Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE DEVELOPMENT OF AN IOT-BASED AUTOMATION SYSTEM FOR PET-HOTEL MANAGEMENT SYSTEM

AIMAN BIN BUANG

Bachelor of Electronics Engineering Technology with Honours

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THE DEVELOPMENT OF AN IOT-BASED AUTOMATION SYSTEM FOR PET-HOTEL MANAGEMENT SYSTEM

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

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2023

DECLARATION

I hereby, declared this report entitled The Development of An IoT-based Automation System for Pet Hotel Management System is the result of my own research except as cited in references.

Signature : 

Student Name : Aiman Bin Buang

Date : 15 January 2023

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APPROVAL

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

Signature : 

Supervisor Name : Amar Faiz Bin Zainal Abidin

Date : 16 January 2023

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DEDICATION

This report is dedicated to my beloved parents who educated and supported me throughout the process of doing this project. I also wanted to say thank you to my supervisor and my friends who have encouraged, guided and inspired me to complete this project.

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ABSTRACT

As the number of people who own pets grows each year, so does the demand for higher-quality pet care products. This has pushed the Internet of Things (IoT) technology forward in this industry. Pet owners can use IoT technology to follow their pets' activities and whereabouts from afar, check their pets' health, and even interact with them. All of these smart pet care gadgets are becoming increasingly important in the lives of pet owners. In this project, we use Internet of Things (IoT) technology to create an integrated system that includes a pet food feeder, water dispenser, and litter box, which are the three most important features that pet owners worry about when they are busy or away from their pets. NodeMcu modules connect the three subsystems to the local network. In addition, the data collected by each sensor is processed and displayed on a smartphone app. Thus, pet owners may access all information about their pet's food and water consumption, as well as defecation timing, duration, and frequency, from a single interface. Additionally, the application has a controlling function that allows pet owners to dispense food at any time and from any location. The application displays an overall statistics chart with the stated values that updates over time.

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ABSTRAK

Apabila bilangan orang yang memiliki haiwan peliharaan tumbuh setiap tahun, begitu juga permintaan untuk produk penjagaan haiwan peliharaan berkualiti tinggi. Ini telah mendorong teknologi Internet of Things (IoT) ke hadapan dalam industri ini. Pemilik haiwan peliharaan boleh menggunakan teknologi IoT untuk mengikuti aktiviti dan lokasi haiwan peliharaan mereka dari jauh, memeriksa kesihatan haiwan peliharaan mereka, dan juga berinteraksi dengan mereka. Semua alat penjagaan haiwan peliharaan pintar ini menjadi semakin penting dalam kehidupan pemilik haiwan peliharaan. Dalam projek ini, kami menggunakan teknologi Internet of Things (IoT) untuk mencipta sistem bersepadu yang merangkumi pengumpan makanan haiwan peliharaan, dispenser air, dan kotak sampah, yang merupakan tiga ciri paling penting yang dibimbangkan oleh pemilik haiwan peliharaan apabila mereka sibuk atau jauh dari haiwan peliharaan mereka. Modul NodeMcu menghubungkan tiga subsistem ke rangkaian tempatan. Di samping itu, data yang dikumpulkan oleh setiap sensor diproses dan dipaparkan pada aplikasi telefon pintar. Oleh itu, pemilik haiwan peliharaan boleh mengakses semua maklumat tentang penggunaan makanan dan air haiwan kesayangan mereka, serta masa buang air besar, tempoh dan kekerapan, dari satu antara muka. Selain itu, aplikasi ini mempunyai fungsi kawalan yang membolehkan pemilik haiwan peliharaan mengeluarkan makanan pada bila-bila masa dan dari mana-mana lokasi. Aplikasi ini memaparkan carta statistik keseluruhan dengan nilai yang dinyatakan yang dikemas kini dari masa ke masa.

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ACKNOWLEDGEMENTS

I would especially like to thank Allah SWT for giving me the opportunity to complete my Projek Sarjana Muda (PSM). This report serves as a token of my sincere gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for providing me with the opportunity to pursue a Bachelor of Engineering in Electrical and Electronic Technology (FTKEE). I also want to express my gratitude to my supervisor, En. Amar Faiz Bin Zainal Abidin, for his support throughout the day as I worked on my final project and wrote my report, which is titled The Development of An IoT-based Automation System for Pet Hotel Management System. He was directing me to complete this job with entire devotion and attention thanks to his ongoing support and interest. My sincere gratitude is extended to my valued family and friends who have always encouraged and helped me to complete my endeavour. I'm grateful for their spiritual support and the consideration they shown me during this process. May God bless you for your kindness and goodwill.

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CHAPTER 1

INTRODUCTION

1.1 Background

In 2019, there are 6 million dogs and 5 million cats in Malaysia, but dog ownership is 398,000 and cat ownership is 658,000, indicating that cats are more popular in the country.

According to the Department of Statistics Malaysia, approximately 69.7% of Malaysia's working-age population (15-64 years) has acquired pets, mostly cats and dogs, by 2020. According to a 2021 study on the impact of pets on the mental health of Malaysian working-class people, pet owners had significantly higher levels of mental wellbeing than people without pets, and they felt they could cope better with adverse situations and experienced significantly more positive emotions during the lockdown than people without pets. [1]

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This shows that more than half of people have owned a pet, which could result in the construction of various types of pet hotels. Consequently, an IoT-based automation system may be able to address these problems by offering a more dependable and precise method of pet care. However, such a system would need to follow all applicable rules and standards, be dependable, and be simple to use.

The objective of this project is to create an IoT-based automated system for managing pet hotels that may increase pet care's precision, effectiveness, and convenience while also adhering to the relevant norms and specifications. Scheduled feeding, which enables the system to be set to dispense a certain amount of food at a specific time, is one potential feature of such a system. Create an on-demand feeding that, for instance, uses a smartphone app to activate the food dispenser when needed. The device may also be set up to only deliver a certain amount of food each time it is triggered, preventing pets from becoming overfed.

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Figure 1.1 Transmission lines and a beautiful sunset [1]

1.2 Problem Statement

At least one pet is in their home nowadays. The pet can be common, such as a cat or dog, or odd, such as a hedgehog or lizard. However, while most pets require extra attention, their owners may be preoccupied with other activities such as travelling, working, or any other unforeseen activity. Most people will seek a buddy to assist them in caring for their pet in the traditional manner. However, it may not only cause problems for others, but it may also not know how to properly care for your pet. As a result, some people will use a more contemporary approach, such as placing their pet at a pet hotel while they are abroad for better care.

Nowadays, practically every neighbourhood has a pet hotel that is completely licensed, or there will be someone who offers a pet hotel service out of their own home. The problem is that after the pet is delivered there, the owner might be concerned about how the personnel are treating their animals. Each pet hotel has its own facilities and equipment for handling the various pets, hence some pet hotels will have unique methods for handling each pet at their location. The pets will feel awkward if their daily routine is different from what it is used to with their owner. This will be the concern for the pet owner which is wandering around in their minds when they send their pet to pet hotels. There are several situations where pets refuse to even eat their food—not because it is bad—but rather because of the environment in which they were cared for by the personnel.

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1.3 Project Objective

The project's major goal is to create a pet hotel system that allows for wireless contact between the care system, the pet, and the user so that the user may look after their pet even if they have send the pets to pet hotel. This project consist of several features like automatic pet feeder, monitoring camera, schedule feeding, manual feeding through apps, and booking systems. It can be broken down into various sub-objectives to achieve step-by-step:

a) To design an automation pet hotel system board using EasyEDA for the circuit layout, to sketch a 2D project layout using ArtFlow, to construct an automation pet hotel system board with NodeMcu as the controller, and to program the embedded system using Arduino IDE.

b) To build a low cost automation pet hotel management system for the community. The price for the system is around RM200 which is installed at 16x13x14 inch cage for early stage testing.

c) To verify the functionality of the system by performing a set of testing which based on a checklist. This will be done by testing the accuracy of weight sensor which is HX711 and Load Cell in controlling the servo motor in the food dispenser to open when the weight is below 50 grams or close when the food weight is above 150 grams.

d) To validate whether the automation pet hotel system is successful by carrying out a survey that consists of eleven questions. The respondents include of students as well as those who are in love about taking care of pets.

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1.4 Scope of Project

To make sure that the project will stay within the boundaries of the budget, the scope is documented. The scope will be operational so that we can make sure those activities are moving forward in the right way to accomplish the goal. The key issue with this project's development is that customers will constantly require an internet connection in order to use apps to interact with the automation system. This is due to the fact that the NodeMcu can only connect to WiFi that has been programmed using the Arduino IDE. Because the administrator cannot manage the booking system through the apps, the apps will only be designed for user usage. However, administrators can manually examine the information using MIT App Inventor or Firebase. Users cannot select a reservation date; they can only select the number of rooms they wish to reserve using the booking system. Users must personally verify how many rooms they request to the pet hotels in order for them to confirm their reservation.

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Some pets could occasionally refuse to consume the food that has been dropped by the automatic pet feeder. Since some animals don't like to eat cold food, the pet food that the animal didn't consume will need to be manually disposed of. The food dispenser is connected to the cage's bowl using a plastic hose and a filter funnel. The narrow end insertion of the filter funnel and hose design prevents anything except dry, small-sized pet food from coming through.

A bowl will be placed on top of a load cell that has been combined with an acrylic plate at the weight sensor. The smallest force that two load cells can consistently detect is referred to as the load cell attached to the HX711 module with the highest sensitivity. The weight sensor must be calibrated while the bowl is empty when the project is turned on in

order to provide an accurate weight value afterwards. If the pet tries to enter the bowl in that situation, the weight sensor will detect an uncertain weight throughout the calibration process, which will result in an inaccurate reading for the duration of the calibration that can affect the entire function of the weight scale. The weight sensor value can only be viewed using a serial monitor in Arduino IDE because no LCD is used to display the weight for user and administrator.

Some crucial elements, including a watering dispenser, a waste disposal system, and a pet health monitoring system, won't be present in the prototype. This is due to the requirement that the project's development budget not exceed RM200.

1.5 Project Contribution

The care and welfare of pets in a hotel setting could be improved in a variety of ways with the help of an IoT-based automation system for pet hotel management. The ability to provide care more accurately and efficiently is one possible contribution. Many of the chores involved in taking care of pets in a hotel, such feeding might be automated with the aid of an IoT system. By doing so, users might be able to lower the possibility of human mistake and guarantee that their dogs are getting consistent, excellent treatment.

The ease and security for owners who leave their pets at pet hotels may also be improved by this approach. Owners might receive the opportunity to watch their pet from a distance using a smartphone app or other interface. Owners may feel more at ease while away from their pet as a result of this. Overall, the care and welfare of pets in a hotel setting might be significantly improved by an IoT-based automated system for pet hotel management.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The success of this project depends on the results of several investigations and enquiries. For this research, information and studies were obtained from a variety of sources, including books, articles, journals, and websites. All of this information was used in this project as a guide to make sure it could be completed in the allotted time. All of the research and data were based on key issues that were connected to this project.

This section examines a few thesis and publishing journals from the IEEE Xplore website in accordance with the parameters provided in Figure below. "Pet Feeder," "IoT," and "Pet Hotel" are a few keywords that are used to search related information. This review of the literature is concerned with the IoT and pet hotels-related pet feeding. Nine of the thirty articles about pet feeders that were selected centre on IoT ideas.

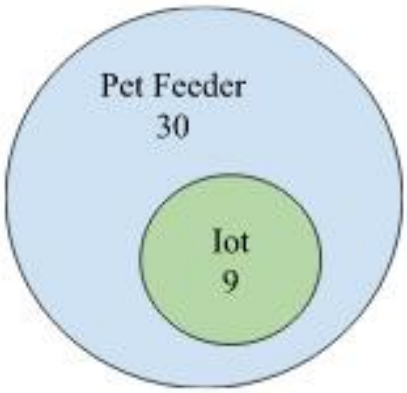

Figure 2.1 Common type related article and publication journal

Figure 2.2 indicates the growth of research papers from 2015 to 2022. This demonstrates that more research articles are produced each year. This number demonstrates that the total number of papers published increases year over year. In 2020, there were the most research articles published, and in 2017, there were the least.

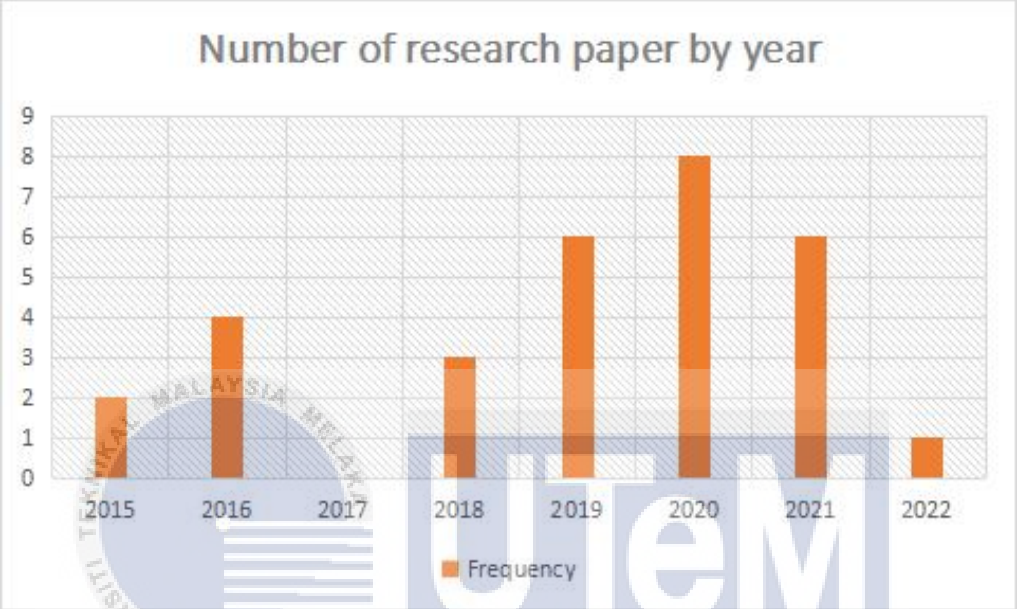

Figure 2.2 Bar Chart for number of research paper by year

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Figure 2.3 shows the growth research paper by country from 2015 to 2022. This research study has contributions from a total of 14 nations. India has the most research papers published globally, as shown in Figure 2.3. This demonstrates how important India is to the development of an IoT pet feeder system.

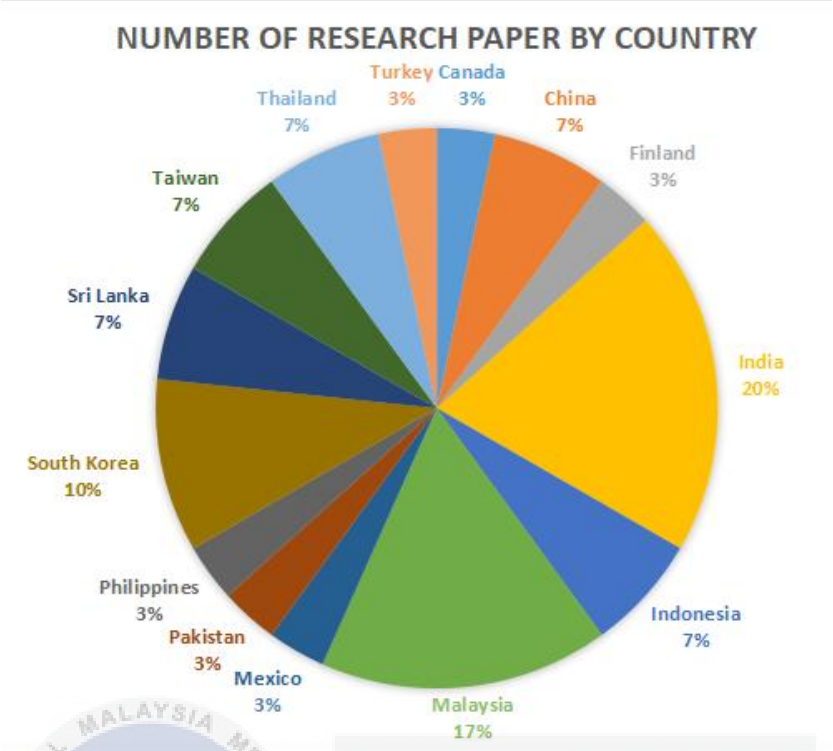

Figure 2.3 Pie Chart for number of research paper by country

Authorship distribution shows the number of authors involved in a published paper, the Figure 2.4 demonstrates the authorship distribution of the IoT Pet Feeder article. From the figure, the majority of published papers were produced by two authors and followed by one authors and three authors.

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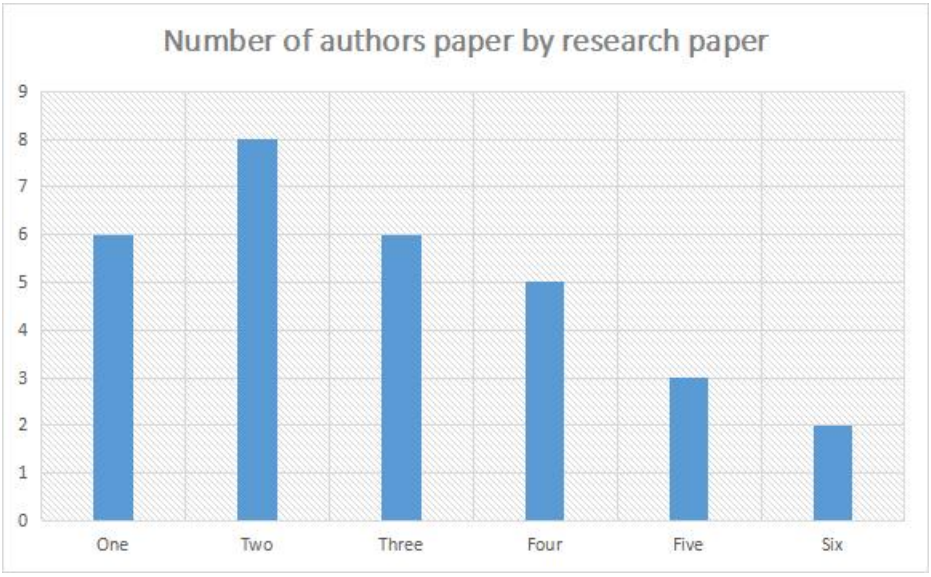

Figure 2.4 Bar Chart for number of authors paper by research paper

Figure 2.5 displays the distribution of the number of references. This demonstrates a growing amount of referrals year over year as search site technology advances quickly in the internet world. The year 2021 has the most references (30 in one document), and the years 2015 and 2018 have the fewest references (3 each).

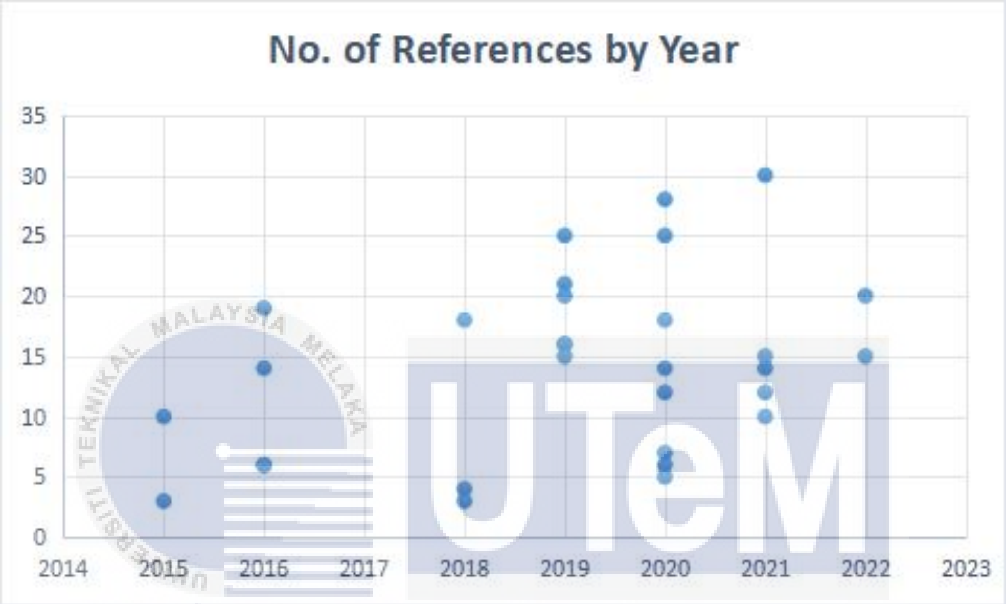

Figure 2.5 Scatter Chart for number of references by year

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In figure 2.6 is the k-chart for the Pet Hotel Management System.

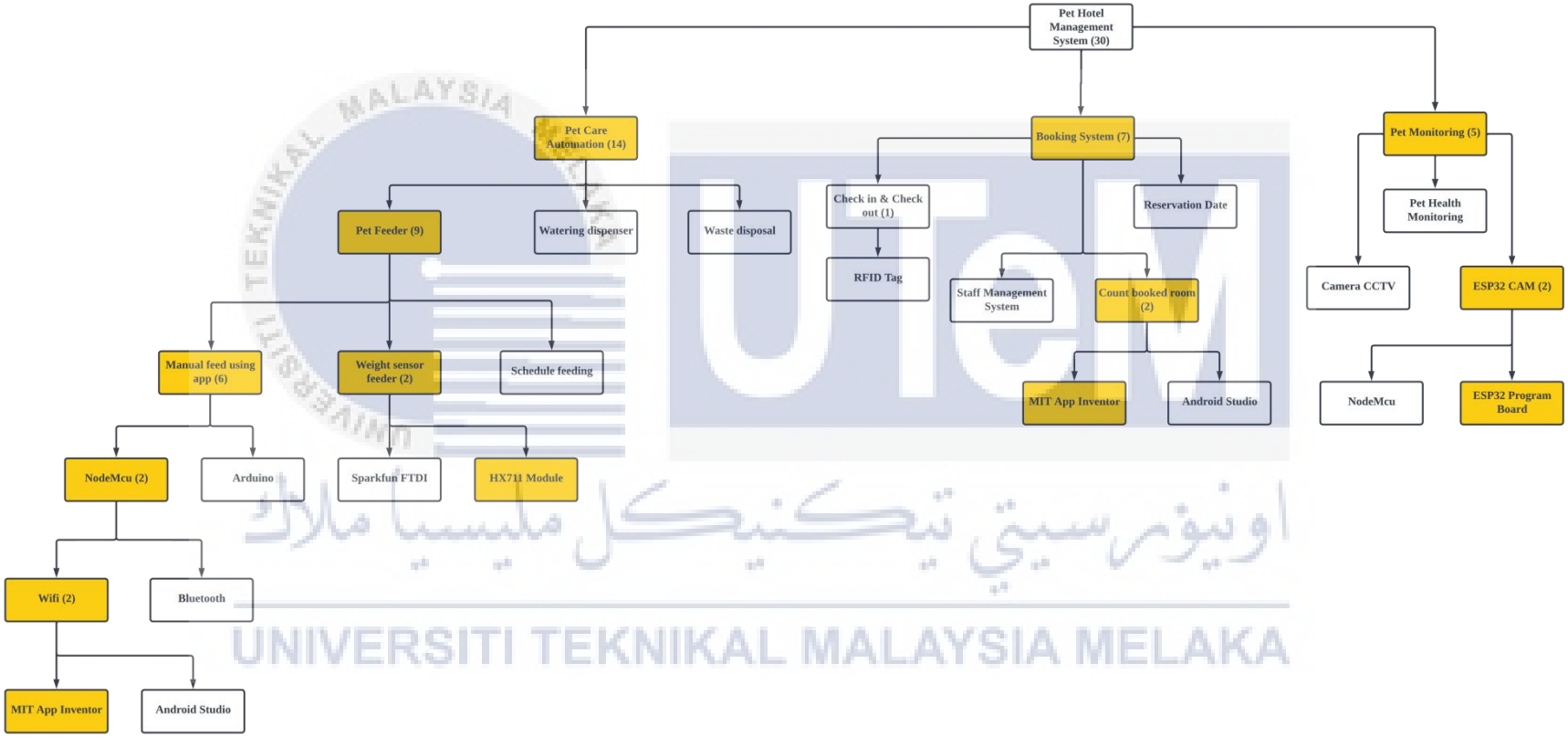

Figure 2.6 K-Chart for pet hotel management system

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2.2 Related Research

This section will provide a summary of the prior research projects that have been completed. The references came from a variety of reputable and approved sources, including books, journals, articles, and websites. Aside from that, this section discusses the advantages and cons of past initiatives compared to current one.

2.2.1 Implementation of an IoT based Pet Care System

Several works have covered the enhancement by utilising the pet implementation of location-awareness capacity and assisting pet owners in readily teaching their dogs about behaviour and food management. The investigation revealed that the pet monitor gadget, which was interested in IoT principles, had made significant development and met the requirements of pet owners looking for work without difficulty. The idea was to make it possible for pet owners to automate routine tasks like as feeding and monitoring. Various sensors are used to monitor various pet actions, such as an infrared sensor to check if there is food on the tray. A pet collar with an RFID tag allows the creature to convey its identify. The Arduino acts as a gateway for delivering the collected data to cloud storage, from where it may be accessed and viewed using a phone number or other electronic devices. There was no risk of data loss because the whole network was wireless. Finally, according to the research, Real Time Clock (RTC) should be added to the feeder. [2]

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2.2.2 Intelligent Pet Monitor System

A new pet-care system has been proposed as a result of this research. The basic services of the proposed smart pet care system were remote feeding, remote automated defecation, CCTV service, and a smartphone app that could provide control information for the aforesaid services. Using the owners' smartphones, the system can feed the dogs while they are gone, track their movements and status, and control the faeces pad. The recommended solution distinguishes out in terms of IoT technology since it incorporates sensors and wireless communication. As a result, if a wireless connection is available, the recommended system is not limited in terms of location or time. [3].

2.2.3 Implementation of Smart Pet Care Applications in an IoT Based

Every year, as the number of pet owners grows, so does the need for higher-quality pet grooming products. This has aided the development of this Internet of Things (IoT) technology industry. Pet owners may use IoT technology to track their pet's activity and whereabouts, as well as check their pet's health and connect with them. All of these smart pet care gadgets play a vital role in the daily life of pet owners. The main goal of this research is to activate an integrated system that incorporates the three essential aspects that pet owners should be concerned about whether or not they are busy. The litter box, cat food bowl, and water dispenser are all included. These three subsystems are connected to the local network using Arduino Uno boards and Wi-Fi modules. The data collected by each sensor is also analysed and displayed on a smartphone app. Pet owners may obtain all information on their pet's food and water intake, as well as the time, length, and frequency of faeces, through a single interface. Additionally, the programme offers a control function that

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allows pet owners to supply food at any time and from any location. In the programme, a general statistical diagram with the stated variables is displayed and updated on a regular basis. [4]

2.2.4 Pet Humanization

Consumers in Malaysia are increasingly treating their dogs as family members. This is one of the "pet humanization" megatrends that is sweeping the globe. Dogs used to be treated as surveillance pets, living outside the home to monitor and defend the house, just like cats used to be viewed as mice catchers. Changing lifestyles and social behaviour are fueling the pet humanization trend, with fewer young couples marrying, postponing establishing a family, or having fewer children. According to literature evaluations, an interesting phenomenon on people's behaviour change has been described in a recent article on www.marketeeronline.co, both for single households and couples without children. They own or plan to own pets. [5] Furthermore, young adults, or millennials, are more likely to keep dogs and consider them as treasured family members than previous generations. The fundamental reason is that pet-owner companionship has grown increasingly desirable.

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2.2.5 Weight controlled pet feedding system

In 2009, Anke Schumann and Yildiray Sager suggested a pet feeding system that may feed the pet with varied amounts of food depending on its weight. There is a weight management system that keeps track of the pet's current weight, target weight, and other information. The pet owner estimated the appropriate amount of food for the animal's weight and entered it into the storage system. While the pet is on a weight scale, the system will always update the current weight. [6] One of the advantages of

this proposed system is that it can constantly monitor the weight of the pet on a daily basis. The training progress for different weights of pets can be changed by the pet owner. However, this proposed method has a drawback in that it can only be utilised for one pet at a time. If more than one pet uses the same feeding system, the system will not identify it, and the weight recorded in the storage system will be inaccurate.

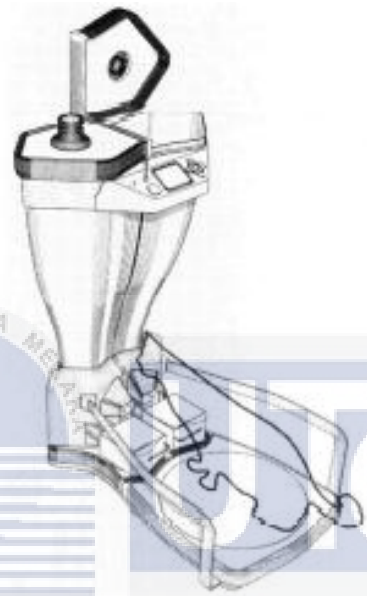

Figure 2.7: Weight controlled pet feeding system. [6]

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2.2.6 Intelligent water dispensing system for pets

In 2018, Christopher NERO and Stephen M. Baquet proposed an intelligent pet water dispenser. It's a system for giving your pet water and nutritional supplements. The majority of the systems just enable water to stay in a bowl. In high-humidity conditions, it will cause the water to stagnate, whereas in low-humidity environments, it will cause the water to continually evaporate and be refilled, resulting in water waste. [7] This proposed device will provide unlimited water to the pet. The proposed method can keep track of how much water is consumed by tracking the water in the

bowl. Furthermore, it will only provide a limited amount of water to the pet in order to avoid water waste. One of the system's flaws is that it can't tell which pet is drinking water and how many pets are doing it at the same time. As a result, the system's tracking features may not be accurate enough. One alternative is to put a camera module to differentiate the pet. In addition, a collar with RFID can be used to identify pets.

2.2.7 Internet of Things for Human - Pet Interaction

In 2016, Yung-Sheng Shih, Hooman Samani, and Chan-Yun Yang suggested a human-IoT pet interaction system . The Raspberry Pi 2 Model B is the system's principal hardware component for receiving and processing sensor data. To retrieve the image on the devices, a camera module is attached to the Raspberry Pi. For monitoring purposes, the temperature sensor and heart rate sensor will collect the pet's current physiological data. [8] The system is simple to maintain because the hardware component on the pet may be replaced without any additional technological skills. Furthermore, when compared to the smart pet housing system for monitoring purposes, the system gave the pet more freedom to walk around. The system requires a pet to carry a large object about with them, which may cause the animal to get uncomfortable and attempt to remove it from their body. It's possible that the sensor system's lifespan will be severely reduced as a result.

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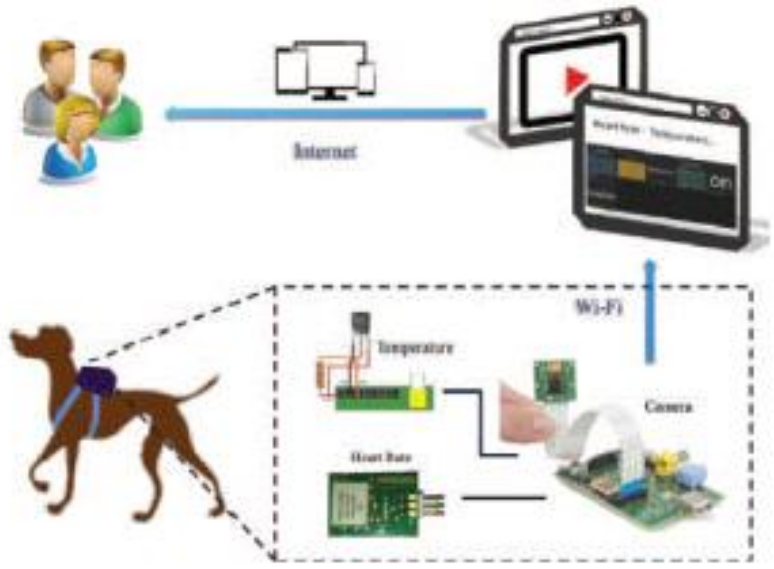

Figure 2.8 Diagram of overall system architecture design [8]

2.2.8 Smart Pet House

A smart pet housing system was presented by Ahmed Mandy, Hassan Qazweeni, Mohammed Noureddine, Talal AlRadhwan, and Mohammed El-Abd in 2016. The suggested system is divided into many subsystems, including a monitoring system, a smart ventilation system, and a smart lighting system.

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A rotatable webcam serves as the monitoring mechanism. In addition, an infrared sensor detects the presence of a pet in the smart home. The pet's live feeds will be displayed on the camera.

Two temperature sensors and a fan make up the smart ventilation subsystem. The fan can be controlled manually or automatically based on the system's pre-programmed temperature value. A light sensor and three LEDs make up a smart illumination subsystem. When the light level falls below the pre-programmed value,

the light can be turned on manually or automatically, and it can be turned off when the level rises above the pre-programmed value. [9]

The system is made up of numerous subsystems that may communicate with one another, allowing the pet owner to operate them all from a single application. Only the computer connected to the controlling system can interact with the smart pet house in the suggested system. The system will not be able to regulate manually if the pet owner is not present, and the pet owner will not be able to watch their pet while travelling or working outside. A network module might be added to the system, allowing the control system to be utilised wirelessly from a smartphone connected to the internet.

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Figure 2.9 GUI for the monitoring system [9]

2.2.9 Pet Feeding Control System

Andy H. Gibbs proposed a pet feeding control system in 2018. The pet feeding control system will ensure that one or more pets are eating the precise food that has been connected to them via an RFID collar or a wireless transmitter device. On a network server, the specific food for each pet will be saved. The device will sound an alarm if an unauthorised pet eats the food. [10]

The technology can recognise each pet and supply their specific food, which is kept on a network server and may be changed using their smartphone. Furthermore, the alarm system is a wonderful way to keep other uninvited pets from eating the food offered. However, the system is overly reliant on the network, as the storage of data and the execution of commands all require the use of a network in order for the system to function properly.

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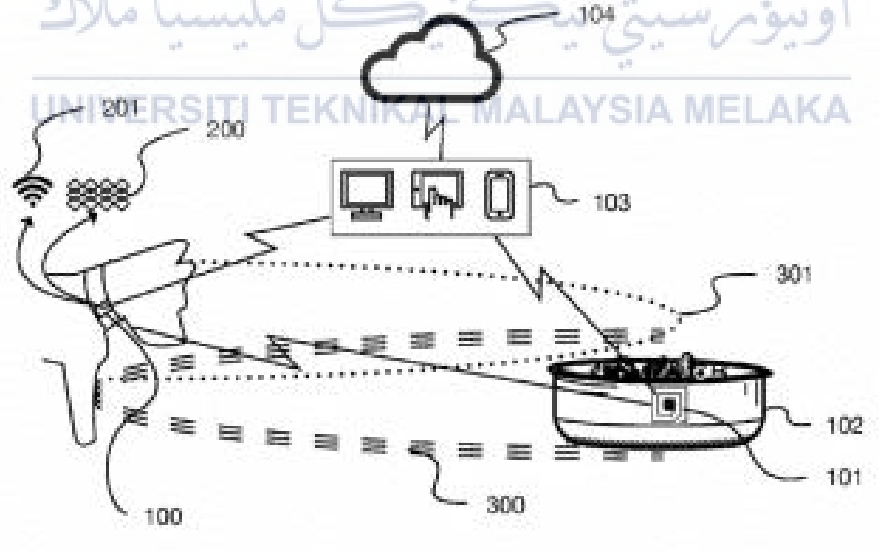

Figure 2.10 Pet Feeding Control System [10]

2.2.10 Remote controlled and GSM based automated pet feeder

In 2015, Prashant Singh, Amit Kumar Sharma, Payal Sood, and Paramdeep Singh proposed a remote controlled and GSM basedautomated pet feeder system.

The interactive remote controller, infrared remote control, and a phone can all be used to control the pet system remotely. The signal received by the IR receiver or GSM module is controlled by a CPU. The GSM module is used to deliver AT commands from the device via data transmission. [11]

The system's dual power supply with battery charger and left feed alert is a specific strength. In the event of a power outage or a power cut, a dual power source can keep the system running. When an ac supply becomes available, the machine will switch back to using the battery. The left feed alarm will then use the GSM module to notify the pet owner if there is any food left. For the following feeding period, the system will lessen the feeding amount. The system is only suitable for a single pet with no means of identification. If a pet owner feeds more than one pet, it might lead to problems, such as the pet eating the food from the other pet. [12]

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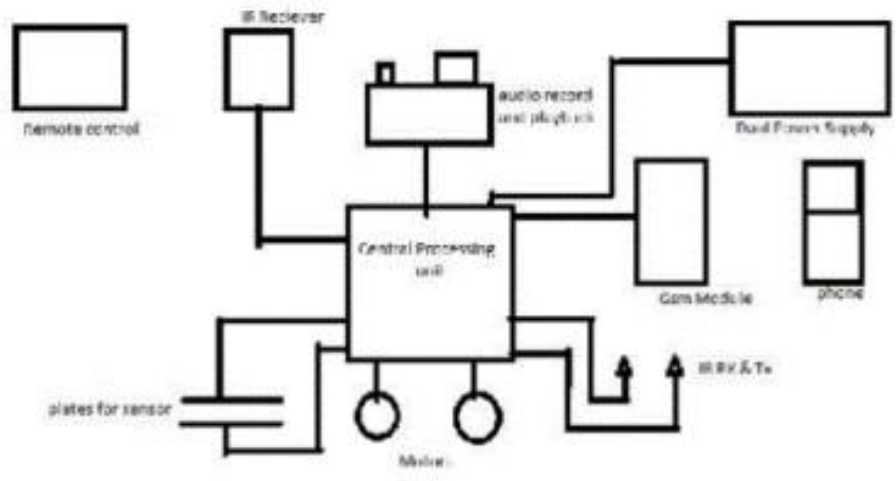

Figure 2.11 Remote controlled and GSM based automated pet feeder [12]

CHAPTER 3

METHODOLOGY

3.1 Introduction

The explanation in this chapter will be roughly about the research technique and the reasons for how the research was carried out. The strategy that will be used at the start of this project will be the first step. After that, the tools and methods utilised will be followed until the project's development is completed. This chapter will explain the process flow and design requirements for the creation of this project

3.2 Project Overview

Final Year Project (FYP) 1 and FYP 2 are the two halves of this project. Finding a supervisor for this FYP is the most critical step in completing this project before deciding on a title. Then, decide on the major goals that will explain why this project has to progress. This project's scope must also account for the project's restrictions. Some hardware and software study will be done in the literature review section to decide the hardware and software that will be used for this project. In order to obtain a better understanding of the project that is being developed, research of previous projects that are related to this project is required. Following that, based on the investigation, a selection of hardware and software is made. All of the following will be completed during FYP1.

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The creation of the hardware design will be the first step of FYP 2. A circuit was designed and the component was interfaced using the components purchased during FYP 1. The circuit must then be checked for continuity and any errors must be resolved. The circuit layout for the top was then etched, and the components were soldered on top of it. After that, the hardware prototype was created. Following that, development of the project's coding and application design were completed. After both software and hardware development is completed, the two will be combined to form a full system. The performance of the project is then evaluated through project testing. If the project still has errors, software and hardware troubleshooting will be used to pinpoint the source of the problem. The project will then be checked by the student and lecturer. Following that, an analysis will be conducted in order to analyse the project's effectiveness. Finally, the report will be completed using all of the project's data.

The gantt chart reveals the flowchart's finer details. Every semester, a gantt chart is created as a schedule for project management to show how the project is carried out. The gantt chart serves as a baseline for the project, ensuring that it is completed on schedule.

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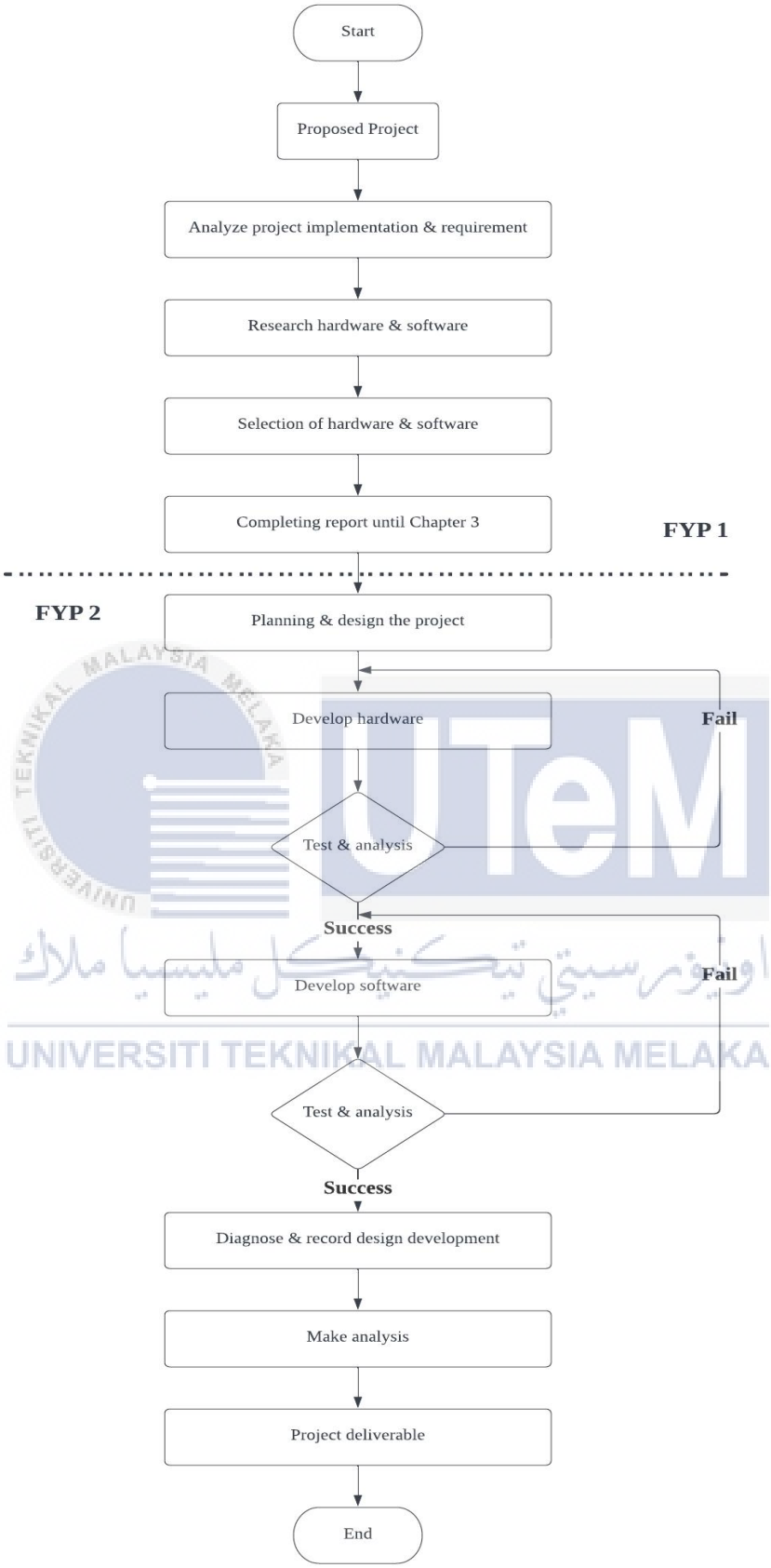

Figure 3.1 Flowchart of the Final Year Project (FYP 1 and FYP)

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3.3 Project description

This project is made up of both hardware and software components. The Arduino Uno is the most important component in the hardware section. The purpose is to operate as a controller for all of the subsystems, including the food distribution system's servo motor, weight sensor, and camera module. The signal from the android apps will be received by the NodeMcu. Because the signal from the android app button is received, the NodeMcu will send it to the servo motor inside the food dispenser, which will rotate 90 degrees. The food will drop down from the hole inside to dispense the food once the servo motor has turned. The weight sensor will be in charge of indicating the exact weight of the food that has been supplied. A camera module will also be connected to the NodeMcu for a real-time monitoring system.

The software, which is an Android app that communicates with the NodeMcu, comes next. The android app will have features such as a regular feed button, a feed schedule button, a booking system, and a monitoring button. When the user presses the button, the signal is wirelessly sent to the NodeMcu. It will accomplish the duty assigned once it receives the signal supplied from the cell phone.

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3.4 Block diagram

System design is one of the planning steps that must be completed prior to the project's implementation. The project overview will be more understandable and provide a clear view of what has to be done to ensure the project's success when this design is completed. This project comprises both hardware and software development. A block diagram is made early on to show the layout of the entire design. The project's block diagram is depicted in Figure 3.2.

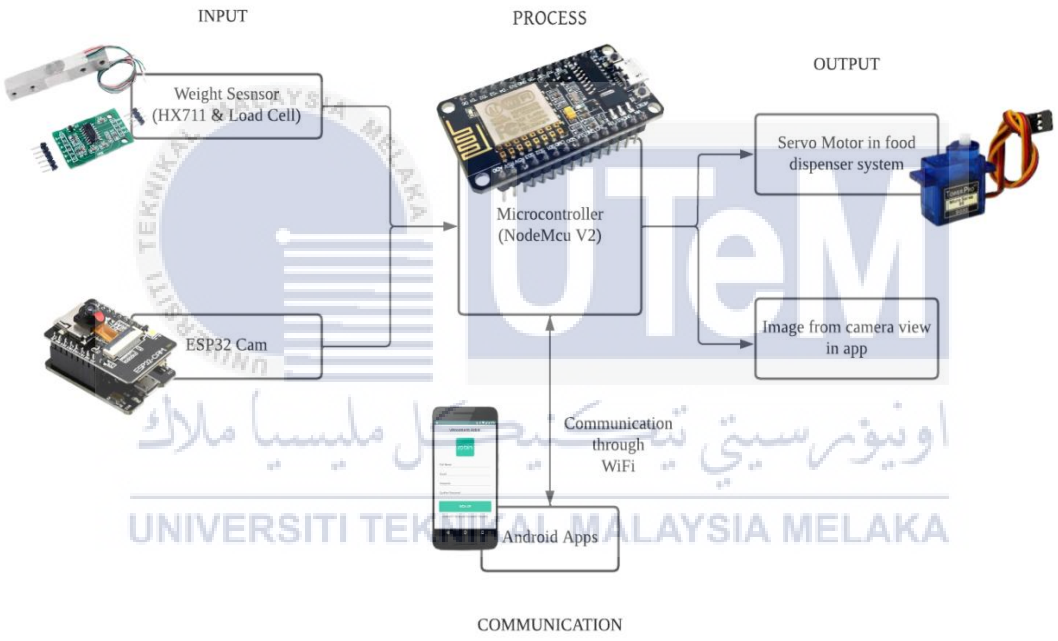

Figure 3.2 Block diagram of project

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3.5 Project Layout

The 2D project layout for the Pet Hotel Management System is shown in Figure 3.3. It is made up of a number of parts that serve as input and output devices. The cage utilised in the prototype is 16x13x14 inches. For this project, the weight sensor is a HX711 and a load cell. For easier use, both of the components are fastened to the acrylic plate. The weight sensor's acrylic plate is protected by a box that is made to contain a feeding dish of the right size.

An upside-down plastic bottle that has been sliced in half will be fastened to the inside edge of the filter funnel. A servo motor with a plate for close and open attachment will be used to secure the bottle's head. The feeding bowl will be located in front of the hose end of the filter funnel. The camera will then be placed in a box of an appropriate size for safety and fixed in the corner so that it faces the pet feeder.

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The PCB board for the project is kept in a PVC fuse box that measures 6x4x3 inches. A battery case for two AA batteries to power the servo motor will also be located in the fuse box. On both sides of the fuse box is a USB battery box that serves as the power source for the PCB board and camera and can hold 4 AA batteries.

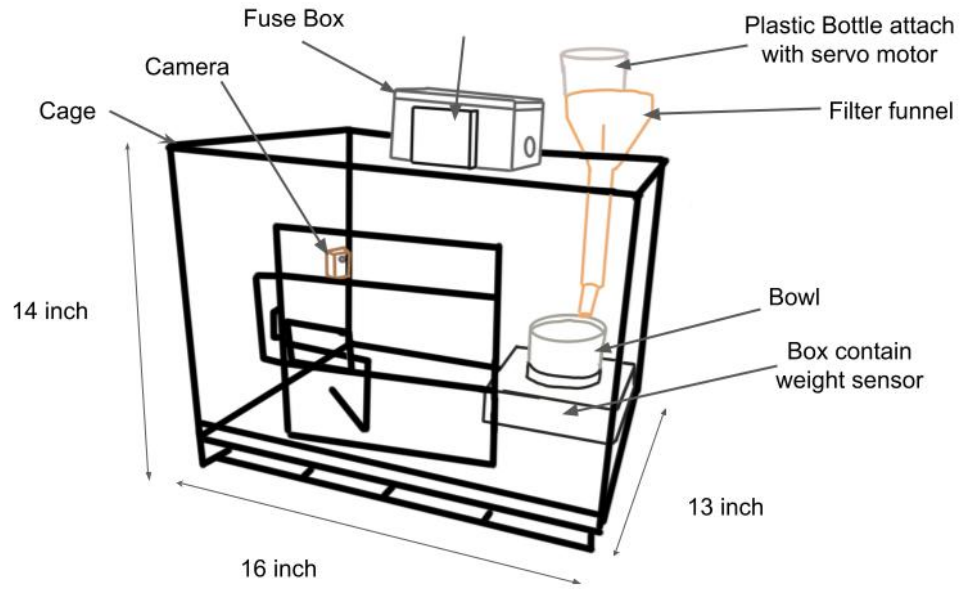

Figure 3.3 2D sketch layout of the project

3.6 Circuit Layout

The details of each component's particular pin connection to the NodeMCU will be covered in this section. This data is required for knowing the system's general functionality and ensuring that it is configured properly. The circuit connection has been well illustrated for understanding, as can be seen in the figure below. The connections for the NodeMCU pin with the HX711 Module, servo motor SG90, and external batteries are shown in Table 3.3 as references for the connections. This table makes it simple to follow along and look for any potential problems by providing a full overview of how each component is connected to the NodeMcu pin. The connections for the servo motor SG90 to the external batteries are shown in Table 3.5 and the connections for the HX711 Module with the load cell are shown in Table 3.4. These tables serve as a general setup and troubleshooting guide for the circuit connections. For the ESP32-CAM, it is connected directly to ESP32 program board. Both NodeMcu and ESP32-CAM will use micro USB as power supply which is connected to 6.0 Volts battery.

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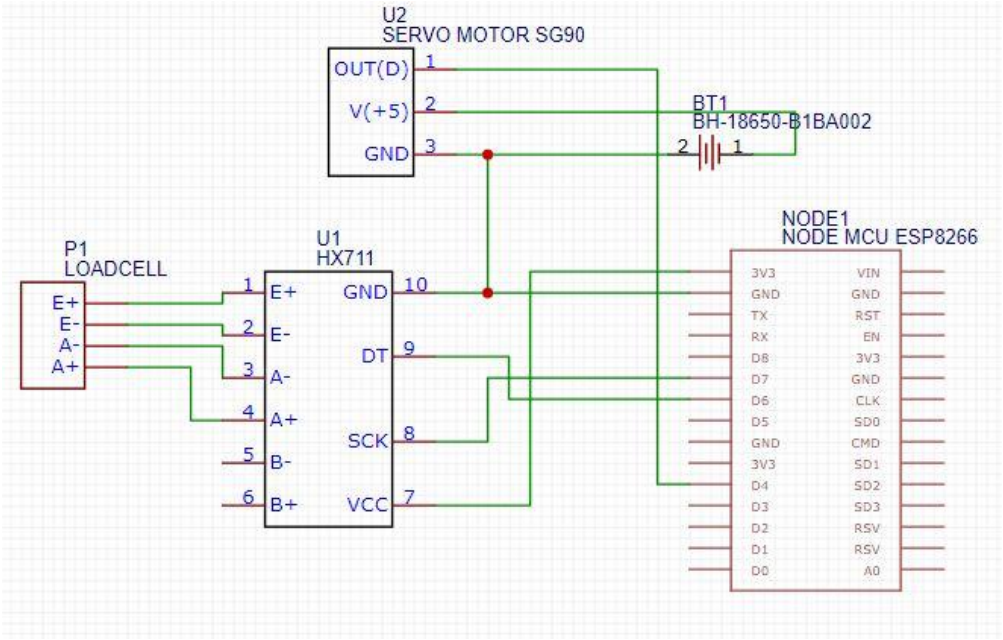

Figure 3.4 Schematic Circuit for the project

3.6.1 Connection

3.6.1.1 Circuit Connection

Table 3.3 Connection table for NodeMcu

Components	Components Pin	NodeMcu Pin
HX711 Module	GND	GND
	DT	D6
	SCK	D7
	VCC	3V3
Servo Motor SG90	OUT(D/ORANGE)	D4

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	GND (BROWN)	GND
External Batteries	GND	GND

Table 3.4 Connection table for HX711

Components	Components Pin	HX711 Pin
Load Cell	E+	E+
	E-	E-
	A-	A-
	A+	A+

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Table 3.5 Connection table for servo motor SG90

Components	Components Pin	Servo Motor SG90 Pin
External Batteries	+Ve	V (5+) (RED)
	-Ve	GND (BROWN)

3.7 Flowchart

The flow of the Pet Hotel apps is depicted in Figure 3.6. After the program has loaded, it will display the project's main page, which will prompt the user to sign up or log in. If the user already has an account, user can easily log in and go to the home page. On the other hand, new users are only required to enter their email when they register a new account. The apps will deliver a verification link through email for the user to confirm their account before allowing them to log in. The customer can choose the preferred room for their pets. After completing the booking process, the user will move on to the Feeding Option screen, where they may decide whether to schedule feeding or manually feed. The user will then have the choice of viewing their pet or not.

This flow is depicted in Figure 3.7 if the user selects the 'FEED OPTION' button in the app. The user will have the option of feeding the pet manually or scheduling a certain feeding time. If the user chooses to feed the pet manually, users must first push the 'FEED' button, after which the servo motor will turn, dropping the food into a bowl. If the user chooses to schedule feeding, the app will present them with four options: 'Morning 9 A.M.,' 'Evening 3 P.M.,' and 'Night 9 P.M.' After the user selects an option, the servo motor rotates to drop the food at the time set by the user. If the weight of the food in the bowl is less than 150 grams, the servo motor will remain open in both cases. When the weight reaches 150 grams, the servo motor closes, indicating that the meal has been consumed. The software will display a pop-up stating "The food has been dropped down. Want to take a look ?". If the user presses the ‘Yes’ button at the pop-up, they will be redirected to the Camera Screen to monitor their pets. If not, the user will remain on the screen.

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The flow is visualized in Figure 3.8 if the user selects the 'START' button in the app. The app will display the camera's display so that the user can keep an eye on the pet at the hotel. The user may check whether the pet has eaten the provided food or not. In order to stop the camera view display, the require to press the ‘STOP’ button to turn off the camera display. If the user has completed their task in the app, users will remain on the screen or can just exit the app.

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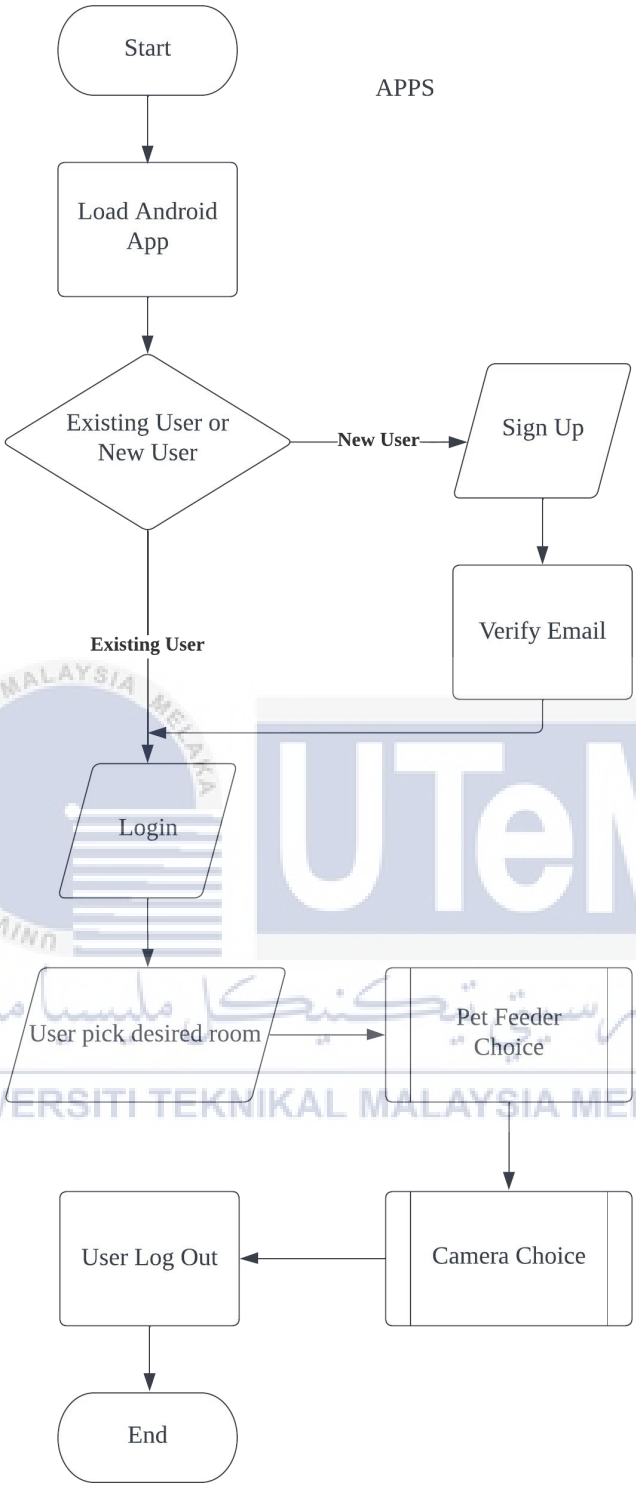

Figure 3.6 Flowchart for booking apps

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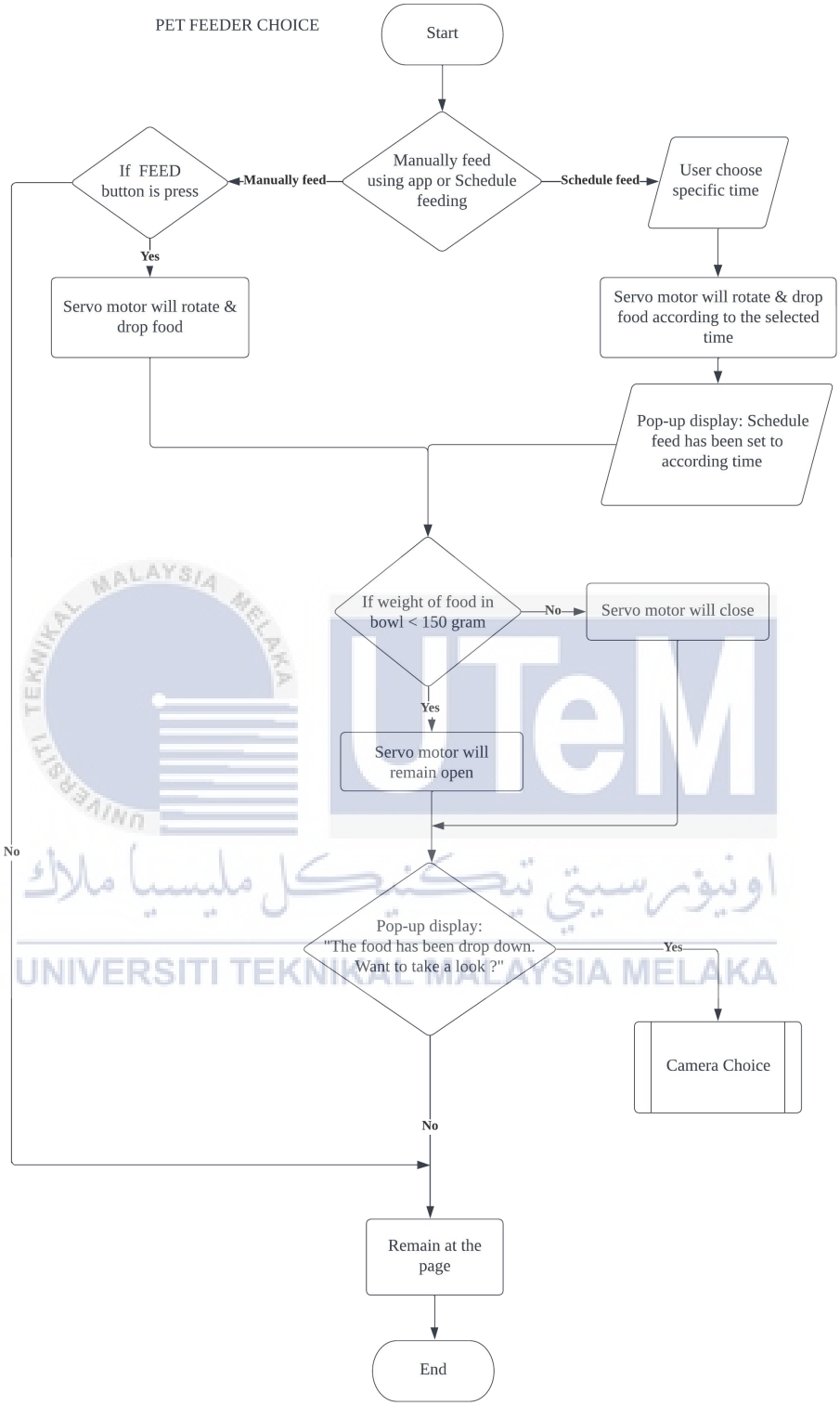

Figure 3.7 Flowchart Pet Feeder Choice

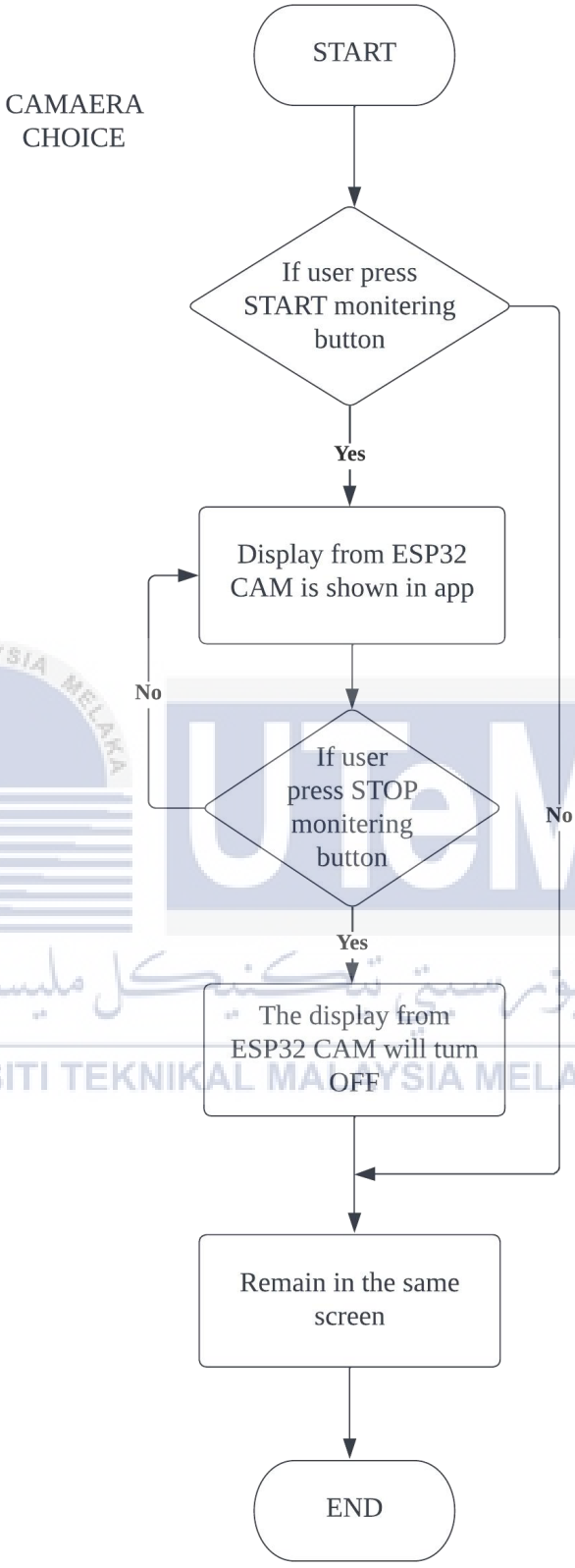

Figure 3.8 Flowchart for Camera Choice

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3.8 Component Overview

3.8.1 Selection of Components & Components Functions

The precise role of each component required to construct this project is displayed in Table 3.6. Moreover, it states whether the component is an output or an input. It is simple to recognise the structure of the components with the aid of the graphics that are provided for each component.

Table 3.6 List of components with its functions

Component	Input/Output	Function
NodeMCU V2 	-	NodeMCU is an open source platform built on the ESP8266 that allows things to be connected and data to be transferred over Wi-Fi. Additionally, it may address many of the project's requirements on its own by offering some of the most essential microcontroller functionalities, like GPIO, PWM, ADC, and others.
ESP32 Camera 	Input/Output	The ESP32-CAM is widely applicable in multiple Iot applications. It is appropriate for IoT applications such as wireless positioning system signals, industrial wireless control, wireless monitoring, QR wireless identification,

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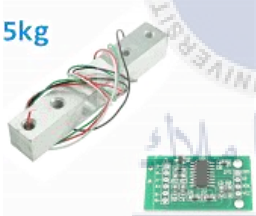
		and smart home equipment. For IoT applications, it is the perfect answer.
Servo Motor 	Output	The servo motor's job is to translate the controller's control input into rotational angular displacement or angular velocity of the motor output shaft. The joints are driven by a servo motor.
HX711 and Load Cell 	Input	The HX711 is a precision 24-bit analog-to-digital converter (ADC) designed to link directly with a bridge sensor in weighing scales and industrial control applications. It's designed specifically for boosting cell signals and reporting them to another microcontroller.

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3.9 Project Costing

To create this project, all costing for each components and materials used is listed in the Table 3.7.

Table 3.7 List of costing components and materials used

No	Component	Supplier	Unit	Price (RM)
1	MB102 Solderless Breadboard Large	Shopee	1	3.90
2	SG90-180 Degree (Plastic) Servo Motor	Shopee	1	6.90
3	NodeMCU V2 Board + USB	Shopee	1	22.70
4	ESP32 CAM Module	Shopee	1	25.90
5	5KG Load Cell & HX711 with Base Tray	Shopee	1	24.80
6	AWG22 Multicore Wire (Green)	Shopee	1	7.50
7	Solder Wire 0.6mm	Shopee	1	6.00
8	PVC Electrical Box EB643	Shopee	1	12.90
9	ESP32 CAM Program Board	Shopee	1	6.90
			Total	**117.50**

The above table is a proof that the objective, 'To build a low cost automation pet hotel management system for the community.' is achiecved.

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CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter will discuss the research's findings and explain its findings. A series of reliability tests is conducted once the hardware and software projects are finished to see if the hardware is actually effective depending on the hardware state. After comparing projected results to actual results depending on the scenario, the flow program's results are examined. A survey is conducted to gather user feedback, opinions, and comments as well as to analyse the project's effectiveness.

4.2 Reliability testing

Ageing tests are one of the procedures used in reliability testing to confirm and validate that the user is receiving a high-quality product.

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4.2.1 Ageing test

Table 4.2 presents an ageing test that places the project under circumstances that are outside of typical service or storage ranges and produces test results in a brief amount of time.

Table 4.1 Ageing Test table

Condition	Before	After
The project is placed outside for five hours from 3.00pm until 7.00pm. Project still functions.	3pm 	7pm 

4.3 Funtionality testing

To ensure that the project is fully functioning before being used by the user, functionality testing was conducted as part of this testing phase.

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4.3.1 Unit testing and integration testing

Unit testing and integration testing are done in this section. A test to verify the functionality of a particular application component is known as unit testing. Integration testing is done to identify any problems that may exist when several modules interact with one another to construct the overall system once all components have been produced and integrated.

Table 4.2 Unit Test table

Component	Method Test	Expected Outcome	Actual Outcome
NodeMcu	Using the coding in Arduino IDE to check the WiFi connection of the NodeMcu.	The serial monitor in Arduino IDE shows the IP address of the NodeMcu.	The serial monitor in Arduino IDE shows the IP address of NodeMcu in URL form which is 'http::///192.168.43.42'
HX711 & Load Cell	Set the calibration value in Arduino IDE and put a load that has an actual weight value.	Value of the load is the correct value in grams.	Value of the calibration is 625 and the value of weight has a plus minus of 0.5 grams.
Servo Motor SG90	Using example coding for servo in Arduino IDE to detect the way of its rotation.	The rotation is at 90 degrees with a delay of 1000ms.	The rotation is being set to 180 degrees in Arduino IDE to make the servo turn exactly to 90 degrees.
ESP32-Cam	Using example camera web server coding in Arduino IDE to power up the camera.	Arduino IDE will generate the link through the serial monitor for the camera view.	Arduino IDE generates the link through the serial monitor for the camera view capture.

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4.4 Comparison between expected and actual result

This section will show how to compare expected and actual results based on hardware design, application design, and programme flow design.

4.4.1 Project Design

Table 4.3 compares the project's actual design against what was planned.

Table 4.3 Comparison of expected and actual project design table

Description	Expected Design	Actual Design
Hardware prototype		

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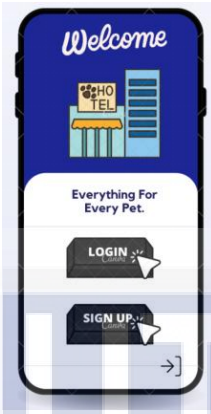
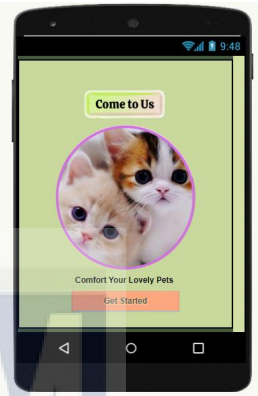
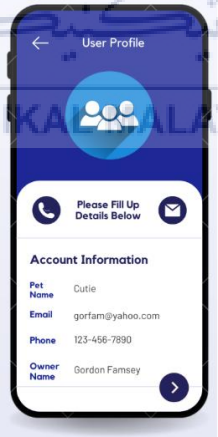
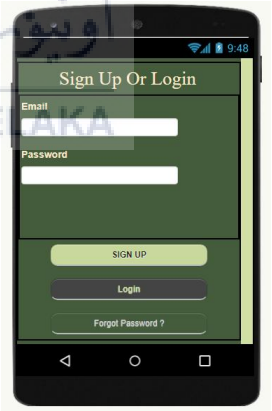
4.4.2 Application design

Table 4.4 show the different between expected design and actual design of the application.

Table 4.4 Comparison of expected and actual application design table

Description	Expected Design	Actual Design
Design for main screen		
Login and Sign Up Screen		

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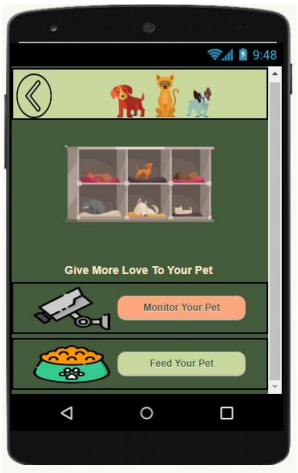
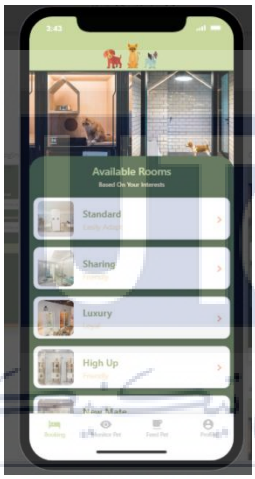
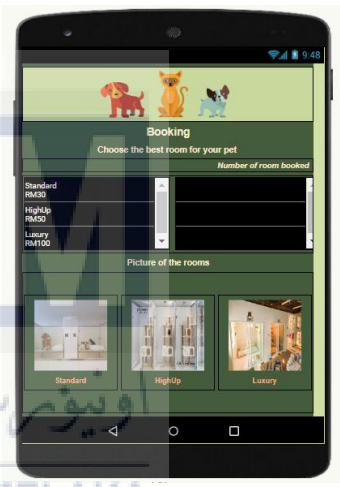
Design for option screen		
Design for booking screen		

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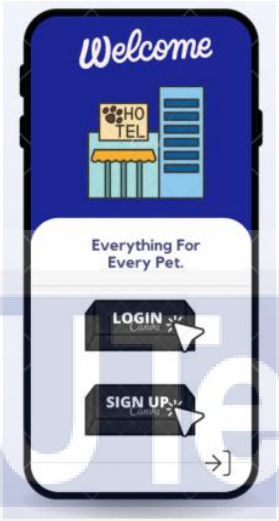
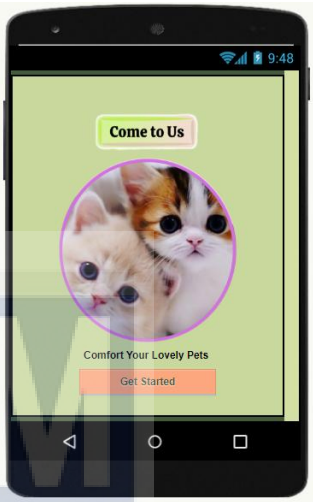
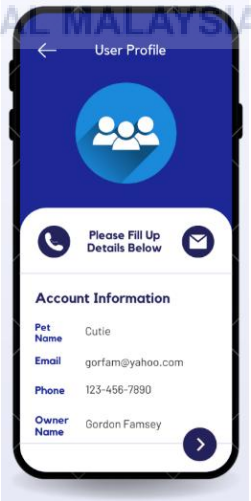
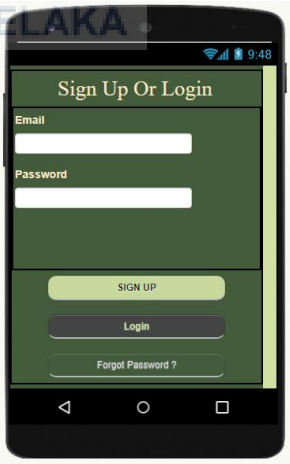
4.4.3 Design flow of the program based on the scenario

Table 4.5 show design flow of the program for expected and actual design for starting page of the project.

Table 4.5 Design flow of program based on scenario for starting screen

Scenario & flowchart	Expected Result	Actual Result
After the program has loaded, it will display the project's main page, which will prompt the user to sign up or log in. 		
If the user already has an account, the user can easily log in and go to the home page. On the other hand, new users are only required to enter their email when they register a new account. The apps will deliver a verification link through email for the user to confirm their account before allowing them to log in.		

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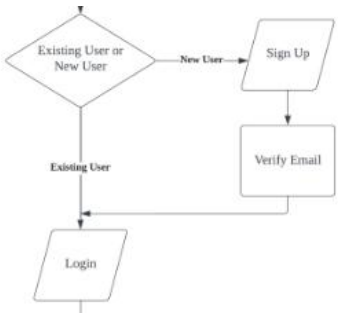
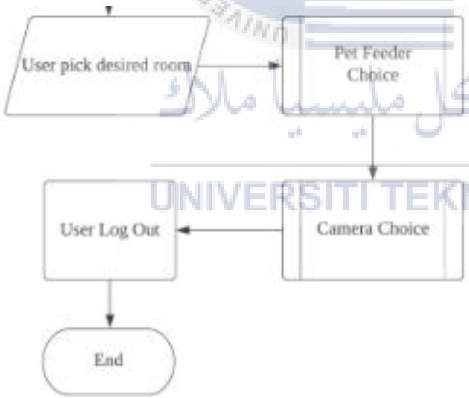
<td> 
</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The customer can choose the preferred room for their pets. After completing the booking process, the user will move on to the Feeding Option screen, where they may decide whether to schedule feeding or manually feed. The user will then have the choice of viewing their pet or not.
 
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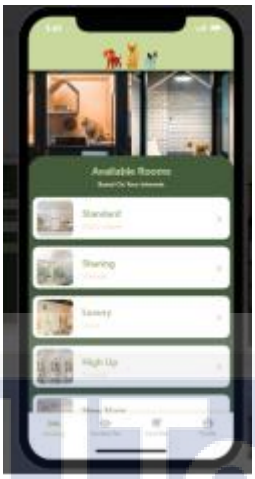
<td> 
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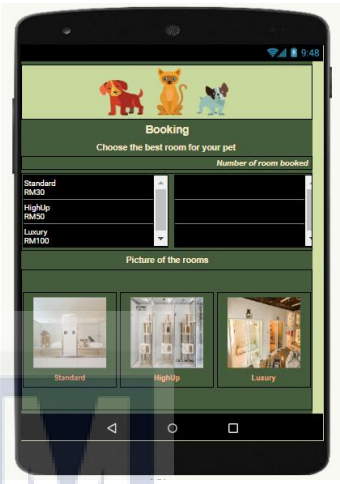
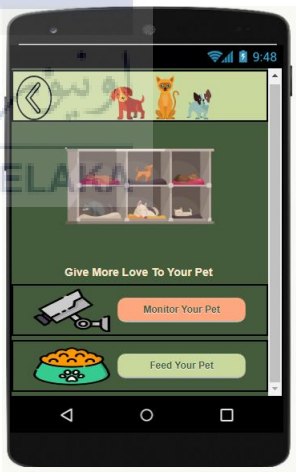
<td> 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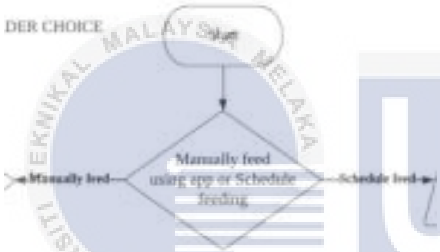
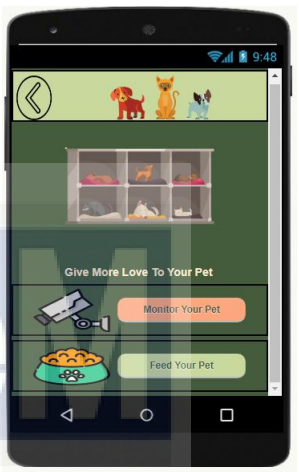
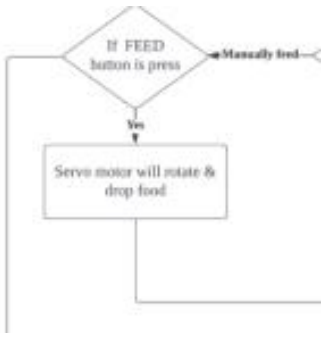
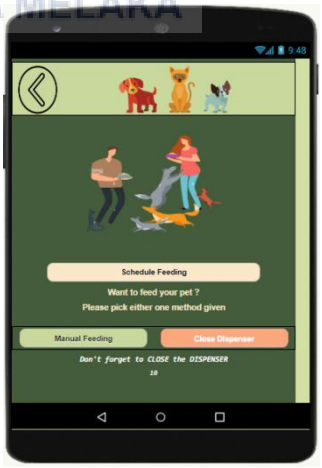
4.4.4 Design flow for pet feeder choice

Table 4.6 show design flow for the pet feeder choice based on scenario and flowchart with an actual result in the apps.

Table 4.6 Design flow of program based on scenario for pet feeder choice

Scenario & flowchart	Actual Result
The user will have the option of feeding the pet manually or scheduling a certain feeding time. 	
If the user chooses to feed the pet manually, users must first push the 'FEED' button, after which the servo motor will turn, dropping the food into a bowl. 	

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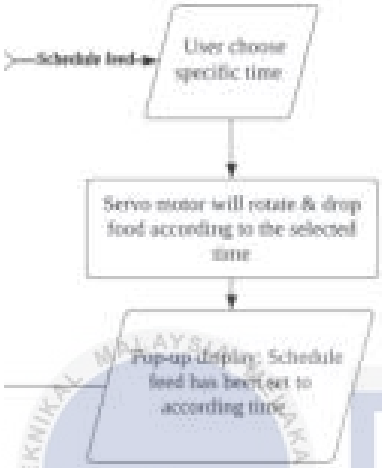
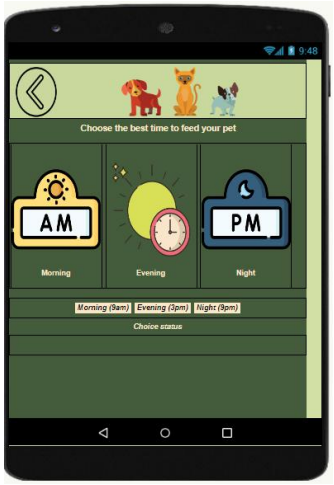
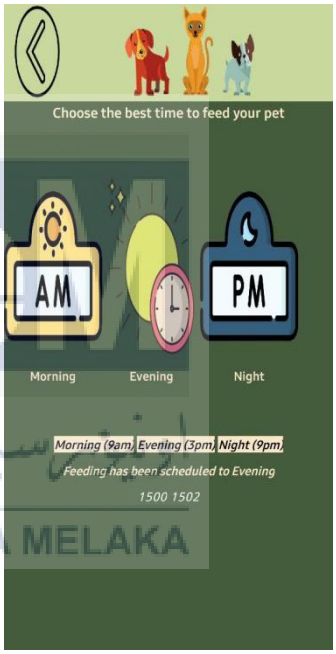
If the user chooses to schedule feeding, the app will present them with four options: 'Morning 9 A.M.,' 'Evening 3 P.M.,' and 'Night 9 P.M.' After the user selects an option, there will be a pop-up which states the schedule feed has been set.







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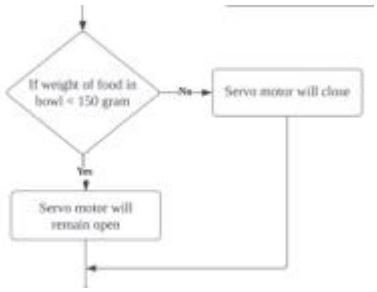
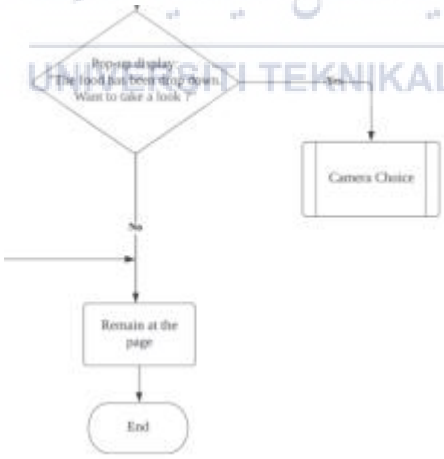
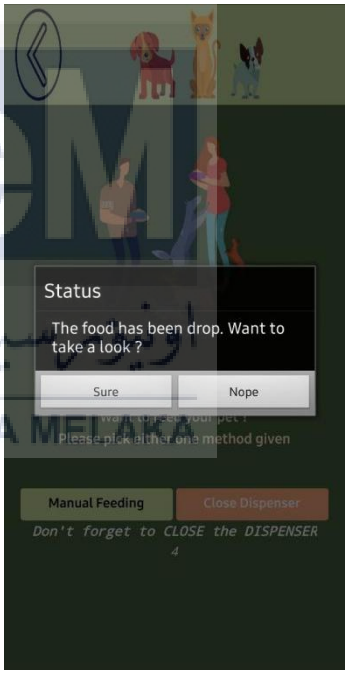
If the weight of the food in the bowl is less than 150 grams, the servo motor will remain open in both cases. When the weight reaches 150 grams, the servo motor closes, indicating that the meal has been consumed.  	Hardware process which only can be viewed in serial monitor
The software will display a pop-up stating "The food has been dropped down. Want to take a look ?". If the user presses the 'Yes' button at the pop-up, they will be redirected to the Camera Screen to monitor their pets. If not, the user will remain on the screen.  	

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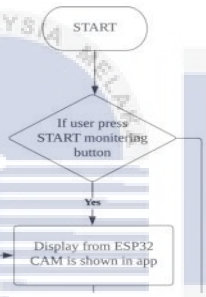
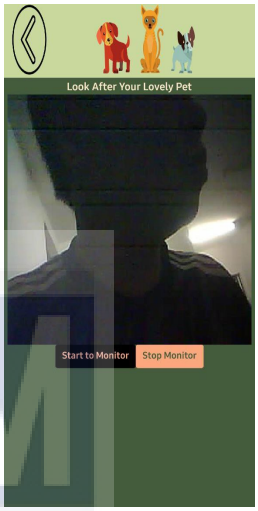
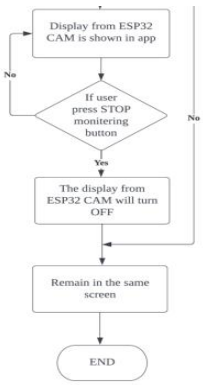
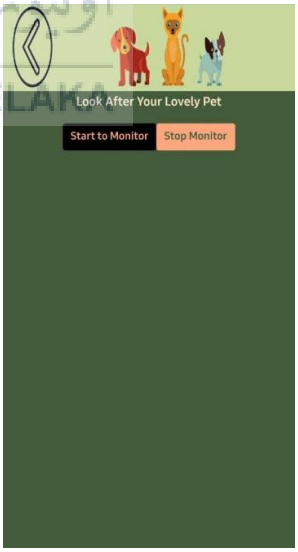
4.4.5 Design flow for camera choice

Table 4.7 show design flow for the camera choice based on scenario and flowchart with an actual result in the apps.

Table 4.7 Design flow of program based on scenario for camera choice

Scenario & flowchart	Actual Result
If the user selects the 'START' button in the app. The app will display the camera's display so that the user can keep an eye on the pet at the hotel. 	
In order to stop the camera view display, the require to press the 'STOP' button to turn off the camera display. If the user has completed their task in the app, users will remain on the screen or can just exit the app. 	

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4.5 Result analysis and survey questions

40 individuals who love pets and already own a pet from a variety of fields participated in the survey. This poll is being conducted to gather feedback and assess how well the automation pet hotel management system is working. Additionally, respondents also need to answer several general questions about pet hotels around the community.

Question 1: Is it necessary to send pets at a pet hotel if the owner goes away for a trip ?

According to Figure 4.1, the majority of survey participants believe that leaving pets in a pet hotel while the owner is gone is necessary. It has been proven that they require a pet hotel when they travel in order to assure the welfare of their animals. There are 2 people who are opposed to leaving their pet in a pet hotel when they travel. Pet owners occasionally may have other options besides leaving their pets at a pet hotel to care for them while they are away from home.

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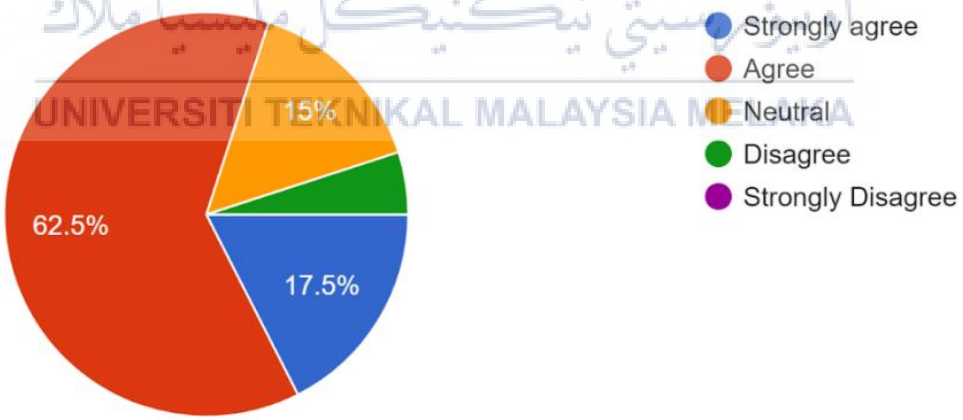

Figure 4.1 Pie chart for question 1

Question 2: Does the owner who sends their pets to a pet hotel need to worry about their pets' condition there?

Figure 4.2 reveals that 20 respondents strongly agree or agree that they worry about their pet's condition while it is staying at the pet hotel. This demonstrates how the monitoring system will make pet owners feel less anxious when they leave their pet in a pet hotel. While there are 12 individuals who are unsure of their pet's condition and have neutral thoughts. However, 8 respondents strongly disagree and do not worry about their pets when they are staying at a hotel since they have complete faith in the pet hotel to protect their pets' wellbeing.

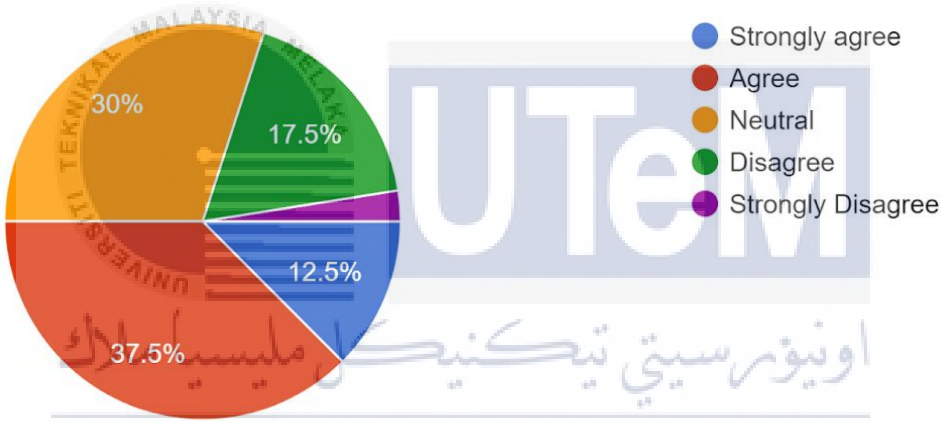

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Figure 4.2 Pie chart for question 2

Question 3: Does the pet hotel need to take full responsibility if the pets scratch each other at the pet hotels ?

According to Figure 4.3, 16 respondents strongly agree and 17 think that pet hotels should be held entirely responsible if their pets fight. Since the pet motel should separate a few pets that might get along poorly with others. The owner should be aware if their pet is friendly with others to protect the safety of other pets, according to 3 respondents, who disagree with this statement.

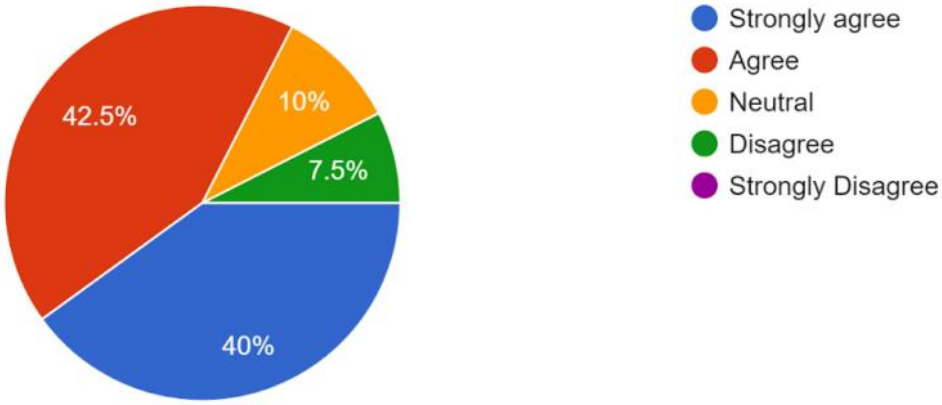

Figure 4.3 Pie chart for Question 3

Question 4: Does a monitoring system need to be installed for every pet hotel to allow owners to see their pets' condition ?

Figure 4.4 demonstrates that the majority of respondents concur that any pet hotel needs to have a monitoring system. In addition, 13 respondents strongly concur that pet motels must include a surveillance system. This demonstrates how crucial the monitoring system is to the project. While there is disagreement between the other two respondents' perspectives.

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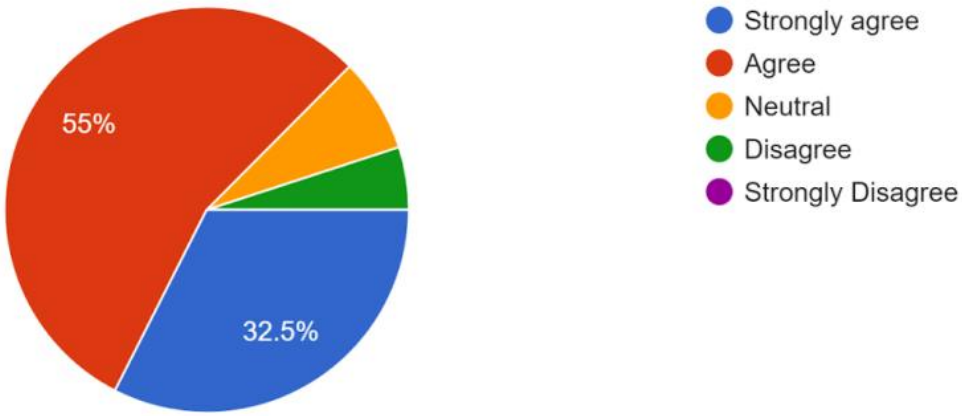

Figure 4.4 Pie chart Question 4

Question 5: What is the best time to feed your pets ?

The majority of respondents indicated that mornings were the ideal time to feed their pets (see Figure 4.5). Because pets must have gone without food overnight, owners will feed their animals in the morning, in accordance with the scheduled meal time (9AM). While 10 respondents preferred to feed their pets in the afternoon, the other respondents preferred to do it in the evening. On the other hand, no one chooses to give their pets food in the evening.

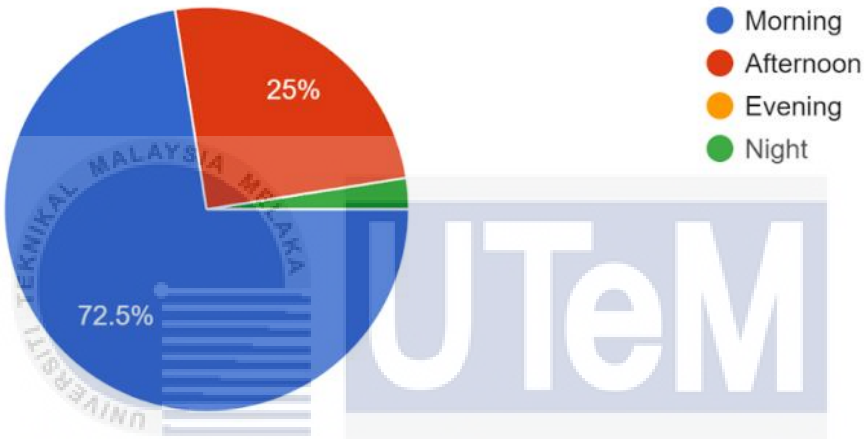

Figure 4.5 Pie chart for Question 5

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Question 6: As for the prototype, is the size of the cage convenient for a pet to live in ?

Figure 4.6 reveals that 15 respondents agreed that the cage's size was appropriate for housing a pet. As for the prototype, it demonstrates that pets may live well in the cage given its size. However, 12 respondents said "No," stating that the cage was too small for the pet to stay in. Regarding the size of the cage, 13 respondents are undecided.

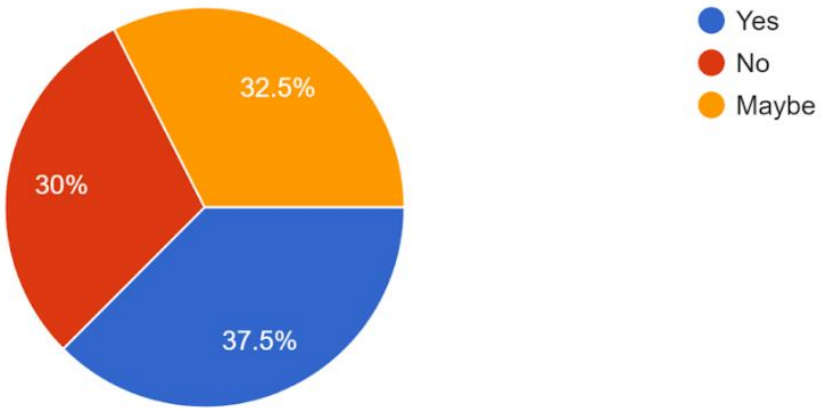

Figure 4.6 Pie chart for question 6

Question 7: Which type of automation feeder features do you prefer ?

The schedule feeding capabilities, which allow the owner to set the feeding process to occur at a specific time, are popular with responders, as shown by Figure 4.7. 17 respondents selected the automatic feeding option because they would likely enjoy having food available for their pets' meals at all times. Five respondents, however, preferred manual feeding options because they wished to monitor their pets' own eating.

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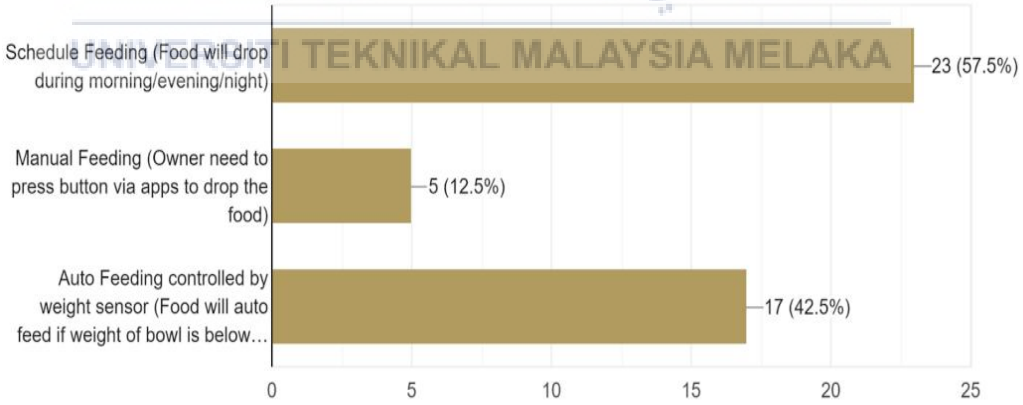

Figure 4.7 Bar chart question 7

Question 8: Do pet hotels need to keep updating their facilities to ensure better service of pet care ?

According to Figure 4.8, half of the respondents strongly believe that pet hotels must continue to update its facilities in order to provide better care for animals. Additionally, 17 respondents agree on the matter. No one disagrees with the pet hotel facilities enhancement strongly or disagreeably. This demonstrates that the majority of respondents desire to improve the pet hotel's facilities to protect the welfare of their pets.

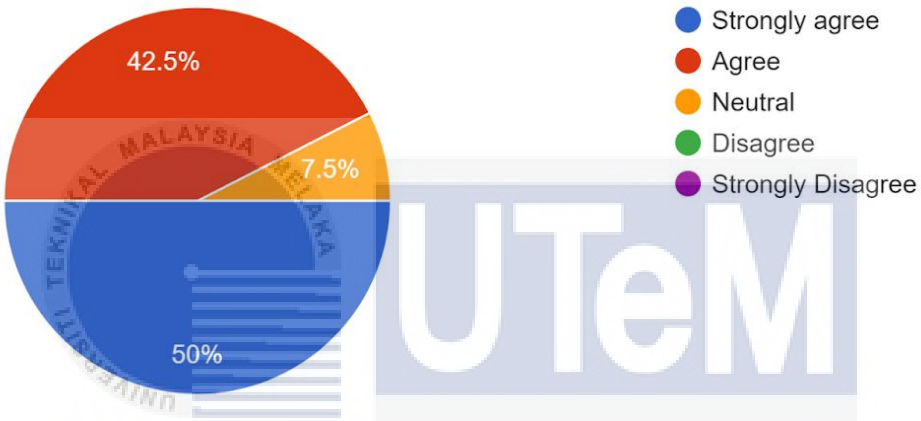

Figure 4.8 Pie chart question 8

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

As a conclusion, the goal of this project is to create an application using MIT App Inventor that will show the pet hotel booking process as well as how the apps and various components interact. In order to improve user interaction with apps, the Automation Pet Hotel Management system integrates WiFi technology into the NodeMCU. The pet hotel could benefit greatly from the Internet of Things (IoT) idea. Mobile phone capabilities and WiFi have the potential to improve this sector of society in order to protect pets' wellness.

This project successfully accomplished its goals of designing an automation pet hotel system using EasyEDA for the circuit layout, creating a 2D prototype sketch using ArtFlow, and built an automation pet hotel system using NodeMcu as the controller with a programme written in the Arduino IDE. While developing the product, all the criteria are met. Next, a low-cost project that will be sustainable for the community should be built. Most animals, including cats and dogs, will consider a 16x13x14-inch box with an automatic pet hotel system to be convenient. The project's estimated cost was less than RM 200.00, however the actual cost came to RM 117.50. Some of the testing for each piece of hardware to determine its reliability uses an ageing test to determine the functionality of the device. Last but not least, the objective-based goal of this project has been fulfilled.

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5.2 Future Works

Here are some proposals for additional follow-up work on an automation pet hotel management system project:

i) Integrating with other systems: Integrating the pet hotel management system with other systems such as a point-of-sale system, inventory management system, or accounting software can help streamline operations and provide more comprehensive data on a pet hotel's performance.

ii) Mobile App integration: Developing a mobile app that allows pet owners to check-in and check-out their pets, view their pet's daily activities, and receive notifications of any issues that arise while their pet is in the hotel can provide convenience and peace of mind for pet owners.

iii) Automated watering system: Implementing a watering system that can be controlled through the management system can help ensure that pets are hydrated on schedule, even if staff members are unavailable.

iv) Advanced security features: Adding advanced security features such as facial recognition or RFID tags can help ensure that only authorised personnel have access to the pet hotel and that pets are only released to their rightful owners.

v) Predictive maintenance: Implementing predictive maintenance algorithms that can predict when equipment is likely to fail and schedule maintenance accordingly, can help minimise downtime and ensure that the pet hotel is running smoothly.

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APPENDICES

Appendix A Gantt Chart of Final Year Project 1

PROJECT PLANNING PSM 1																	
	2022																
Project Activity	MARCH				APRIL				MAY				JUNE				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
PSM1	PSM General Briefing						Mid Term Break										
Proposed Project: ➢ Find Supervisor ➢ Decide project title. ➢ Analyze project implementation & requirement ➢ Identify objective, problem statement & scope of project. ➢ Literature Review.																	
Research for Hardware & Software: ➢ Sketch prototype ➢ What component to use ➢ Cost of project ➢ Identify Software to use																	
Selection of Hardware & Software used: ➢ Finalize hardware & software used ➢ Finalize project design ➢ Buy component																	
Project deliverable (PSM1): ➢ Completing report until Chapter 3 ➢ Prepare slide presentation ➢ Turnitin Report ➢ Submission PSM1 report																	

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Appendix B Gantt Chart of Final Year Project 2

PROJECT PLANNING PSM 2																
	2022												2023			
Project Activity	OCT				NOV				DEC				JAN			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PSM 2	PSM General Briefing						Mid Term Break									
Development of hardware design:																
➢ Purchase component & interfacing component																
➢ Planning & design the project																
➢ Troubleshoot design																
➢ Assemble component																
➢ Construction of circuit																
Development of software design:																
➢ Coding for component interfacing																
➢ Build an apps																
➢ Troubleshoot coding																
Combining hardware and software design:																
➢ Integrate hardware and software																
➢ Troubleshoot																
➢ Finalize prototype																
Make test & analysis:																
➢ Prepare survey questions																
➢ Analysis survey																
➢ Record design development																
Project deliverable (PSM 2):																
➢ Completing report																
➢ Turnitin Report																
➢ Completing executive summary & poster																
➢ Presentation preparation																
➢ Submission PSM2 report																

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