a reset button. Another microcontroller board called the Arduino Mega 2560 is based on the Atmega2560. In comparison to comparable boards on the market, it has more memory space and I/O pins [15].

### 2.4.2 Global System for Mobile Communication (GSM)

The Global System for Mobile Communication (GSM) is a digital cellular system used for mobile devices. Through GPRS, this enables the device to access functions like SMS and mobile networks [16]. Wi-Fi modules are pieces of electrical hardware on a host device that enable wireless internet connectivity. You can also call them WLAN modules. Hence, an Arduino Wi-Fi module is a WLAN module compatible with the Arduino Uno. Thus, they run on Arduino software [16].

### 2.4.3 Barcode Scanner

The hardware is a barcode or barcode scanner to track information about the products. The use of QR codes has grown significantly as a result of automation in online retail warehouses. Scanners are positioned at every conveyor belt used for routing so that the items may be identified, routed, differentiated, and the status of the products tracked. The barcode scanner is a piece of equipment that produces the data (the number) that each barcode holds after reading the barcodes using an included laser. All courier services use barcode scanners to keep packages safe in mailboxes and prove that the packages have already been delivered to the receiver [17].

### 2.4.4 Camera

As cameras have so many uses, including visitor monitoring systems, surveillance systems, attendance systems, and more, they have long dominated the electronics sector. While today's camera can not only take photos but also be cctv, Many CCTV cameras can now connect to wifi and save video to memory. A FIFO camera module with several pin configurations is the OV7670 Camera Module, which is offered by various Manufacturers. Full-frame, windowed 8-bit images in a variety of formats are offered by the OV7670. Up to 30 frames per second (fps) in VGA can be processed by the image array. So today, many high-rise residential buildings use CCTV cameras and put them in their mailbox rooms to make sure their mail or parcels are safe. Sometimes their parcels go missing, and they can playback the CCTV and know where the parcel is [18].

### 2.4.5 Keypad

A keypad is used as an input device to read and process the key the user presses. There are four rows and four columns in a 4x4 keypad. Between the rows and columns are switches. An action such as pressing a key connects the switch's corresponding row and column [19].



### 2.4.6 Arduino IDE

IDE (integrated development environment) is a known programme made available by Arduino.cc and is used for editing, compiling, and uploading code to Arduino devices. Arduino IDE basically writes code and compiles the code into Arduino Uno to run the hardware[20].

The Arduino IDE supports C and C++ languages. Arduino IDE can use many Arduino modules, such as Arduino Uno, Arduino Mega, and many more. So, the Arduino IDE is the most important software to run hardware [20].

### 2.4.7 Proteus Design Suite

The Proteus Design Suite is a collection of unique software applications used mostly for electrical design automation. It is a Windows programme for designing printed circuit boards (PCBs) and simulating schematics. Printed circuit boards (PCBs) are manufactured using the software, which is primarily used by electronic design engineers and technicians to build schematics and electronic prints. It is also used as a rapid prototyping tool for research and development. There are two features that are most important to Proteus: schematic capture and PCB design. Proteus can design, test, and debug [21]

## 2.5 Comparison between previous project

Table 2.1 presents a comprehensive comparison of the previous project, drawing insights from 21 literature reviews conducted and searched, all of which are associated with the SPPS project as detailed in the referenced articles.

**Table 2. 1 Comparison between Previous Project**

| NO | AUTHOR | TITLE | FUNCTIONAL | REMARKS (method&application |
|---|---|---|---|---|
| **1** | G.Moon and S. Park | Improved Parcel Delivery Service by using Points Information and RFID | • To improving delivery services in a major city | • RFID use for automatic data collection might improve system performance in practise<br>• Information on the delivery location, including the types of buildings and the required walking distance to hand over the package. |
| **2** | Ha Yoon Song | A Design of a Parcel Delivery System for Point to Point Delivery with IoT Technology | • To design parcel delivery system using IoT | • Using Internet of Things (IoT) technology based on ThingPlug and LoRa technology for quick and inexpensive delivery. |

*Table 2. 1comparison between previous project*

| | | | | |
|---|---|---|---|---|
| **3** | Ido Orenstein | Flexible parcel delivery to automated parcel lockers: models, solution methods and analysis | • Display a logistic model for the distribution of little packages to a number of service points (SPs)<br>• To perform effective methods for solving it | • The petal approach, the savings heuristic, and tabu search with a big neighbourhood are the ideas upon which the methods are built.<br>• Demonstrate the benefits of our model compared to the traditional nonflexible one. |
| **4** | T.Kobata, Y. Tada and T.Muromaki | Development of automatic parcel delivery system using image processing techniques | • To create a system for automated package delivery for personal delivery services. | • Developed at a reasonable price and capable of delivering not only packages but also other things.<br>• This system is made up of a transport robot and a table unit.. |
| **5** | Junsu Kim | Drone-Based Parcel Delivery Using the Rooftops of City Buildings: Model and Solution | • Delivering packages using drones while using building roofs | • To solve a problem parcel delivery using drone and to reduce delivery time |

| | | | | |
|---|---|---|---|---|
| **6** | Keyju Lee | *A Courier Service with Electric Bicycles in an Urban Area: The Case in Seoul, Keyju Lee( 27 February 2019).* | • Developing a truck-bike hybrid vehicle to save operational expenses | • Changing out some of the trucks with bicycles.<br>• Investigating the implications for lowering overall carbon emissions. |
| **7** | Roberto Nocerino | E-bikes and E-scooters for smart logistics: environmental and economic sustainability in pro-E-bike Italian pilots | • Examines the effectiveness of electric scooters and bicycles for transporting items in metropolitan settings. | • The initiative encourages the use of green and efficient automobiles.<br>• To show result of economic sustainability of this replacement. |
| **8** | S. Ze-hong and Z. Guang-yuan | Multi-functional Parcel Delivery Locker System | • The system is the smart access system which functions to realize the SMS sending, password generation and password authentication | • Multifunctional parcel delivery locker system using C51 MCU and GSM<br>• To make sure parcel in safe place and receiver get notification parcel arrived |

| | | | | |
|---|---|---|---|---|
| **9** | Stanislava Turská | Concept of Smart Postal Mailbox | • To deliver goods when the recipients aren't around | • Using Arduino as the controller, check if a package is in the mailbox.<br>• A low-cost, smart postal mailbox prototype that is intended to deliver letters and standardised packages. |
| **10** | Jaranin Kaewsrisuphawong | Development of a smart box prototype for mail and parcel posts using iot and solar energy. | • Create a working prototype of a smart box to accept package posts from the postal service. | • This system provides to a receiver utilising solar energy and the Internet of Things.<br>• This system will send notification to receiver after parcel are dropped into the box |
| **11** | Tareq Khan | A Solar- powered IoT Connected Physical Mailbox Interfaced with Smart device | • A smart mailbox with Internet of Things (IoT) connectivity has been created that automatically notifies the smartphone whenever new mail arrives. | • The suggested mailbox has a low power gadget with sensors, a Bluetooth Low Energy (BLE) system-on-chip microprocessor, and a rechargeable battery that gets power from a solar panel. |

| | | | | |
|---|---|---|---|---|
| **12** | Muhammad Eizaz Afzal Bin Mohamad Zamree | Smart mailbox with security system | • To improving mailbox function that can help receiver and courier services to have more secure and efficient parcel receiving system. | • This project using Smart IoT technology, camera and servomotor.<br>• By using Blynk application, receiver will receive notification. |
| **13** | Mohammed Fakhruzzman Mohamed Firdaus | Development Prototype of Smart Mailbox That Send Email to User When Parcel Barcode Being Scanned | • To development Smart Mailbox which is send notification to receiver when parcel has been scanned. | • The project will use Arduino Uno as the microcontroller<br>• Using the smart mailbox technology, parcel delivery may be completed more quickly. |
| **14** | Jonathan Ross | ADDSMART: Address Digitization and Smart Mailbox with RFID Technology | • To develop smart mailbox, digitizing addresses of location and building. | • An Arduino microcontroller board is used in the project to integrate wireless sensors, cameras, locks, and RFID readers and tags into a system. |

| | | | | |
|---|---|---|---|---|
| **15** | P.Chandra Prakash Reddy | DELIVERY COLLECTION OF PARCELS WITH SMART SHIPMENT CONTAINER USING ARDUINO | • To delivery parcel using smart shipment prototype | • This system presents a low cost, less time-consuming, safe and effective implementation of Smart Box System through the wireless sensor networks. |
| **16** | Robocraze | Interfacing GSM Module with Arduino | • To show how use GSM SIM900A | • It functions to send and receive any notification.<br>• GSM module combined with microcontroller (Arduino) to process. |
| **17** | CircuitSchools staff | QR Code/Barcode Scanner using Arduino & QR Scanner Module | • To study how to interface a (1D/2D) barcode and QR code scanner module with Arduino. | • Arduino act as microcontroller.<br>• To monitor information about the items and their state in the inventory, barcodes and QR codes are frequently utilised. |
| **18** | Abhimanyu Pandit | How To Use 0V7670 Camera Module with Arduino | • To learn how to utilise an Arduino and a 0V7670 camera module. | • The identical pin setup, code, and procedures may be used to connect the camera module OV7670 to an Arduino Mega. |

| | | | | |
|---|---|---|---|---|
| **19** | MOHAMED FEZARI | Integrated Development Environment "IDE" For Arduino | • To editing, compiling and uploading code int the Arduino device. | • It operates on the Java Platform, which is readily available for operating systems like MAC, Windows, and Linux and has built-in functions and commands that are essential for debugging, modifying, and compiling the code in the environment.<br>• Primarily utilised for entering and generating code into an Arduino module |
| **20** | ELECTRO WINGS | 4X4 Keypad arduino uno | • To enter code or type any numerical or alphabet. | • A keypad is utilised as an input device to recognise and interpret the key that the user pushes. |
| **21** | EA & HAM Club, NIT Warangal | What is proteus | • To do simulation before performing hardware | • A proteus is used for run simulation before doing hardware to get simulation result |

## 2.6 Summary

This chapter summarises the previous work related to the smart package pickup system. Moreover table 1 show comparison between previous project, it also highlights the research needed to complete this project's investigation. In thisproject's research, the Arduino UNO microcontroller is chosen for controlling the GSM module and keypad. Lastly, the LCD and keypad act as the output.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

This chapter will generally cover methodologies and procedures in this project, along with the software and hardware components needed to finish the project. The Arduino Ide will be used for coding, and the Arduino Uno will serve as the project's microcontroller.

## 3.2 Methodology

Challenges in research will undoubtedly include the need for specialised methods or techniques, information analysis, and other issues. The definition of methodology is eitheras a technique for achieving something or as an element of logic used for studying reasoning.This is a prototype of a smart parcel pick-up system for high-rise buildings that will keep parcels safe and help them reach their owners.

## 3.3 Project System Flowchart

Figure 3.1 shows the project's operational system in order to make the system flow more clear.

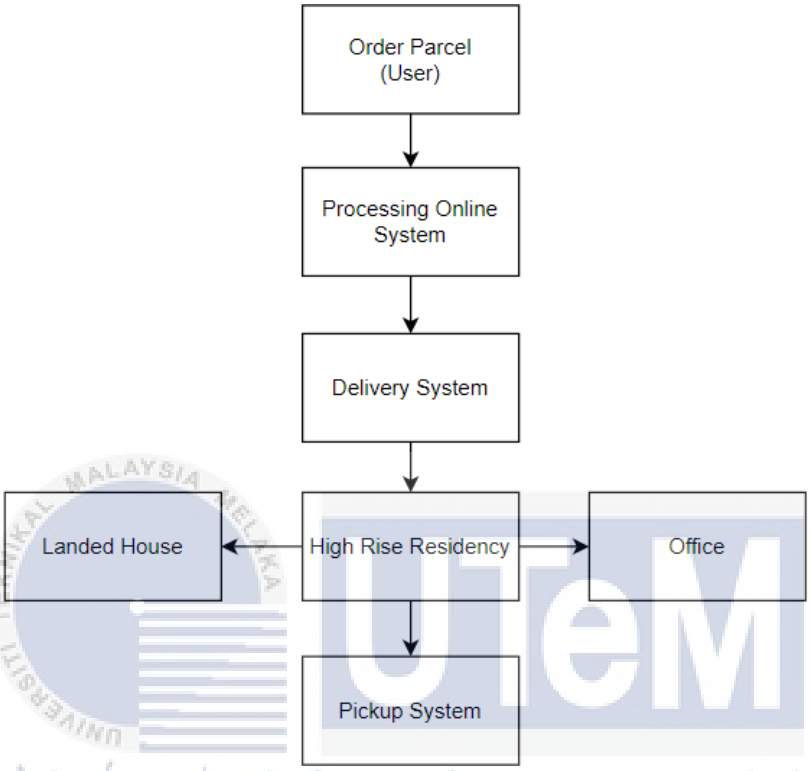


**Figure 3. 1Project operational system**



a) Order Parcel (User)

The user will order a parcel by using an online shopping application, for example, Shopee, Lazada, etc. The user can choose any item and compare the items they want, which makes it easier for them.

b) Processing online system

The user needs to enter their address, phone number, and name for online shopping details to deliver the parcel. A payment option is given, which is that the user can

pay by online payment or cash on delivery (COD). The system will show up to ship, and a tracking number was given.

c) Delivery System

i) Office

A courier makes a delivery, the receptionist signs for it, and the package is put to one side until the owner picks it up.

ii) Landed Property

The courier will leave the parcel at the mailbox gate or on some property that is not allowed to be entered, so the courier will leave the parcel at the guardhouse.

iii) High rise residency

Some of the high rises are not allowed to enter the building, so the parcel will be left at the guard house. Other times, a courier making a delivery can enter the building and have the choice to leave it in the lobby or deliver it door-to-door.



d) Pickup system (high rise)

i) High rise

Since certain high-rise structures already make use of cutting-edge technology, all the packages will be scanned, sorted by receiver, and then given alerts for pickup. By using the QR codes they get through email, the recipient may collect their package while adhering to social distance limits and enabling contactless pickups.

## 3.4 System architecture

The most important hardware for carrying out this process is the barcode scanner to scan barcode parcels and the GPS module to give notification to the receiver. In addition, an Arduino power jack is used as the main source of power for this system. Figure 3.2 will present this project flowchart.

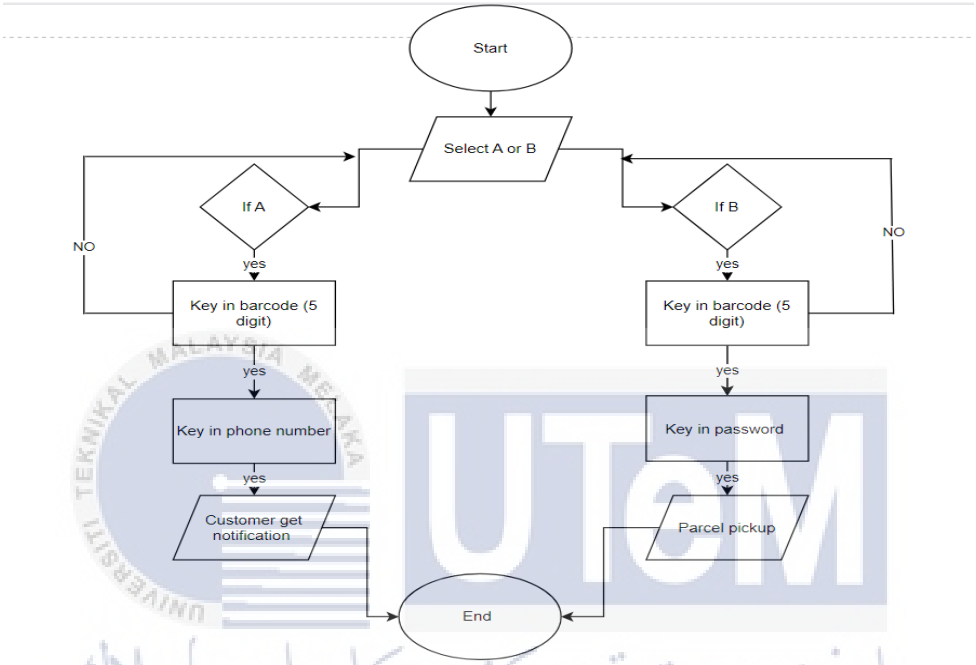


**Figure 3. 2 Flowchart**



a. Arduino Mega acts as a microcontroller to switch on all device hardware, which is a keypad, Lcd and a GSM module.

b. The user needs to select A (delivery guy) or B (receiver).

c. If A the delivery guy needs to enter a 5-digit barcode, he will then need to enter the receiver phone number.

d. The receiver needs to key in a 5 digit , barcode number and password to pick up their parcel, and after the system shows success, the receiver can pick up their parcel.

## 3.5 Hardware Components

A computer system's or electronic device's actual hardware components are required for its operation. Together, these parts execute a variety of actions and functions. Any project is just not based on software, such as simulation; if you use simulation, the result data will be perfect, which excludes such factors as environmental factors. Hardware is the way to get the actual result and can be combined with software.

### 3.5.1 Arduino Uno mega board

Figure 3.3 shows The Arduino Mega 2560 is a microcontroller board based on theATmega2560. This board consists of 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analogue inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a


**Figure 3. 3 Arduino Mega 2560**

reset button, as shown inthe figure. Furthermore, simply connect it to a computer with a USB cable or power it withan AC-to-DC adapter or battery to get started.

### 3.5.2 4X4 Membrane Keypad

A 4x4 membrane keypad is commonly used in a variety of electronics projects. It has 16 buttons that are placed in a 4x4 grid and are protected by a flexible membrane, ensuring their long-lasting use. Typically, a 4x4 membrane keypad has 8-pin wiring, with 4 pins for the columns and 4 pins for the rows. Figure 3.4 shows the inside of a 4 x 4 membranekeypad.


**Figure 3. 4 4X4 Membrane Keypad**

Substitute a non-conductive material, such as plastic, that serves as the base for the keypad. Thin copper or silver wires or stripes known as conductive traces connect the buttons to the microprocessor. Buttons are flexible buttons made of silicone or a similar substance that, when pressed, connect to the conductive traces and complete an electrical circuit. Glue or tape are used to adhere a layer of sticky substance between the substrate and the buttons. Cover layer: a transparent coating that covers the keypad's buttons and shields them from wear and tear.

### 3.5.3 (Liquid Crystal Display) LCD

Liquid Crystal Display is also referred to as LCD. Based on Figure 3.5, LCD is a flat-panel display technology that is commonly found in electronic products such as digital clocks, cellphones, tablets, computer displays, and TVs. The 16x2 character LCD, which has16 columns and 2 rows and can show 32 characters, is a popular LCD for Arduino.

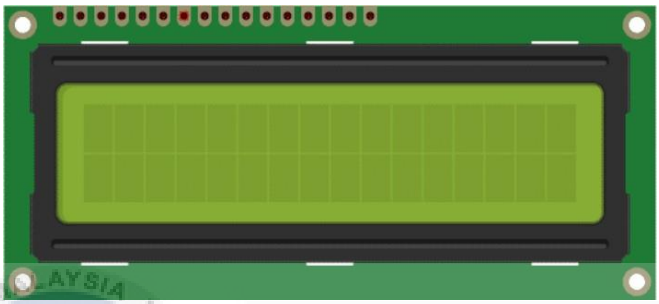

**Figure 3. 5 LCD (Liquid Crystal Display)**

### 3.5.4 GSM Module

A physical component that enables communication via the GSM network is known as a GSM (Global System for Mobile Communications) module. Based on Figure 3.6, GSM module it allows devices to conductvoice conversations, transmit and receive text messages known as SMS (Short Message Service), and access data services like GPRS (General Packet Radio Service) or Internet connectivity.

**Figure 3. 6 GSM Module**

## 3.6 Software Development

This software is important for the operation of the overall project system. Withoutthis application, the system cannot be developed with a pairing circuit or have its embeddedcircuit tested.

### 3.6.1 Arduino Ide

A software environment called the Arduino IDE (Integrated Development Environment), based on Figure 3.7, is used to programme Arduino boards. An open-source electronics platform called Arduino is built on simple hardware and software. For creating, building, and uploading code to Arduino boards, the IDE offers a user-friendly interface.


**Figure 3. 7 Arduino IDE**

### 3.6.2 Proteus 8

Electronic Design Automation (EDA) software called Proteus 8 was created by Labcenter Electronics. Based on Figure 3.8 Integrated circuits, microcontrollers, and other electronic components are among the electronic circuits that are generally used for developing and modelling.

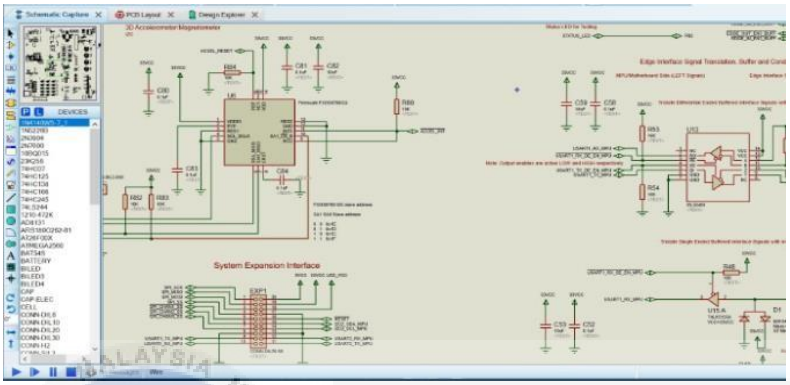


**Figure 3. 8 Proteus**

## 3.7 Sustainable Development

The effective collection and distribution of packages is made possible by a GSM- based smart package pickup system, which makes use of GSM (Global System for Mobile Communications) technology. The system uses GSM networks to create wireless connections between mobile device-equipped pickup employees and a central control unit. Each product is given a special identification number or barcode, which delivery staff may scan or manually enter into their mobile devices. Customers receive SMS or push updates on the status of their packages through the system, which can include authentication techniques for secure package handling. The GSM-based smart package pickup system integrates with current systems to improve operations, package tracking, and general efficiency, resulting in more efficient and sustainable package pickup and delivery procedures.

## 3.8 Summary

The proposed procedure for beginning a new system development project is described in this chapter. If the project is to achieve its final purpose, each of the chapter's suggested changes must be carried out effectively. In this chapter, each hardware and software system component is thoroughly explained. By describing each step in detail, a flowchart and a block diagram are both used to explain how the processing system works. The hardware and software applied for this project, as well as the explanation for its implementation, were covered in more detail in this chapter.

# CHAPTER 4

# RESULT AND DISCUSSION

## 4.1 Introduction

This chapter emphasizes the troubleshooting process and examines the project's outcomes, concentrating on two core aspects: the electric power generated by the standalone PV solar system and the effectiveness of the smart parcel pickup system. It will delve into the analysis of tabulated project results, providing a comprehensive explanation and evaluation of the findings.

The project prototype has been crafted using specific components and tools derived from Chapter 2's study. Component selection was guided by the insights detailed in Chapter 3. Additionally, hardware for the standalone PV solar system and the smart parcel pickup system has been partially assembled in line with the circuit designs simulated in Chapter 3. Throughout the project's phases—design, simulation, assembly, and troubleshooting—all software and tools mentioned in Chapter 3 have been consistently employed. Multiple rounds of testing and adjustments to the system's coding have been undertaken to ensure it aligns with the intended output.

## 4.2 Result and Analysis

### 4.2.1 System Functionality

There are two systems connected in this project a standalone PV solar system and smart parcel pickup system.

Firstly, the system begins its operation by utilizing the solar panel as the primary power source. The solar panel is connected to a solar charge controller, serving a crucial role as a protective measure against overcharging for the 10A battery. This controller not only safeguards the battery but also manages its charging process and integrates it back into the system to generate power. Additionally, the system efficiently utilizes the solar charge controller's USB port to activate the Arduino, showcasing an effective use of solar energy to power the core components of the system. Figure 4.1 shows the standalone PV solar system proposed in this project.



**Figure 4. 1 Standalone PV solar**

The second system is a smart parcel pickup system that necessitates a microcontroller for system control. This microcontroller manages an LCD for display

purposes, a keypad for user interaction, and a GSM module 900A. The required code has been uploaded to an Arduino microcontroller.

The keypad serves as an input method for users to enter various codes, phone numbers, or passwords. The GSM 900A module enables communication functionalities, likely allowing the system to make calls or send messages using a GSM network. Additionally, the LCD is used to display information to the user, such as entered numbers.

To power up the microcontroller, the system ingeniously utilizes the USB port provided by the solar charge controller. This USB port acts as the power source, effectively activating the microcontroller. Moreover, the output from the solar charge controller is specifically allocated to power the GSM module 900A, ensuring it receives the requisite power supply to operate seamlessly.

The comprehensive design of this smart parcel pickup system is depicted in Figure 4.2, offering a visual representation of how each component interconnects and operates within the system, elucidating the overall configuration and functionality of the system setup.

**Figure 4. 2 Overall Hardware Prototype**

## 4.3 Project testing result

### 4.3.1 Data user of the system

This section presents user-collected data showcasing time variations using the smart parcel pickup system with solar. Table 4.1 and 4.2 shows data sender and receiver of the system (SPPS), successful/unsuccessful operations, and time taken per transaction. Figure 4.3 graph bar sender visualize correlations between parcel quantity, system success/failure, and time duration, offering insights into system performance and user interactions.

**Table 4. 1 Data sender of the system (SPPS)**

| SENDER | TIME (s) | No item of parcel | SYSTEM |
|---|---|---|---|
| Hamdan | 61.40 | 4 | Succesfull |
| Nazmi | 10.00 | 1 | Unsuccesfull |
| Arif | 41.00 | 3 | Succesfull |
| Irfan | 18.44 | 2 | Sucesfull |

**Table 4. 2 Data receiver of the system (SPPS)**

| Receiver | TIME (s) | No item of parcel | SYSTEM |
|---|---|---|---|
| Aisha | 12.71 | 1 | Unsuccesfull |
| Hasya | 31.95 | 4 | Succesfull |
| Aqilah | 12.01 | 1 | Succesfull |
| Natasha | 19.13 | 3 | unsucessfull |
| Najmi | 71.80 | 5 | Sucessfull |

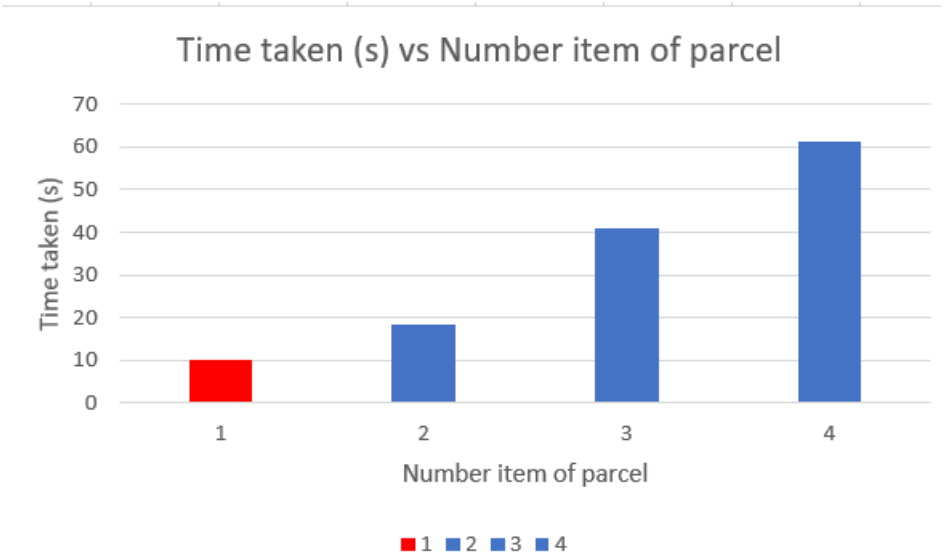


**Figure 4. 3 Graph bar sender**

In Figure 4.3, the "Sender" did four actions. Hamdan, Arif and Irfan went well and took different times, between 10.00 and 61.40 seconds, involving 1 to 4 items. Nazmi show unsuccessful with the time taken is 10 second for 1 parcel. The orange bars show unsuccessful actions, always taking 10 seconds for the Nazmi. But for successful actions, the Figure 4.4 graph bar receiver graph shows that more parcels from the sender meant more time taken.



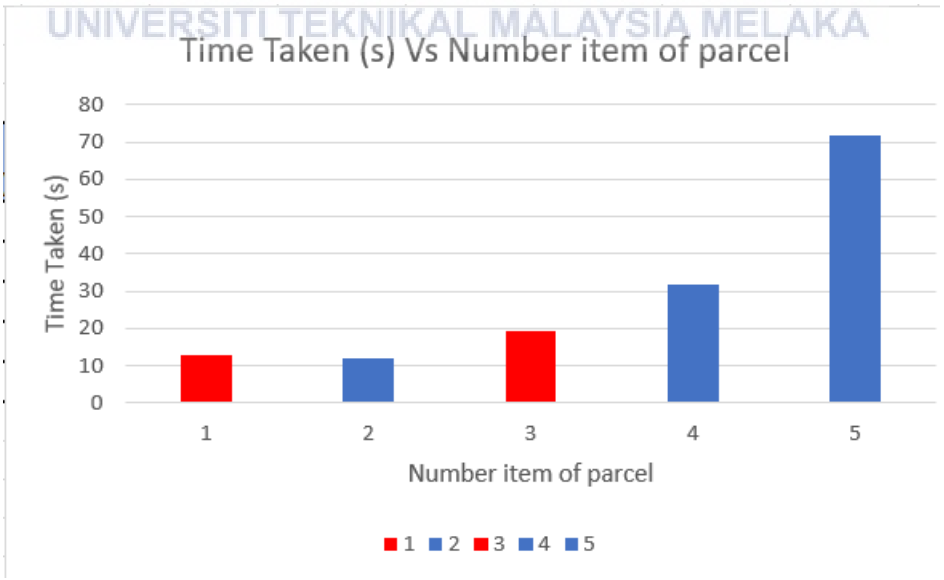


**Figure 4. 4 Graph bar receiver**

Table 4.2 shows, the "Receiver" was involved in five operations. Out of these, Hasya, Aqilah and Najmi were successful, taking different durations from 12.01 to 71.80 seconds and involving 1 to 5 items. However, Aisha and Natasha encountered unsuccessful attempts in their operations. Table 4.4 bar graph for the receiver displays two unsuccessful attempts, one with a single item of parcel, taking 10 seconds, and another with 3 items, taking 19.13 seconds. Additionally, Table 4.2 illustrated that as the receiver handled more parcels, it resulted in increased time taken for each transaction.

Both users encountered a mix of successful and unsuccessful operations, with the "Sender" achieving a success rate of 75% and the "Receiver" achieving a success rate of 60% in their respective interactions within the system

### 4.3.2 Smart parcel pickup system

Based on the data in Table 4.3, the system operated for 14 hours using a battery as its power source. The initial voltage value at 8:00 AM was recorded at 12.39V, which decreased to 12.33V by 10:00 AM. Subsequently, the voltage consistently dropped by 0.03V every two hours. The system eventually shut down after the 14-hour duration. Figure 4.5, graph illustrates that the voltage values were inversely proportional to time, steadily decreasing, while the current remained constant at 0.5A due to the system's load requirements.

**Table 4. 3 Data Voltage load usage over a period of time**

| TIME | VOLTAGE (V) | Current (A) |
|---|---|---|
| 8.00 am | 12.39 | 0.5 |
| 10.00 am | 12.36 | 0.5 |
| 12.00 pm | 12.33 | 0.5 |
| 14.00 pm | 12.30 | 0.5 |
| 16.00 pm | 12.27 | 0.5 |
| 18.00pm | 12.25 | 0.5 |
| 20.00pm | 12.21 | 0.5 |
| 10.00pm | 12.18 | 0.5 |

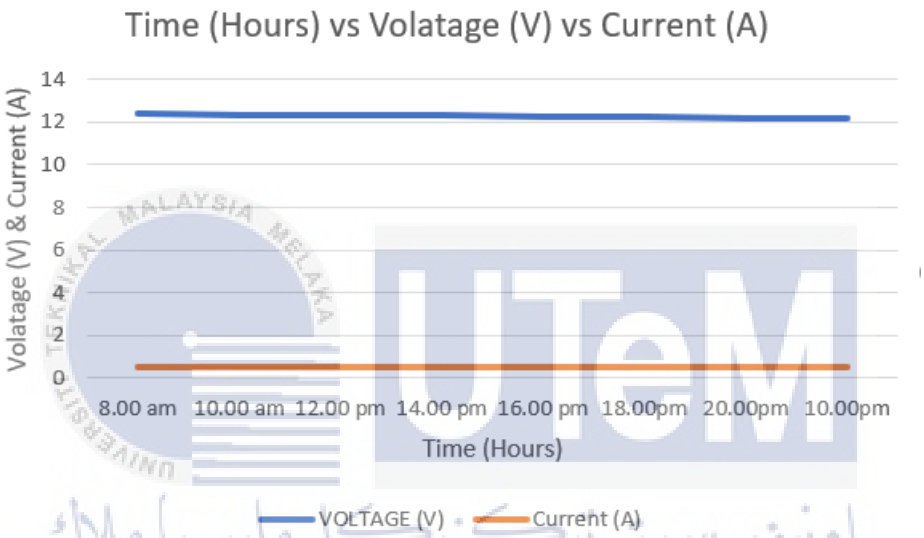


**Figure 4. 5 Graph of reading voltage and current**



### 4.3.3 Battery-based solar charging system analysis

On this part, one data sample were collected from 8 am to 6 pm. to show the difference in voltage and current for one day. As a result, the voltage, current and power readings are shown in recorded tables and plotted graphs.

**Table 4. 4 Data analysis of Solar Panel**

| TIME (hours) | Solar Panel Voltage (V | Solar Panel Current (A) | Solar Panel Power (W) | Battery Bank Volatge (12V) |
|---|---|---|---|---|
| 8:00 | 6.23 | 0.101 | 0.629 | 12 |
| 10:00 | 6.30 | 0.125 | 0.788 | 12 |
| 12:00 | 7.30 | 0.134 | 0.978 | 12 |
| 14:00 | 6.60 | 0.113 | 0.746 | 12 |
| 16:00 | 6.45 | 0.103 | 0.664 | 12 |
| 18:00 | 5.03 | 0.080 | 0.424 | 12 |

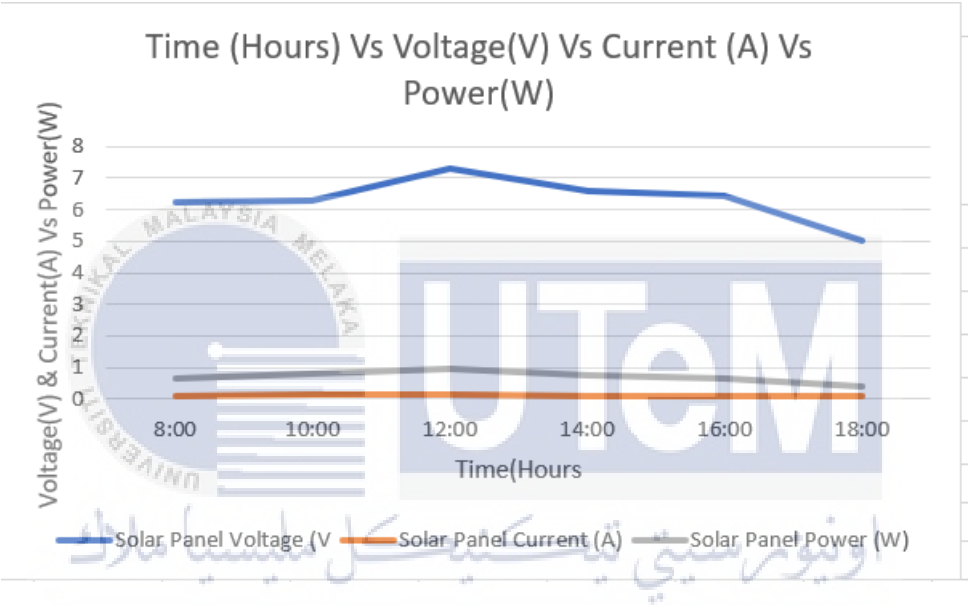


**Figure 4. 6 Graph of reading voltage, current and power**

Based on the data in Table 4.4, the solar panel exhibited its lowest power generation at 6 PM, registering a value of 0.424W, coinciding with the sunset and reduced sunlight. Conversely, the solar panel produced its highest recorded power output at 12 PM, reaching 0.978W. However, the power generation declined around noon due to inclement weather, characterized by rain and increased cloud cover in the evening hours.

In figure 4.6, both voltage and current demonstrate a linear increase until noon (12:00 PM) due to weather conditions and peak sun intensity during that time.

However, after noon, the graph depicts a decline in voltage, current, and overall power output. This decline is attributed to cloudy weather conditions, which adversely affect the solar panel's ability to charge the battery consistently. The unstable voltage, current, and power observed post-noon suggest that weather conditions significantly interfere with the solar panel's efficiency in charging the battery.

## 4.3 Summary

In this chapter, Basic software can facilitate the implementation of this system, yet adjustments may be necessary based on the suitability of the planned system. Nevertheless, initial testing has proven the feasibility of evaluating key parameters at this stage. This system streamlines and enhances the monitoring of system usage duration. Addressing weaknesses identified in the preliminary tests requires the utilization of improved system configurations.

# CHAPTER 5

# CONCLUSION

## 5.1 Conclusion

In conclusion, the objective of this project, which is to design and develop a smart package pickup system (SPPS) for a high-rise residential building using a solar power system and to investigate the performance of a courier system using the SPPS system, was achieved. The smart package pickup system powered by GSM worked well fortracking and gathering shipments. It offered real-time tracking and automated pickup procedures through the use of GSM technology, making it practical and effective. Unique verification numbers added to the system's security measures made sure that only authorised recipients could access their items. Users' experiences were made simpler by the user- friendly interface it provided via a mobile app or SMS notifications. In addition, it accelerated the pickup procedure, increasing productivity and saving time. It was possible toimprove the performance of the courier system by analysing system data. Overall, the adoption of this intelligent package pickup system improved the functionality of the courier system while enhancing security and efficiency in high-risk situations.



## 5.2 Project Limitations

During the development process, several limitations and challenges hindered the completion of this project. Primarily, the main factor impeding this process and causing system errors is the GSM module. The GSM model 900A can only use a Malaysia-based SIM card and requires a strong signal to send messages. Additionally,

solar energy is needed to charge the system's battery. However, during the current rainy season, it is difficult for solar panels to generate sufficient power (watts) to effectively charge the battery. Furthermore, the GSM module is not stable when powered directly from the Arduino due to the Arduino's low current output, while the GSM module requires 0.4A to remain stable. Consequently, separate power supplies from the solar charge controller are necessary for both the GSM module and the Arduino to function properly.

## 5.3 Future Improvement

In the future improvement, this project can be applied by implement barcode scanner functionally within system. For instance, users can scan a barcode or QR code associated with their parcel ID or user information to initiate a pickup request. Another that, by Use barcode labels on parcels for accurate inventory management. The scanner can help update the system when parcels are added or removed. Another that, using camera to estimate size of parcel based on captured images, this information can aid in allocating appropriate storage space. Moreover, it can allow user to visually verify the contents or condition of the parcel before pickup through mobile app. Additionally, RFID integration for room access, RFID can be use for user to access the parcel room. RFID access control adds a secure authentication layer, reducing the risk of unauthorized access to the parcel room.



## 5.4 Commercialist

The smart package pickup system can be changed to fit the specific needs of different businesses, like offices, apartments, or stores. It can also work together with existing security or access control systems, making it a good choice for businesses that want to upgrade what they already have. Being able to customize

and work with existing systems makes it more attractive to businesses looking for advanced and customized solutions. Nowdays, people are currently more to automated solutions, this smart package pickup system has the potential to be a standout choice. It can give businesses an advantage and make it easier for them to succeed in selling it.

## REFERENCES


[1] I. Orenstein, T. Raviv, and E. Sadan, 'Flexible parcel delivery to automated parcel lockers: models, solution methods and analysis', *EURO Journal on Transportation and Logistics*, vol. 8, no. 5, pp. 683–711, Dec. 2019, doi: 10.1007/s13676-019-00144-7.

[2] G. Moon and S. Park, 'Improved Parcel Delivery Service by using Delivery Points Information and RFID'.

[3] H. Y. Song and H. Han, 'A design of a parcel delivery system for point to point delivery with IoT technology', *Future Internet*, vol. 12, no. 4, Apr. 2020, doi: 10.3390/FI12040070.

[4] T. Kobata, Y. Tada, and T. Muromaki, 'Development of automatic parcel delivery system using image processing techniques', in *International Symposium on Flexible Automation, ISFA 2016*, Institute of Electrical and Electronics Engineers Inc., Dec. 2016, pp. 292–295. doi: 10.1109/ISFA.2016.7790177.

[5] J. Kim, H. Moon, and H. Jung, 'Drone-based parcel delivery using the rooftops of city buildings: Model and solution', *Applied Sciences (Switzerland)*, vol. 10, no. 12, Jun. 2020, doi: 10.3390/app10124362.

[6] R. Nocerino, A. Colorni, F. Lia, and A. Luè, 'E-bikes and E-scooters for Smart Logistics: Environmental and Economic Sustainability in Pro-E-bike Italian Pilots', in *Transportation Research Procedia*, Elsevier B.V., 2016, pp. 2362–2371. doi: 10.1016/j.trpro.2016.05.267.

[7] K. Lee, J. Chae, and J. Kim, 'A courier service with electric bicycles in an Urban Area: The case in Seoul', *Sustainability (Switzerland)*, vol. 11, no. 5, Mar. 2019, doi: 10.3390/su11051255.

[8] S. Ze-Hong and Z. Guang-Yuan, 'Multi-functional Parcel Delivery Locker system', in *2015 International Conference on Computer and Computational Sciences, ICCCS 2015*, Institute of Electrical and Electronics Engineers Inc., Dec. 2015, pp. 207–210. doi: 10.1109/ICCACS.2015.7361351.

[9] S. Turská and L. Madleňáková, 'Concept of smart postal mailbox', in *Transportation Research Procedia*, Elsevier B.V., 2019, pp. 1199–1207. doi: 10.1016/j.trpro.2019.07.167.

[10] J. Kaewsrisuphawong, V. Waelun, J. P. N. Ayuthaya, S. Paengkanya, and T. Daengsi, 'Development of A Smart Box Prototype for Mail and Parcel Posts Using IoT and Solar Energy', in *ICOIACT 2022 - 5th International Conference on Information and Communications Technology: A New Way to Make AI Useful for Everyone in the New Normal Era, Proceeding*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 77–81. doi: 10.1109/ICOIACT55506.2022.9972195.

[11] T. Khan, 'A Solar-Powered IoT Connected Physical Mailbox Interfaced with Smart Devices', *IoT*, vol. 1, no. 1, pp. 128–144, Sep. 2020, doi: 10.3390/iot1010008.

[12] M. Eizaz Afzal Bin Mohamad Zamree, M. Afif Sufi Bin Yusni, M. Luqman Hakim Bin Mohmmad Najib, M. Nafis Bin Hamdan, M. Shakir Zufayri Bin Suhaimi, and S.-I. Song, 'SMART MAILBOX WITH SECURITY SYSTEM'. [Online]. Available: https://www.thestar.com.my/news/nation/2020/03/19/online-shopping-goes-up-as-people-stay-in.

[13] M. Fakhruzzaman, M. Firdaus, and K.-A. Kamarudin, 'Development Prototype of Smart Mailbox That Send Email to User When Parcel Barcode Being Scanned', *Research Progress in Mechanical and Manufacturing Engineering*, vol. 3, no. 1, pp. 839–847, 2022, doi: 10.30880/rpmme.2022.03.01.089.

[14] J. R. Tew and L. Ray, 'ADDSMART: Address digitization and smart mailbox with RFID technology', in *2016 IEEE 7th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference, UEMCON 2016*, Institute of Electrical and Electronics Engineers Inc., Dec. 2016. doi: 10.1109/UEMCON.2016.7777879.

[15] P. Chandra, P. Reddy, I. Sangeetha, and M. Vishal, 'Delivery Collection of Parcels with Smart Shipment Container using Arduino', *International Journal of Electrical Engineering and Technology (IJEET)*, vol. 12, no. 3, pp. 35–41, 2021, doi: 10.34218/IJEET.12.3.2021.005.

[16] 'Interfacing GSM Module with Arduino – Robocraze'. https://robocraze.com/blogs/post/interfacing-gsm-module-with-arduino (accessed May 16, 2023).

[17] 'QR Code/Barcode Scanner using Arduino & QR scanner module – Circuit Schools'. https://www.circuitschools.com/barcode-qr-code-scanner-using-arduino-qr-scanner-module/ (accessed May 03, 2023).

[18] 'How to Use OV7670 Camera Module with Arduino Uno'. https://circuitdigest.com/microcontroller-projects/how-to-use-ov7670-camera-module-with-arduino (accessed May 03, 2023).

[19] '4x4 Keypad Interfacing With Arduino UNO | Arduino'. https://www.electronicwings.com/arduino/4x4-keypad-interfacing-with-arduino-uno (accessed Jun. 16, 2023).

[20] M. Fezari and A. Al Dahoud, 'Integrated Development Environment "IDE" For Arduino Integrated Development Environment "IDE" For Arduino Introduction to Arduino IDE', 2018. [Online]. Available: https://www.researchgate.net/publication/328615543

[21] 'What is Proteus. In this detailed guide about Proteus we… | by EA & HAM Club, NIT Warangal | Medium'. https://ea-ham-nitw.medium.com/what-is-proteus-6d408f5d2d5c (accessed Jun. 16, 2023).

# APPENDICS

## Gantchart

| No. | Task | PSM1 | | | | | | | | | | | | | | PSM2 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weeks | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 |
| 1 | Work on the Software/Hardware | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Project Title Conformation and Registeration | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Briefing with Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Study the Project Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Drafting Chapter 1: Introduction | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Task progress evaluation 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Drafting Chapter 2: Literature Review | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Table of Summary Literature Review | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Drafting Chapter 3: Methodology | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Work on the Software/Hardware | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | First Draft submission to Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Task progress evaluation 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | Submisiion Report to the Panel | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | Presentation of BDP1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | Drafting Chapter 4: Analyse Data and Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | Data Analyse and Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | Record the Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | Drafting Chapter 5: Conclusion and Recommendation | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | Compiling Chapter 4 and Chapter 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Submit Latest Report to Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | Finalizze the Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 | Presentation of BDP2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

## Ganttchart 2

| No. | Task | PSM1 | | | | | | | | | | | | | | PSM2 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weeks | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 |
| 1 | Work on the Software/Hardware | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Project Title Conformation and Registeration | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Briefing with Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Study the Project Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Drafting Chapter 1: Introduction | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Task progress evaluation 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Drafting Chapter 2: Literature Review | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Table of Summary Literature Review | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Drafting Chapter 3: Methodology | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Work on the Software/Hardware | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | First Draft submission to Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Task progress evaluation 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | Submisiion Report to the Panel | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | Presentation of BDP1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | Drafting Chapter 4: Analyse Data and Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | Data Analyse and Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | Record the Result | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | Drafting Chapter 5: Conclusion and Recommendation | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | Compiling Chapter 4 and Chapter 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | Submit Latest Report to Supervisor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | Finalizze the Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 | Presentation of BDP2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |