Faculty of Electrical and Electronic Engineering Technology

DEVELOPING OF EGG INCUBATOR WITH MONITORING SYSTEM USING INTERNET OF THINGS (IoT)

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

2021

DEVELOPING OF EGG INCUBATOR WITH MONITORING SYSTEM USING INTERNET OF THINGS (IoT)

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this project report entitled "Developing Of Egg Incubator With Monitoring System Using Internet Of Things (Iot)" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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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 Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

Signature :

Supervisor Name : NURUL KAUSAR BINTI AB MAJID

Date : 10/01/2022

DEDICATION

Specially dedicated to my beloved mother and family

ABSTRACT

The most prevalent type of fowl in the world is chicken and it also one of the main food sources of daily needs. Furthermore, chicken meat is sometimes described as being healthier than red meat, with lower cholesterol and saturated fat levels, it has grown popular in a variety of cuisines. However, hatching eggs has become a major issue in livestock, particularly in small herds. This is one of the major issues leading breeders to lose a significant amount of profit when it comes to hatching egg production. Most breeders continue to employ the old approach artificially because it is difficult for hens to lay eggs again when they are breeding. External environmental conditions, such as wild animals or inclement weather, can also disrupt the egg hatching process. The objective of this project is to design and develop Smart Egg Incubator with a monitoring system using the Internet of Things (IoT). This project will fill with the sensor senses the temperature and humidity that will send it to the ESP32 depending on the current room temperature and the predefined reference temperatures. Furthermore, heat fans and are also employed as warmers to keep the eggs at the proper temperature. A software programme named Blynk will display the status of the Smart Egg Incubator on the smartphone screen. Additionally, users of the incubator will be notified about the condition of the eggs. The ESP32 is a microcontroller that can interpret data from the sensor and run the system to change the condition of the Smart Egg Incubator while automatically reversing the egg. Finally, the development of this smart egg incubator has been successfully planned and implemented so that it can be monitored and controlled according to the temperature parameters set using the Internet of Things (IoT).

ABSTRAK

Jenis unggas yang paling biasa di dunia ialah ayam dan ia juga merupakan salah satu sumber makanan utama keperluan harian. Tambahan pula, daging ayam kadangkala digambarkan sebagai lebih sihat daripada daging merah, dengan paras kolesterol dan lemak tepu yang lebih rendah, ia telah menjadi popular dalam pelbagai masakan. Walau bagaimanapun, penetasan telur telah menjadi isu utama dalam ternakan, terutamanya dalam kumpulan kecil. Ini adalah salah satu isu utama yang menyebabkan penternak kehilangan sejumlah besar keuntungan apabila ia datang untuk pengeluaran penetasan telur. Kebanyakan penternak terus menggunakan pendekatan buatan lama kerana sukar untuk ayam bertelur semula apabila sedang mengeram. Keadaan persekitaran luaran, seperti haiwan liar atau cuaca buruk, juga boleh mengganggu proses penetasan telur. Objektif projek ini adalah untuk merancang dan mengembangkan Smart Egg Incubator dengan sistem pemantauan menggunakan Internet of Things (IoT). Projek ini akan diisi dengan sensor merasakan suhu dan kelembapan yang akan menghantarnya ke mikrokontroler ESP32 bergantung pada suhu bilik semasa dan suhu rujukan yang telah ditentukan. Selanjutnya, kipas haba digunakan sebagai pemanas untuk memberikan suhu panas yang sesuai untuk telur. Keadaan status di Inkubator Telur Pintar akan muncul di skrin telefon pintar dengan menggunakan aplikasi perisian bernama Blynk. Sebagai tambahan, pengguna inkubator akan menerima pemberitahuan mengenai keadaan telur. ESP32 adalah sejenis mikrokontroler yang akan memproses data dari sensor dan dapat menjalankan sistem untuk mengubah keadaan Inkubator Telur Pintar sambil membalikkan telur secara automatik. Akhir sekali, pembangunan inkubator telur pintar ini telah berjaya dirancang dan dilaksanakan agar dapat dipantau dan dikawal mengikut parameter suhu yang ditetapkan menggunakan Internet of Things (IoT).

ACKNOWLEDGEMENTS

Assalamualaikum Warahmatullah Wabarakatuh.

First and foremost, I would like to express my gratitude to my supervisor, En Ab Wafi Bin Ab Aziz and co-supervisor Pn Nurul Kausar Binti Ab Majid for their precious guidance, words of wisdom, and patient throughout this project. Without him, I can lose and flee away from the track I should follow. I also wish to express sincere appreciation to Universiti Teknikal Malaysia Melaka (UTeM) for giving me a chance to further my study in Bachelor’s Degree in Electronics Engineering Technology (Industrial Electronics).

I would also like to show my gratitude to my lecture for teaching me all that is valuable knowledge. My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention also goes to supportive friends for all the motivation and understanding.

Finally, I would like to thank all the staffs, fellow colleagues and classmates and faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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%	-	Percentage
°C	-	Celsius

LIST OF ABBREVIATIONS

V	-	Voltage
DC	-	Direct Current
PC	-	Personal Computer
IDE	-	Integrated Development Environment
IOT	-	Internet of Things
CAD	-	Computer-Aided Design
LBW	-	Low Birth Weight
TCP/IP	-	Internet Protocol Suite
I/O	-	Input Output

CHAPTER 1

INTRODUCTION

1.1 Project Background

The egg incubator is a device that has been used since the 16th century that design to control temperature and humidity until the process of eggs hatching. It assists farmers in hatching eggs without the need for human involvement by keeping the eggs warm, allowing the foetuses inside to grow and hatch without the presence of the mother. By using an incubator device will help farmers to hatch an egg to provide the chicken on an enormous number. For incubating the system, the egg incubator is developed to automate the adjustment system, like the temperature and humidity consistent with set parameters.

One of the inventions that provide opportunities, particularly for farmers, is the smart egg incubator. One of the simplest and quickest methods for producing large amounts of hatching eggs. This idea will improve on some of the current egg incubators on the market.The systems will automatically control the temperature and humidity of the incubator for various types of eggs. The purpose of a practical egg incubator is to take over the animal's role of incubating an egg until it hatches.

The creation of a chicken egg smart incubator for an egg hatching system is described in this study. Furthermore, the incubator is connected to the Internet of Things (IoT) via a phone app called Blynk, which allows farmers to remotely monitor and manage the smart incubator.

1.2 Problem Statement

The process of hatching eggs has become a big problem in agriculture, especially in small herds. This indicates that the problem is one of the main factors causing huge losses to farmers in the production of hatching egg quantities. Most of the breeders still use the old method artificially, it is difficult for hens to lay eggs again if they are in the process of breeding. External environmental factors can also damage the egg hatching process, such as wild animals or unpredictable outdoor weather. This threat not only harms the eggs, but the reproductive process also stops and causing huge losses for farmers.

1.3 Project Objective

a) To develop smart egg incubator with monitoring system

b) To create a phone application that can monitor and set the temperature using IoT.

1.4 Scope of Project

a) This smart egg incubator is limited to the design for chicken eggs only.

b) Monitoring system only monitor temperature and humidity using android application.

c) Required temperature can be set using android application.

d) There are 1 levels for the hatching eggs process where each level has 4 eggs.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, research and case study was done by reviewing the previous research paper, journal, and related project titles that within the project of scope and title. The information is summarized and described what is smart egg incubator and monitoring system by using Internet of Thing. The information's from the past projects can gives insight of how to prepare for the project and it can be used to improve the efficiently and functionality of the system.

2.2 Livestock Farming

Livestock farming can be described as the breeding of domesticated animals raised in an agricultural setting for the purpose of obtaining their labour and commodities such as leather, eggs, milk, meat, and wool. Livestock is an important activity in human development in the world economy that involves raising domestic animals for human consumption and obtaining without going to the forest to hunt (FAO, 2018)

Livestock products such as milk, meat, and eggs from livestock provide high-quality protein for human consumption. The majority of milk produced in traditional civilizations is consumed within the family, with currency obtained from the sale of live animals.. Livestock herds are thus commonly treated as capital assets. The minimum subsistence level for a poor household of two adults and one or two children is something calculate a herd of 40 to 60 sheep and goats, or 5 to 10 head of cattle. If animal numbers fall below this range, production becomes unviable, and households may be forced to abandon the pastoral sector (For and Management, no date).

Livestock farming can divide into three part which is intensive, semi- intensive and extensive. In intensive production systems, animals are housed in confined areas indoors or outdoors and equipped with adequate temperature, humidity, food, and health care so that animal production becomes healthy and fast. Moreover, this system requires both capital and manpower (Hanekom, 2010). Based on Figure 2.1 below, a farmer is feeding bran to the chickens at a regular time so that the growth process of the chickens is constant.

Figure 2.1 : Intensive Livestock Farming

Semi-intensive systems are typically used by small-scale farmers and are characterized by having one or more cages where animals are fed or naturally foraging naturally on plants and insects to supplement the food provided. In addition, by using this system it does not require large investments and higher returns with significant food cost savings (Garner, 2012). Based on the Figure 2.2, a farmer’s place chickens inside and outside the cage so they can feed by giving or naturally.

Figure 2.2 : Semi-Intensive Livestock Farming

Extensive farming is one that is done on an outsized area of land, like grasslands, pastures, or mountains in order that the animals graze and utilize natural resources from various areas. Usually, through with animals tailored to the sort of farm, they need to bring, and it will encourage ecosystem conservation. Nevertheless, this animal farming system characterized by a low productivity per animal and per surface. It uses small amounts of inputs, capital, and labour (Garner, 2012). Based on the Figure 2.3, a farmer released a cow in vast fields to find food extensively and naturally.

Figure 2.3 : Extensive Livestock Farming

2.3 Incubation

Incubation is the process of managing a fertilized egg and ensuring the development of the embryo in the fertilized egg in a satisfactory state until it is hatching. During natural incubation, the mother will generally be present by sitting on the eggs sporadically until they hatch in an open place. Aside from that, it's an artificial incubator where the temperature, humidity, and ventilation are all controlled according to established conditions for hatching purposes. For small incubators, the relative humidity that needs to be set is about 58% with a temperature of 38°C to 39°C. Incubators are typically situated in the corners of rooms, away from walls, to allow for enough ventilation and provide sufficient workspace for the incubator operator. (Adegbulugbe, Atere and Fasanmi, 2013).

There are two type of egg incubator which is traditional and automatic. Traditional Egg Incubator is still using a simple principle with a manual egg reversal process and sometimes labour. These traditional poultry farming methods provide more manpower and pollution problems due to the accumulation of dirt such as chicken manure, it will be even more dangerous when the field becomes dirty that can cause various diseases. Suddenly, it will practical difficulty of manually cleaning dirt for reduce pollution. By using this traditional segment, the potential to grow in the livestock business will not go further with the advancing age of technology (Thomas *et al.*, 2020). Figure 2.4 shows the egg hatching process where the hen is sitting on the egg to keep egg warm.

Figure 2.4 : Traditional Incubation

The automatic egg incubator has an automatic working system by setting the temperature and humidity automatically and equipped with a digital timer. By absorbing automation into traditional poultry farming methods provide advantages to increase productivity, quality, and safety while avoiding waste and can save a lot of time and labour cost. This will also improve hygiene on the farm to reduce diseases in poultry (Thomas *et al.*, 2020). Based on the Figure 2.5 system developed, there are two parts to it which is mechanical and electronic. The mechanical component was a device that used a DC motor and a limit switch sensor to control the angle tilting of the egg trays up and down on an hourly basis.

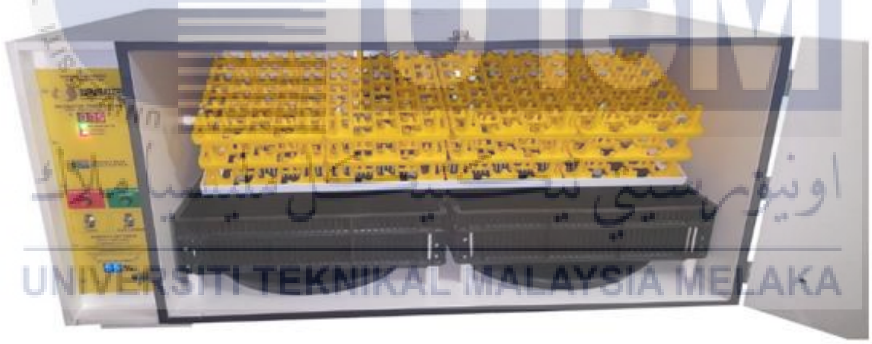

Figure 2.5 : Automatic Incubator

2.4 Smart Egg Incubator

According to (Adegbulugbe, Atere and Fasanmi, 2013) Smart Eggs Incubator is one of the improvements in the evolution of development egg incubator, applications of the Internet of Things in the field of animal husbandry specifically on the hatching of chicken eggs. With that, the purpose of an egg incubator is to maintain a consistent temperature and humidity for the incubation process over a period.The development of smart egg incubator is using three subsystem such as namely embedded system, software application and telegram bots. Based on Figure 2.6 a prototype of smart egg incubator.

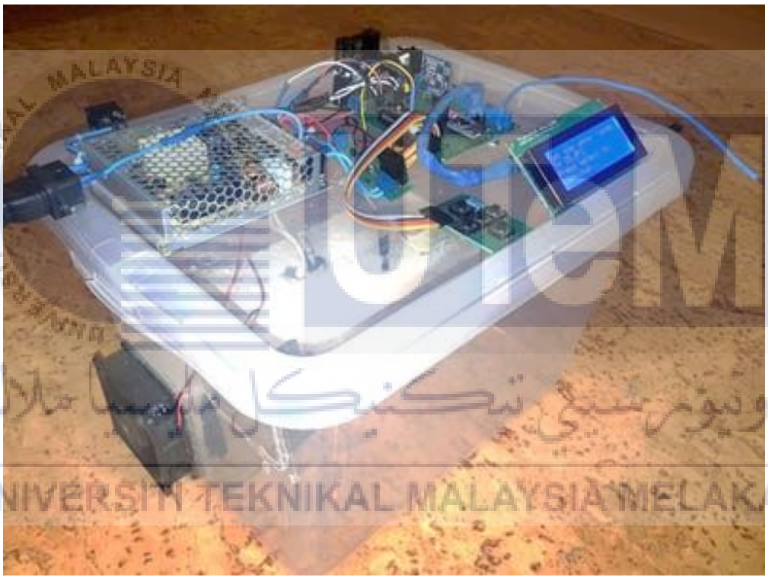

Figure 2.6 : Smart Egg Incubator

Besides, the appliance software is going to be wont to monitor the condition of the incubator by developed using Object-Oriented Analysis, this will cause all operations to be more organized and structured. The sensor data that be utilized in the egg incubator are function to delivered condition of temperature and humidity in the incubator during the process of hatching egg while the telegram bots is functioned to send a message as well to give a notification so that the farmers will alert for anything happens on egg incubators and be able to act more quickly.

2.4.1 Temperature Control in Incubator

Low birth weight (LBW) or premature birth is a predictor of infant morbidity and mortality. In most cases, a newborn born prematurely will be treated in an incubator. Temperature and relative humidity must be kept constant in the incubator. Temperature references were used in the tests, which corresponded to the typical incubator temperature range of 36°C to 38°C. (Sinuraya and Pamungkas, 2019).

Incubators need an air conditioner to provide heat or cooling as well as humidification, as well as a fan to circulate the conditioned air through the eggs before returning it to the air conditioner. (French, 1997). The incubator system based on Arduino microcontroller can control the temperature, humidity, and reversal the quail eggs automatically (Sanjaya *et al.*, 2018). In this project, a heating fan has been used to keep the temperature in the egg incubator with according to a parameter that has been set. Setting up temperature and humidity of egg incubator with table 1.0 below.

Table 2.1: Optimum Temperature Egg Hatching

DAY	HATCHING TEMPERATURE °C	HUMIDITY %
1-21	37.5	57-60

2.4.2 Temperature and Humidity Sensor in Incubator

With Dht11 processed by Arduino can produce an ideal temperature and humidity (Hakiki, Darusalam and Nathasia, 2020) such as show Figure 2.7 below, cause of that the temperature and humidity in egg incubator can be monitor enclosed structure with a fan and heater to keep eggs warm during the 21-day incubation period according to the optimum temperature and humidity of hatching egg process.

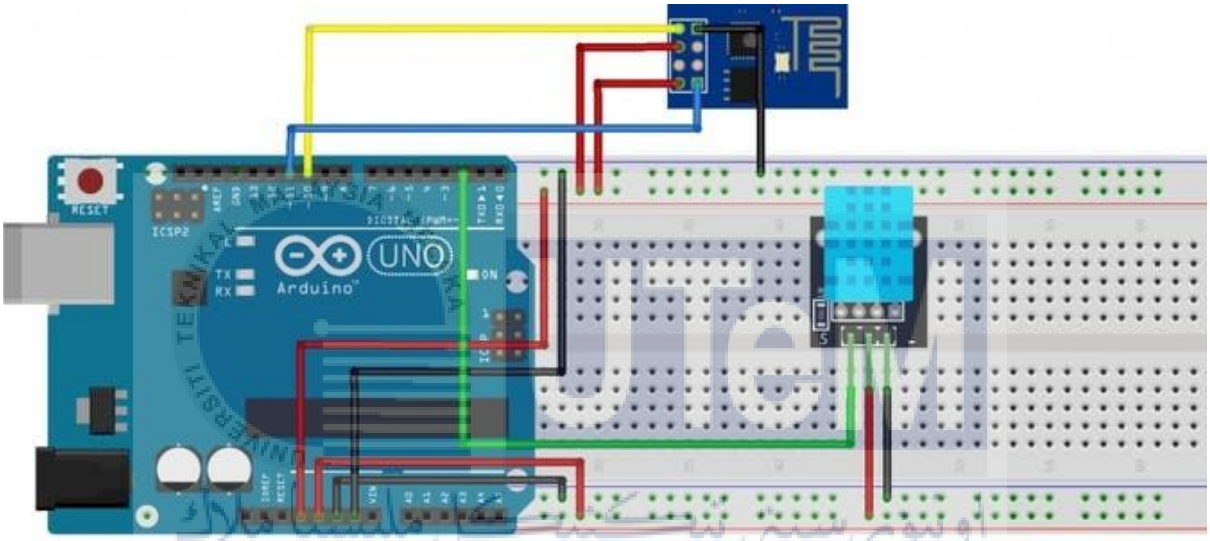

Figure 2.7 : Arduino DHT11 Circuit

The temperature is sensed by the sensor and sent to the Arduino microcontroller based on the current room temperature and predetermined reference temperatures. The microcontroller then compares the sensor read value to the setpoint and makes an automatic decision. If the temperature falls below the minimum of the reference room temperature, the heater will automatically turn on to warm the room until it reaches the target temperature. The temperature is detected in degrees Celsius via the DHT11 sensor module. The sensor creates a voltage of 10mV when the room temperature rises by one degree Celsius (Debele and Qian, 2020).

2.4.3 Incubator Auto Egg Tuner using Stepper Motor Control in Incubator

By referring to Figure 2.8 below show prototype of egg tuner. The eggs will be rotated every six hours starting on day 2 and ending on day 19 using an automatic egg turner system powered by a stepper motor to rotate an iron rod at the bottom of the egg and automatically change position, ensuring that the entire surface of the egg is heated evenly at all stages. (Raja *et al.*, 2019). The movement of a stepper motor is easier to control than that of a DC motor since a stepper motor can rotate to the degree we want it to, whereas a DC motor may generate excessive movement when to rotate it, resulting in less precision (Putu, I Gusti, Sena Sila, I Nyoman Piarsa, 2018).

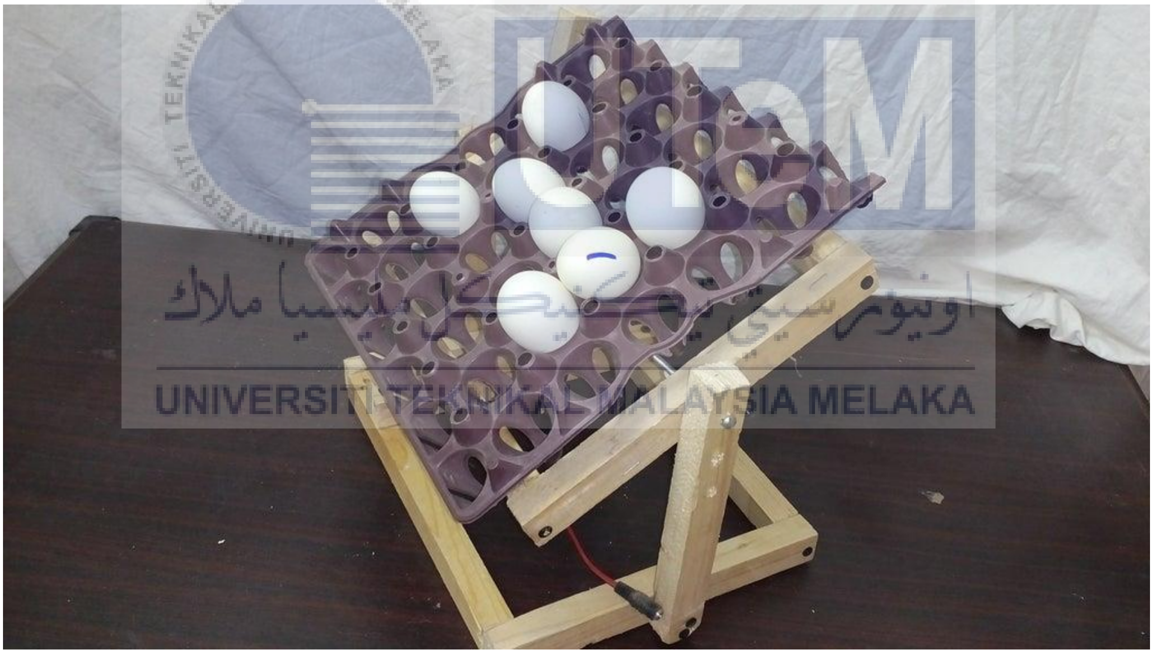

Figure 2.8 : Egg Tuner

This feature is utilised to automatically turn the egg shelf to a temperature that is evenly distributed on all sides, preventing the egg embryo from sticking to one side of the eggshell. The feature operates by rotating the egg shelf every six hours. The egg shelf is first positioned to face the centre, after which the step motor is moved to the fore with a 45° angle and continues in this position for six hours. After those six hours, the step motor will move the egg shelf to the backward position with a 45° angle, where it will stay for six hours before returning to its original position in the centre. It happened again and again until the incubator stopped working (Putu, I Gusti, Sena Sila, I Nyoman Piarsa, 2018).

2.4.4 Incubator Monitoring System using Smartphone Application

The speed of internet technology in daily life has had a huge impact on the world. Computer network services grow bigger with the internet. With the presence of computer networking tools, the ability to connect with one another became much easier (Mazalan, 2020)

The software application such Blynk allow us to create applications and then use it to control Arduino board connected to a PC with internet access, from any distance such as control, servos, receive data with a smartphone (Todica, 2016). According to Blynk website, Blynk is a platform with the Android and IOS apps that can run many hardware modules like Raspberry Pi, Arduino, NodeMCU and over four hundred hardware modules. In addition, to connect the hardware module device to the internet, the sustained choices connectivity Wi-Fi and Ethernet.

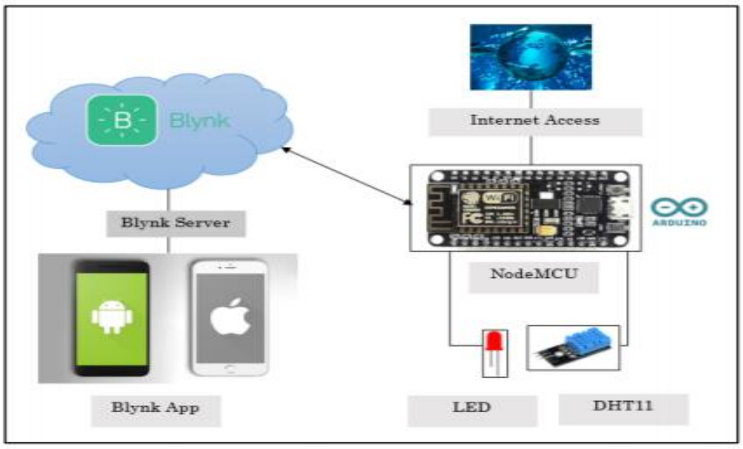

Figure 2.9 : Software Apllication Blynk

2.5 Internet of Thing

The fourth industrial revolution entails control systems and sensor networks, as well as better, quicker, and more optimised artificial intelligence systems. According to ('Development of Monitoring System using the Internet of Things for Industrial Revolution 4.0', 2020) the Internet of Things (IoT) concept was originally used to establish a connection between machine and user, using a sensor, a processor like the Raspberry Pi, and an IoT platform app like Blynk on a smartphone.For this egg monitoring used Blynk application that has addition features there will be an order notification will be sent if there are conditions on different changing incubators that have been determined. Figure 2.10 below show the internet of things illustration.

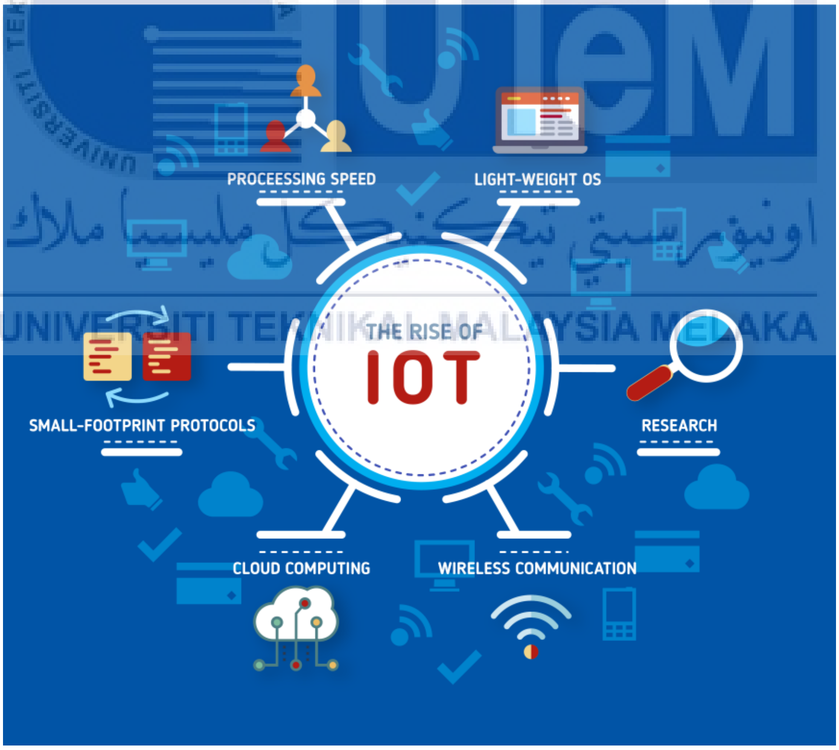

Figure 2.10 : Internet of Things Ilustiration

By using the on/off approach to control the incubator causes the system to run inefficiently. Furthermore, the incubator system's usage of a local network prevents users from controlling and monitoring the incubator remotely. As a result, an Internet of Things system is needed to connect anything to the Internet via a protocol defined by information sensing equipment.

2.6 Related Project

In this chapter, it describes a review of work related to our representational matching solutions and discusses in detail how our solutions advance the current situation. There are several similar projects that can be attached for comparison and improvement, including the previous project titled Development of a smart quail egg incubator based on microcontroller and internet of things, Development of a smart chicken egg incubator based on the internet of things using object-oriented analysis and design, and Thermal optimization of the incubator using a fuzzy inference system.

2.6.1 Development of Quail Eggs Smart Incubator based on Microcontroller and Internet of Things

There is a problem for farmers to produce quail incubated by quail manually. Cause of that, this research has been developed to create a smart incubator quail egg. Where the smart incubator was develop based on system Arduino microcontroller that can control temperature, humidity, and flips the quail eggs automatically. In addition, there are features to help farmers monitor the condition of quail egg incubator successfully with the Internet of Thing from a distance by using an interface called VNC and Pyhhon software (Sanjaya *et al.*, 2018).

Figure 2.11 : Quail Eggs Smart Incubator

2.6.2 Development of The Smart Chicken Eggs Incubator Based on Internet of Things Using the Object-Oriented Analysis and Design Method

Breeders perform the process of hatching chicken eggs using the traditional process, various problems will arise in the process of monitoring the environment in the incubator such as changes in temperature, humidity, and eggs if that is still done manually. To overcome the problem, built -in a web application can be used to monitor the condition of the incubator based on sensor data that has been sent during the egg hatching process. There will be an order notification will be sent if there are conditions on different changing incubators that have been determined by using a software application Telegram Bot, during of experiment for 21- day trial there are 3 eggs were hatch and 1 egg failed to hatch (Santoso *et al.*, 2020).

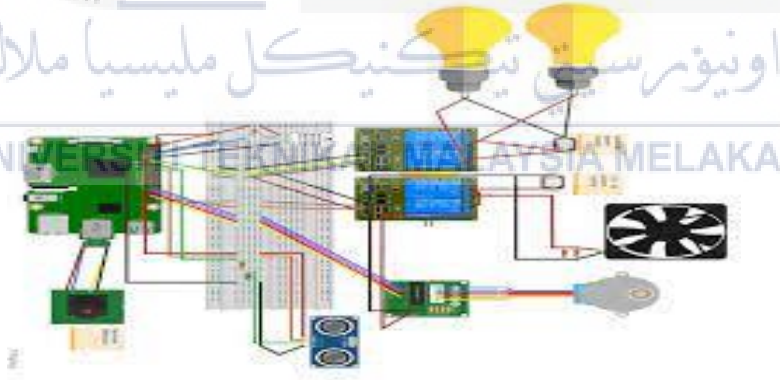

Figure 2.12 : Smart Chicken Eggs using the Object-Oriented Analysis

2.6.3 Thermal Optimization on Incubator using Fuzzy Inference System based IoT

Incubation temperature is the most important and influential element in poultry quality, according to (Rakhmawati *et al.*, 2019). Poor growth, stress, black buttons, threads, weak chicks, chicks with poor erupted down that are bleached in appearance, low hatchability, late embryonic death, and early broiler mortality are all caused by high temperatures. As a result, a controller is required to manage the temperature in order to improve production quality and efficiency. The ideal temperature for egg hatching is 38 degrees Celsius. As a result, this study was carried out to optimise the egg incubator system using fuzzy inference and the Internet of Things (IoT).

2.6.4 Development and Design of Egg Incubator Powered by Solar Energy formulas

According to (Singh *et al.*, 2020) Renewable energy sources, such as solar energy, will be the most abundant source of energy on the planet in the future, and will be able to solve many energy problems while also creating jobs in low- income rural areas. The design and construction of a dual-powered solar incubator is presented in this project, in which solar energy is employed to give the necessary heat to the incubator space so that the process of hatching eggs may be carried out precisely.

Figure 2.13 : Egg Incubator Powered by Solar Energy

2.6.5 Comparison between related projects

Table 2.2: Comparison Related Project

No	Title/Research/Source	Features
1.	Development of Quail Eggs Smart Incubator based on Microcontroller and Internet of Things(Sanjaya *et al.*, 2018).	Using an interface from software called VNC and Python.
2.	Development of The Smart Chicken Eggs Incubator Based on Internet of Things Using the Object-Oriented Analysis and Design Method (Santoso *et al.*, 2020)	A web application was built to monitor the state of the incubator using sensor data sent during the egg hatching process.
3.	Thermal Optimization on Incubator using Fuzzy Inference System based IoT (Rakhmawati *et al.*, 2019)	Using a controller to adjust the temperature in order to increase production quality and efficiency.
4	Development and Design of Egg Incubator Powered by Solar Energy (Singh *et al.*, 2020)	Implementation of a dual-powered solar incubator used to provide the necessary heat to the incubator space

2.6.6 Summary

This chapter looked into the process of problem formulation and the literature review that followed. Both system development and research based on journals from general, primary, and secondary sources are vital steps and building blocks of a solid project.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The chapter focuses on the methodology of developing smart egg incubator and describes the overall approach and framework chosen for research and system development. The chapter is crucial in planning the project to ensure a successful implementation. This guideline given here will provide essential help to have a well-written methodology chapter of the PSM report. The content for the methodology chapter of the PSM1 report can hold methods, techniques or approach that is used in PSM2. In addition, this chapter also justifies the choice of methods or approaches, such as mechanical, electronic and software requirements.

3.2 Development of Smart Egg Incubator

There were three primary parts to the project's development of smart egg incubator, which is three types of design mechanical, electronic, and software. The use of hardwood for design egg tuner in mechanical design. For system circuit is focus on the electronic design. Aside from that, the focus in software is on programming the system with Arduino IDE connected with software application called Blynk.

3.2.1 Flowchart of Project Development

Figure 3.1 shows the workflow of project development of Smart Egg Incubator that represented by using flowchart method. The project begins with a literature review which is a review of scientific sources by researching journals on a related project of Smart Egg Incubator. This provides an overview of the latest knowledge, that allowing to identify relevant theories, methods, and gaps in existing research on the incubator technique and component to use in developing this project.

Next, the design in the early phase of the project where the structure of the prototype is all planned out. This step was designed by using a software application namely Computer-Aided Design (CAD) for a box of Smart Egg Incubators. Completing the project design is to make sure all the hardware components fit inside the egg incubator box.

The main hardware of this Smart Egg Incubator is NodeMCU ESP32, which is to control and monitoring the temperature and humidity of incubator by using a sensor dht11 that be used to deliver a data sensor of condition in egg incubator. As for the NodeMCU ESP32 board will installed to program a system in Arduino IDE based on the Internet of Things.

Furthermore, the software development for this project was using a programming language. The program consists of a sequence of commands that the microcontroller executes one after another by using open-source software tools such as Arduino Integrated Development Environment (IDE). This because it is easy to write and upload it to the board and develop stand-alone interactive objects or can be connected to software on the computer. After the instruction program code was completed, the program code was compiled and upload to the microcontroller to be tested.

Besides that, if the program code is not according to the required condition, the process will be moved to debugging and troubleshooting and loop back to program code testing until its success. In addition, if its success it will move on to obtaining results and analysis of the incubator system whether there is any problem on data and actual specification in this process to allow make any improvement in the future researchers to take it as reference.

Furthermore, for documentation in this project is any communicable material that is used to instruct regarding some attributes of an object, system, and procedure, cause of that these key documents will be easy to use and ensuring that the creation of the project goes without a hitch. Finally, a project presentation together with researchers on smart egg incubators is presented to the panels and will be evaluated.

3.2.1.1 Main Project Flowchart

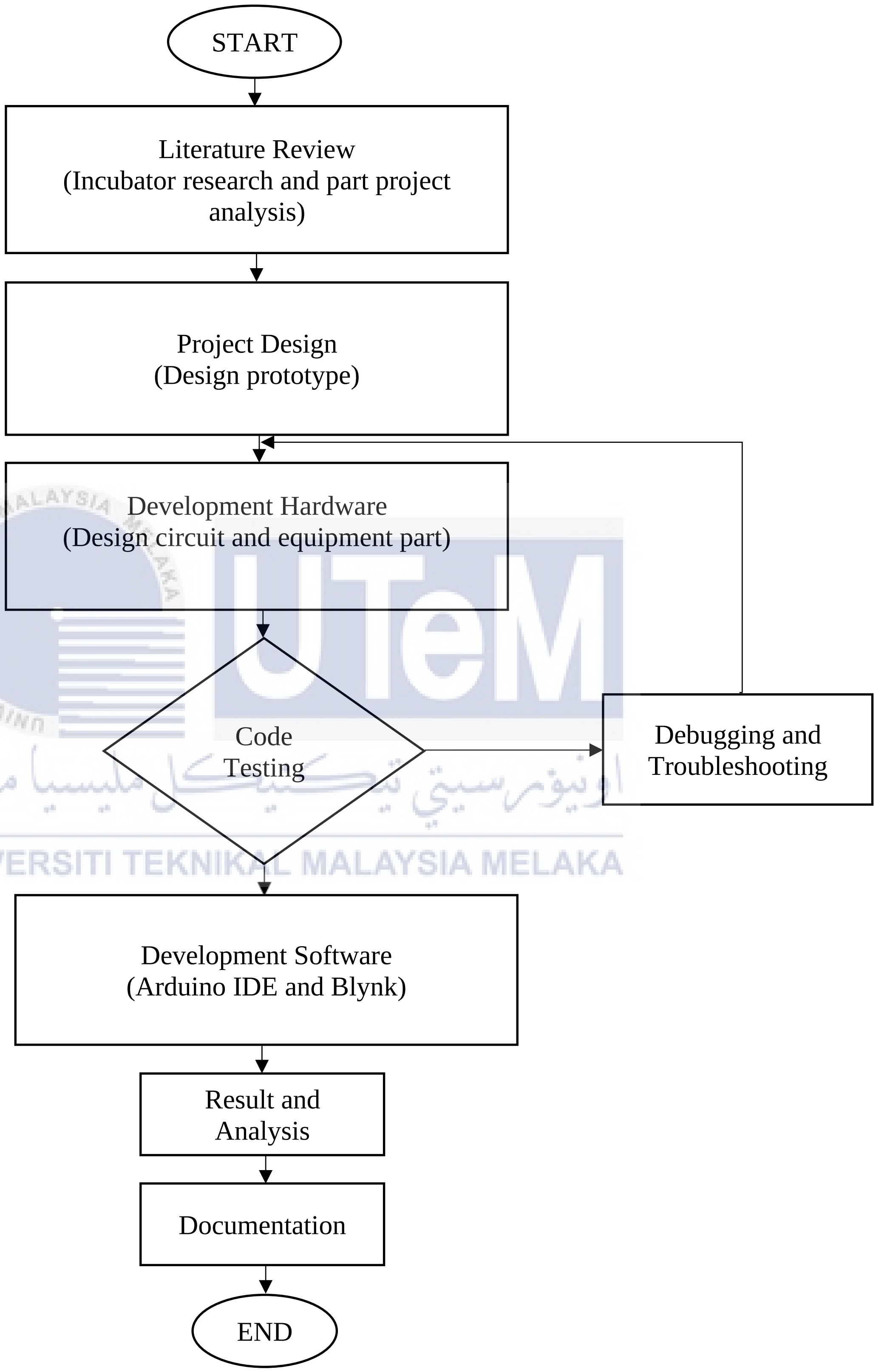

Figure 3.1 : Main Project Flowchart

3.2.1.2 Flowchart Temperature Control System

By referring to Figure 3.2 below, it shows the flowchart of temperature control system for monitoring the incubator according to parameter of temperature that has been set. This functionality is controlled by a microcontroller. The DHT 11 sensor sends temperature data to Arduino. Once the temperature data has been obtained, check the temperature's condition. If the temperature falls below 37°C, the peltier will activate to raise the temperature to the desired level. If the temperature rises above 38°C, the peltier will activate to reduce the temperature.

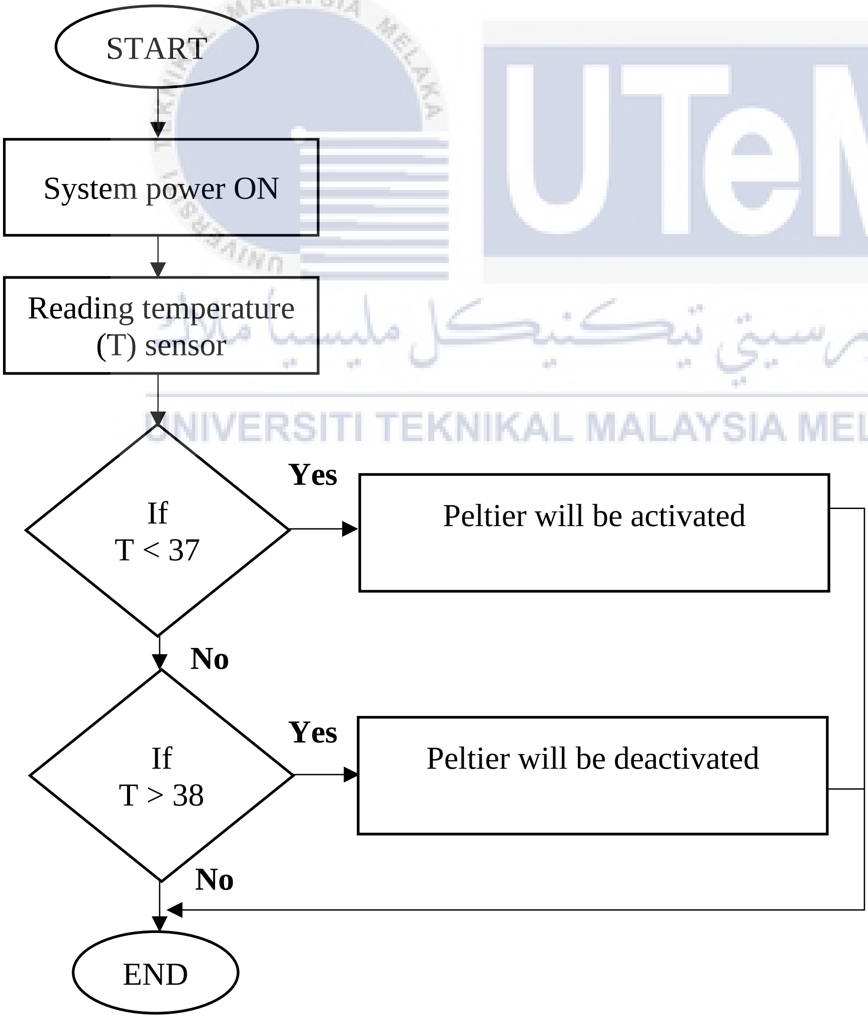

Figure 3.2 : Flowchart Temperature Control System

3.2.1.3 Flowchart Receive Data for Monitoring System

By referring to Figure 3.3 below, it shows the flowchart of farmer to get the notification for monitoring the incubator according to parameter of temperature that has been set. This features work when the sensor detects surrounding air in incubator and then collect data to send data to user.

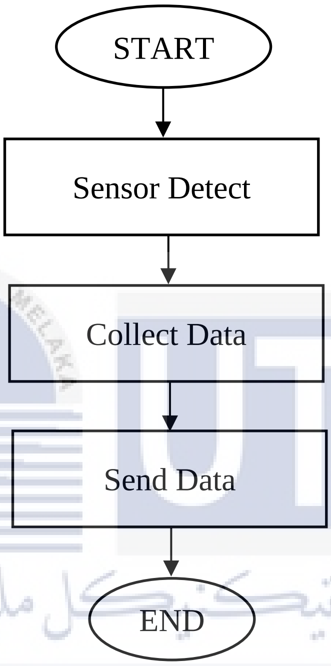

Figure 3.3 : Flowchart Notification for Monitoring System.

3.2.1.4 Flowchart of egg tuner.

By referring to Figure 3.4 for a flowchart of features that can be utilized to automatically turn the egg shelf so that the warmth is distributed evenly on all sides and the egg embryo does not stick to one side of the eggshell. The main work is the turning of the egg every six hours, which begins on day 2 and continues until day 18. After nine hours, the egg shelf will be moved backward with a 45° angle by the step motor, and will remain in this position for six hours before returning to its original position in the centre.

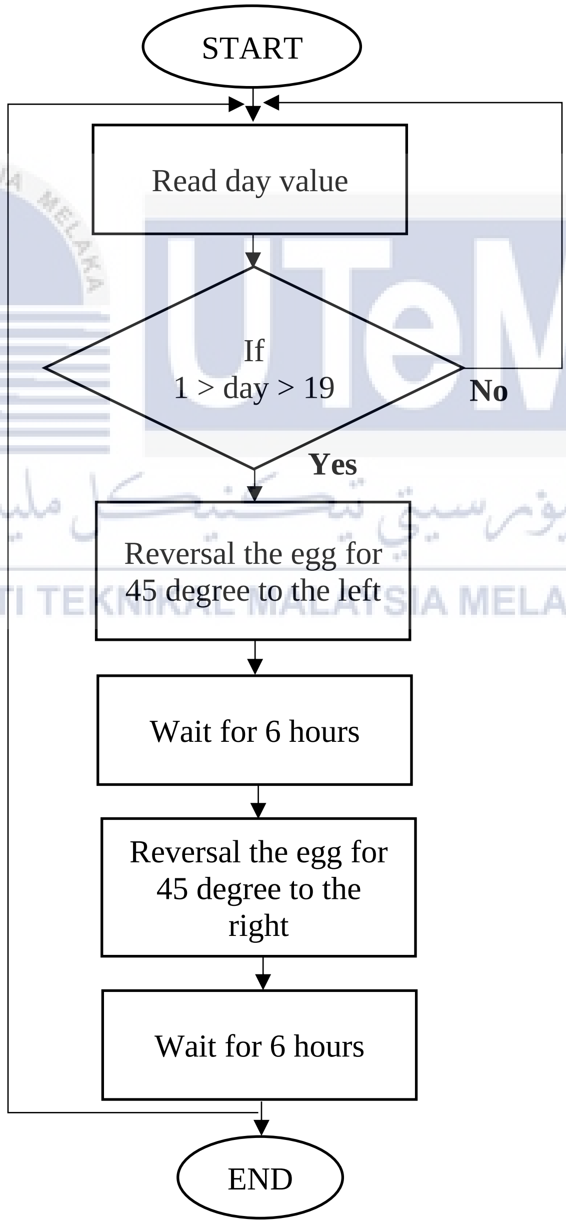

Figure 3.4 : Flowchart of egg tuner

3.2.2 Hardware Development

This sub-topic will be discussing about hardware used in IoT based on Smart Egg Incubator System with DHT 11 to get data of temperature and humidity by sensor ambient air. The hardware that was used in this project includes.

3.2.2.1 Power Supply

By referring to Figure 3.5 below power supply 12v 10a is an electrical device that provides electrical power to a load. A power supply's principal job is to convert electric current from a source to the proper voltage, current, and frequency for powering a load. Power supplies are sometimes referred to as electric power converters.

Figure 3.5: Power Supply

3.2.2.2 ESP32

By referring to Figure 3.6 below ESP32 Wi-Fi is been used in this project cause it support the Wifi direct. Without the use of an access point, Wifi-Direct is an excellent alternative for peer-to-peer connections. Wifi-Direct is easier to set up and has substantially faster data transfer speeds than Bluetooth. This could be used to set up ESP32-based projects using a phone or tablet with WiFi direct capability. At the time of writing, the ESP-IDF SDK had no code examples.

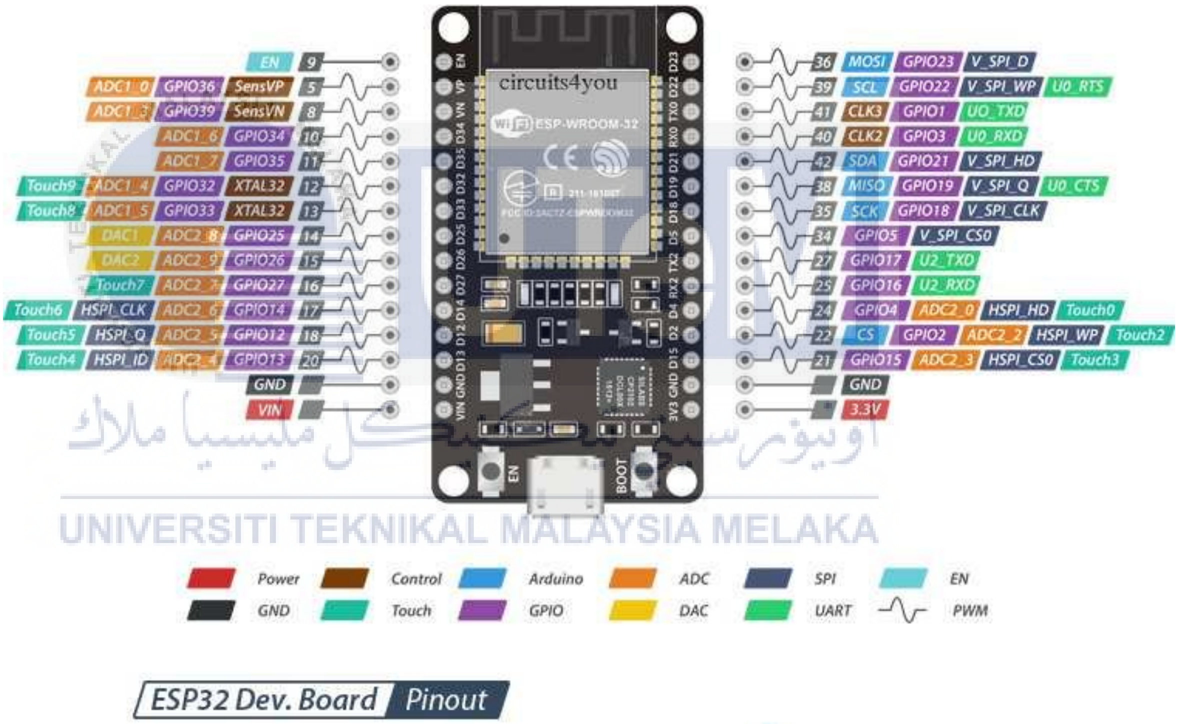

Figure 3.6: ESP32

3.2.2.3 DHT 11

By referring to Figure 3.4 below show a basic, ultra-low-cost digital temperature and humidity sensor which is DHT11. It measures the surrounding air in the egg incubator with a capacitive humidity sensor and a thermistor and sends a digital signal to the microcontroller through the data pin.

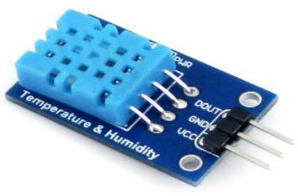

Figure 3.7 : DHT11

3.2.2.4 Relay

Relays are electric switches that utilize electromagnetism to change over little electrical jolts into bigger streams that has been show below Figure 3.7. These transformations happen when electrical inputs enact electromagnets to either frame or break existing circuits. This relay be used in this project to turn on/off any component such us fan, peltier and others.

Figure 3.8 : Relay

3.2.2.5 Servo Motor

Servo motors, or "servos," are electronic devices having rotary or linear actuators that precisely rotate and push elements of a machine that has been show as below Figure 3.9 that has been used to rotate egg tuner. In most cases, servomotors are employed as a high-performance alternative to stepper motors.

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. However, a stepper motor's performance is limited by its lack of feedback, as it can only drive a load that is well within its capacity otherwise, skipped steps under load might cause positioning issues, requiring the system to be restarted or recalibrated.

Figure 3.9 : Servo Motor

3.2.2.6 LM2596

The LM2596 based on Figure 3.10 below is a widely used step-down switching regulator integrated circuit. The adjustable version accepts input voltage ranging from 4.5 to 40 volts and converts it to variable voltage sourcing with a continuous current of up to 3 amps. It is often used in power modules to power/control big loads due to its high current capability.

Figure 3.10: LM2596

3.3 Development of Phone Application with Blynk

There was software application that can create apps for iOS and Android that work with the Arduino ESP32, or any other supported device called Blynk. Furthermore, Blynk allows to create powerful iOS and Android apps that connect smartphone to any compatible device and allow to read data from sensors, control motors, log data, and send notifications. For this project the goal is to migrate application onto the ESP32 and to show how to jump from one device to the other.

3.3.1 Flowchart Blynk Application

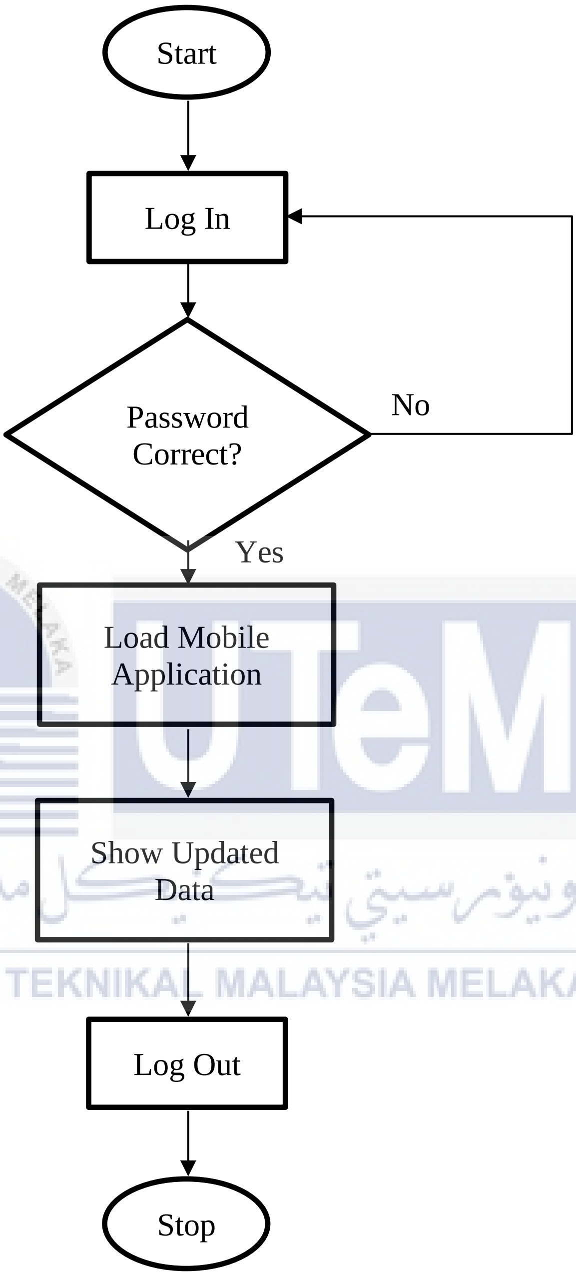

Figure 3.11: Flowchart Blynk Application

CHAPTER 4

RESULTS

4.1 Preliminary Results

This chapter presents the results and analysis on the development of egg incubators with a monitoring system using the internet of things (IoT). In arrange to realize the targets of this project, the anticipated result has been highlighting, in order to arrange the specified, has to fulfil this project. Once the project was completed, the egg incubator box was designed using wood materials and all its components packed in it. Furthermore, this project initiates the Wi-Fi application internet using NodeMCU and Blynk will be connected by referring to Figure 4.1 below.

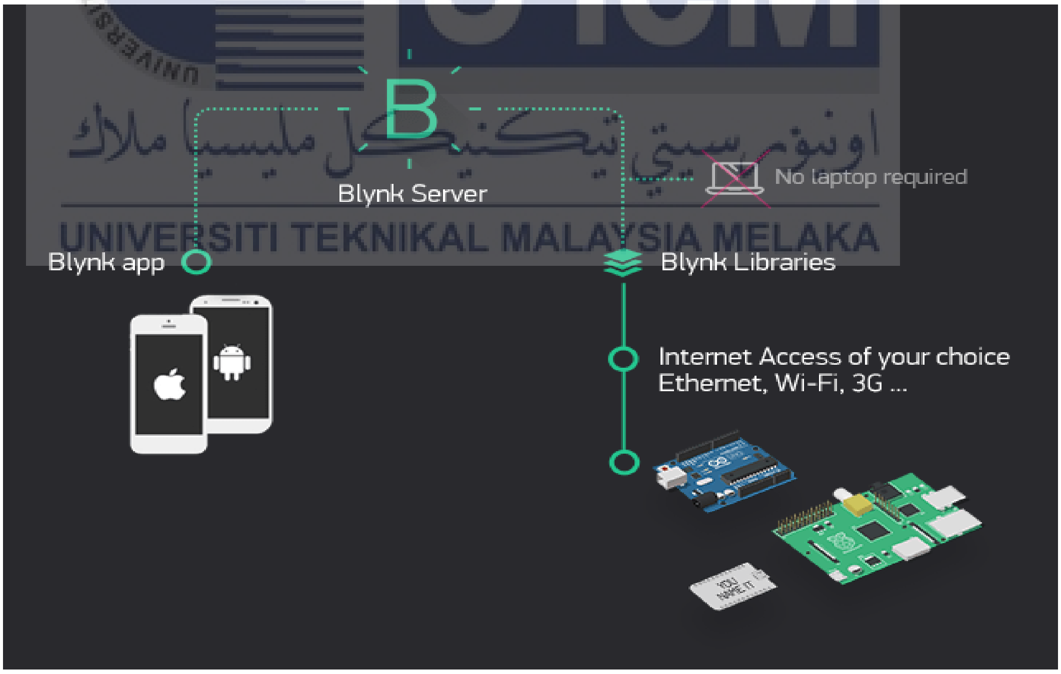

Figure 4.1 : Blynk Application Process

Then, the ‘authentication token’ that will be given via email as reference Figure 4.2 is a function for connecting Blynk and NodeMCU with the condition the device is connected to Wifi internet. The resulting form an as shown in Figure 4.3 shows the reading of temperature and humidity from the sensor dht11 that will be changed and recorded according to the current conditions in the egg incubator.

Figure 4.2 : Authenthic Token

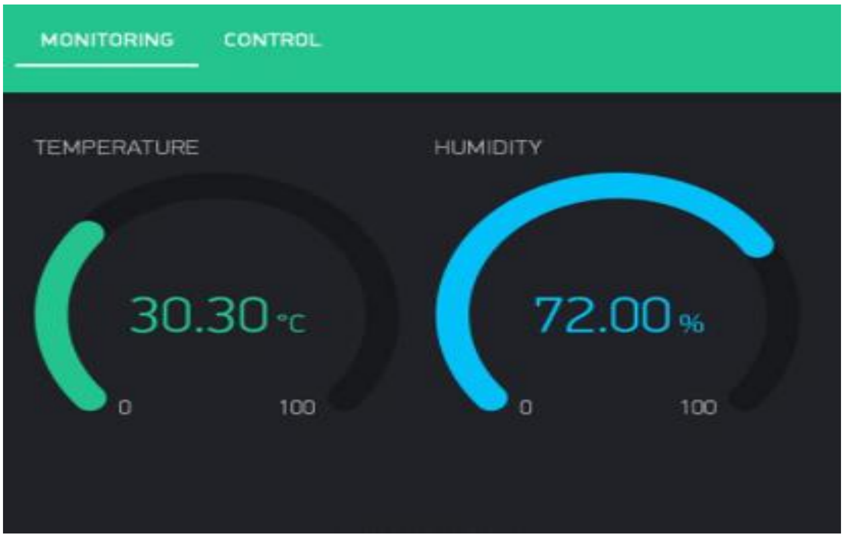

Figure 4.3 : Interface Software Application Blynk

4.2 Results Hardware Smart Egg Incubator

In this topic shows the results when all hardware components are connected. Such a Peltier will be active or deactivated when the temperature is detected by DHT11 is not according to the optimal temperature with using relay. Then, in this project used device called LM2596 which a buck converter step-down converter is a DC-to-DC power converter which steps down voltage while drawing less average current from its input power supply to its output load. Next, servo motor is utilized to automatically turn the egg shelf to a temperature that is evenly distributed on all sides, preventing the egg embryo from sticking to one side of the eggshell. Furthermore, all these changes are controlled by a device controller called NodeMcu ESP32 that connected with software application Blynk.

4.2.1 Hardware

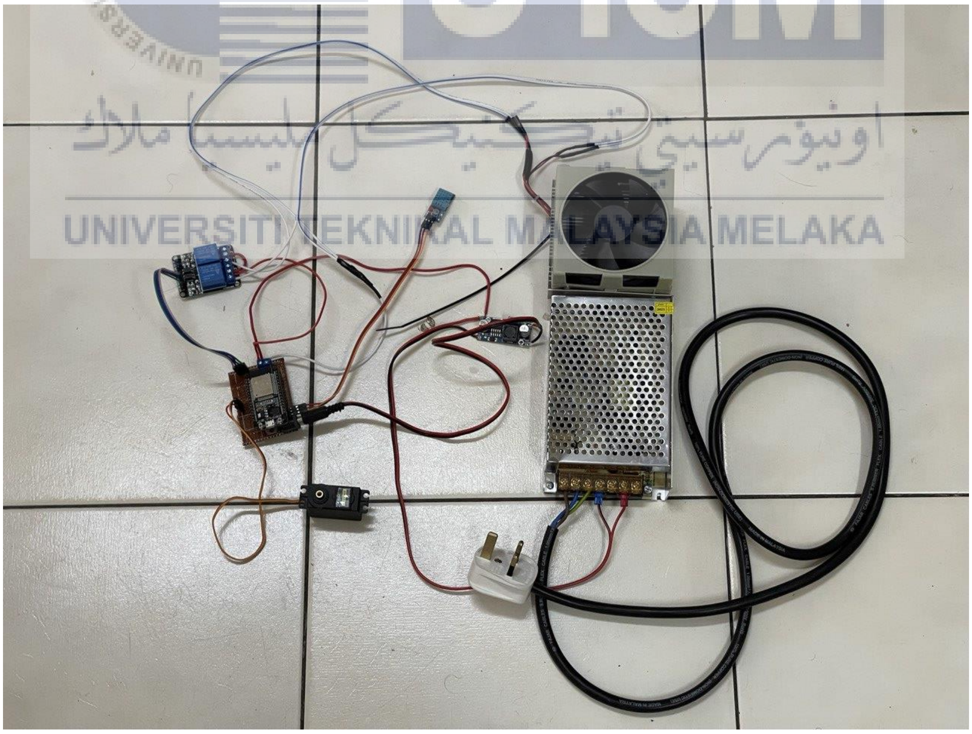

Figure 4.4: Hardware Design

4.2.2 Circuit

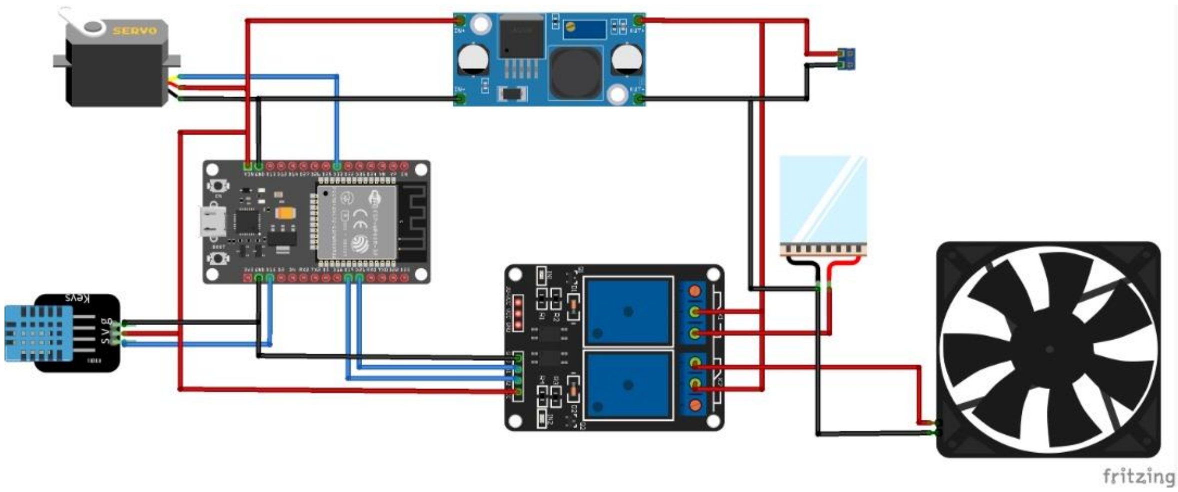

Figure 4.5: Hardware Design

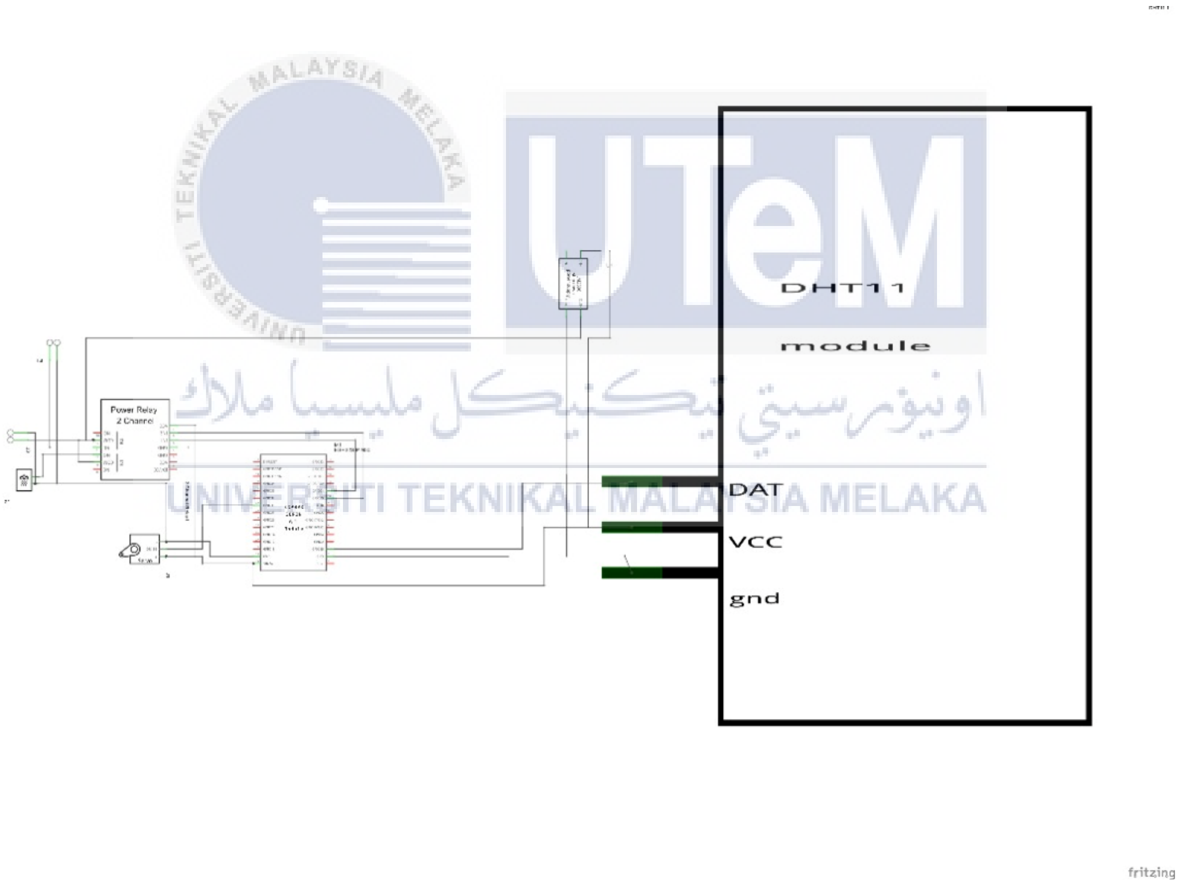

Figure 4.6: Hardware Design

4.3 Results Software Smart Egg Incubator

For results the smart egg incubator software will show the current values of temperature and humidity in the egg incubator casing. In addition, there are two timers for 45-degree angles to the right and to the left which can be set to start and stop to move the egg tuner. Next there is a fan which will move by defaults when the system is on, and it can manually control. Lastly, the main result of this project is to monitor the temperature optimally by using the Internet of Things (IoT) according to a predetermined temperature of 37 °C where it can also be set.

4.3.1 Main Interface

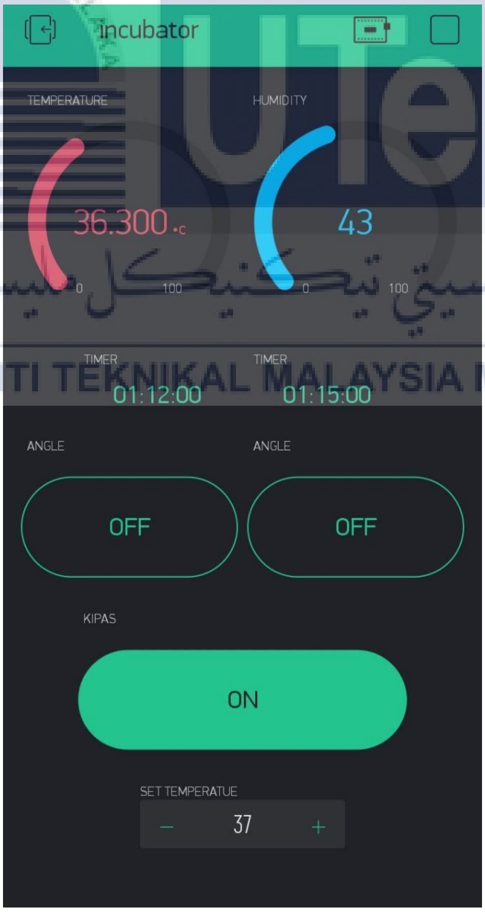

Figure 4.7: Main Interface

4.4 Final Assemble

As shown in Figure 4.8, the final assemble development of a smart egg incubator consists of three key parts design mechanicals, electronic, and software. The use of hardwood in mechanical design for the design of an egg tuner. The electronic design is the focus of the system circuit. Aside from that, the emphasis in software is on programming the system using the Arduino IDE in conjunction with the Blynk software application.

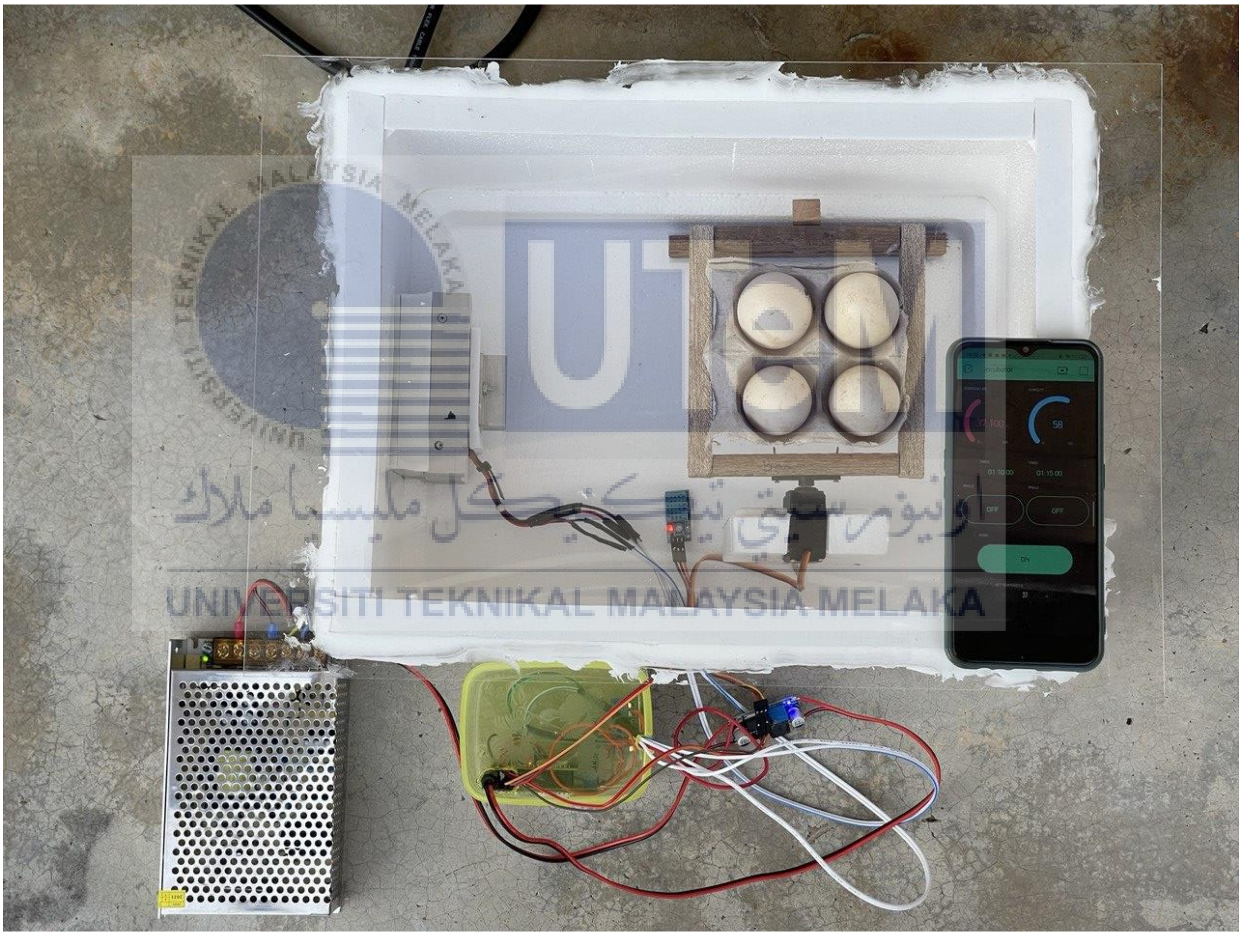

Figure 4.8: Final Prototype of Smart Egg Incubator

4.5 Comparison IoT Method and Conventional Method

The incubator is a device that regulates environmental parameters such as temperature, humidity, and rotating to ensure that viable eggs placed in an enclosure hatch successfully. In most cases, a traditional incubator system includes a thermostat for heating, a manual egg turning process operated by personnel, and a manual monitoring procedure performed by the farmer. These activities appear to be less efficient in the period of Industrial Revolution 4.0, particularly in terms of operation time and labor employed. Refer to Table 4.1 below shows the data of temperature and humidity using for each minute until 140 minutes

In addition, cause of that smart egg incubator system aims to improve the quantity and quality of hatching process by maintaining the natural incubation method without being affected by weather and enclosed environment. In the artificial egg incubation systems, incubation settings are the significant factors which affect the hatchability of poultries.

Lastly, a temperature, humidity, ventilation and turning throughout the time period considerably have an effect on the hatchability of fertile eggs and chicks 'quality. within the incubation system, the most issue affected the hatching quality is that the stability of temperature and humidness. It ought to be monitored often on make sure the temperature and humidness square measure stable at predefined level and to confirm the good fortune formation of embryonic fluids of egg. Within the Fourth technological revolution (IR4.0), the answer for the management and observance system of the brooder may be resolved by applies one in every of the IR4.0 pillar, that's 'Internet Of Things'.

4.5.1 Data Collection using IoT Method

The temperature inside the incubator should be maintained between 37-38 ° C, this reading was enabled by measuring the temperature by placing dht11 at the centre point of the incubator box. Adequate heat control is maintained to avoid overheating and underheating that can affect embryo permeability. Humidity levels are also maintained around 37-42%. This air regulation is necessary during embryonic development for efficient production. This has been achieved by using fans and peltier to distribute the air effectively. Refer to Table 4.1 and Figure 4.8 below shows the data result of temperature and humidity using IoT method for each 10th minute until 140th minutes, temperature data were taken starting at the 10th minute where it showed a value of 29.1℃ and increased by 2℃ until the 40th minute, then at the 50th minute the temperature and humidity reading had reached the optimum temperature of 37℃ and humity 39%, there was an plus minus 1℃ between the optimal temperature until the last time the data was taken which is at the 140th minute. The highest and lowest temperatures taken over 140th minutes using IoT method were 29.1℃ and 38.1℃.

Table 4.1: The Data Collection for Every Minute using IoT Method

Time (Minute)	Temperature (℃)	Humidity (%)
10	29.1	72
20	32.1	57
30	34.1	47
40	36.5	42
50	37.1	39
60	38.2	37
70	37.3	39
80	36.1	42
90	37	41
100	37.6	39
110	38.1	37
120	37.6	39
130	37.1	41
140	36.3	42

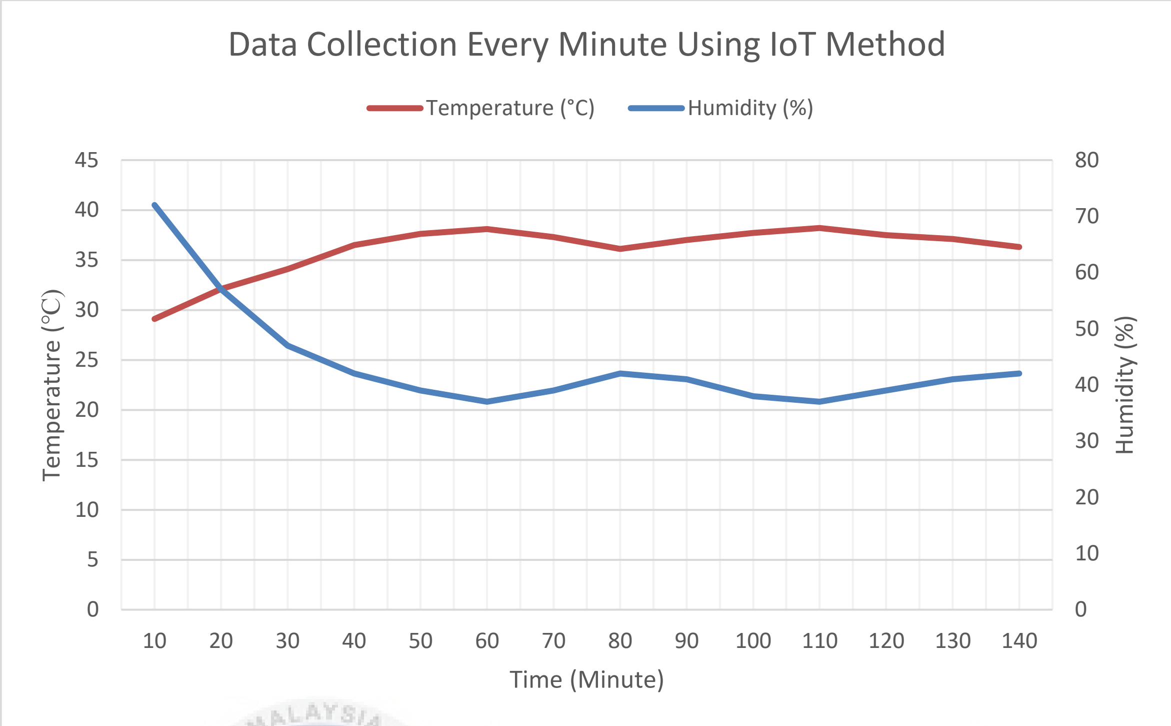

Figure 4.9: Graph Data Collection for Every Minute using IoT Method

4.5.2 Data Collection using Conventional Method

Refer to Table 4.2 and Figure 4.9 below shows the data result of temperature and humidity using Conventional method for each 10th minute until 140th minutes, temperature data were taken starting at the 10th minute where it showed a value of 27°C and it increased until the 90th minute, then temperature and humidity reading had reached the optimum temperature of 37°C and humity 39%, there was an plus minus 1°C between the optimal temperature until the last time the data was taken which is at the 140th minute. The highest and lowest temperatures taken over 140 minutes using conventional method were 27°C and 38.2°C.

Table 4.2: The Data Collection for Every Minute using Conventional Method

Time (Minute)	Temperature (℃)	Humidity (%)
10	27	79
20	28.3	72
30	31.6	62
40	32.1	57
50	33	50
60	34.1	47
70	35.2	42
80	36.5	42
90	37	41
100	37.6	39
110	38.2	37
120	37.6	39
130	37.1	41
140	36.3	42

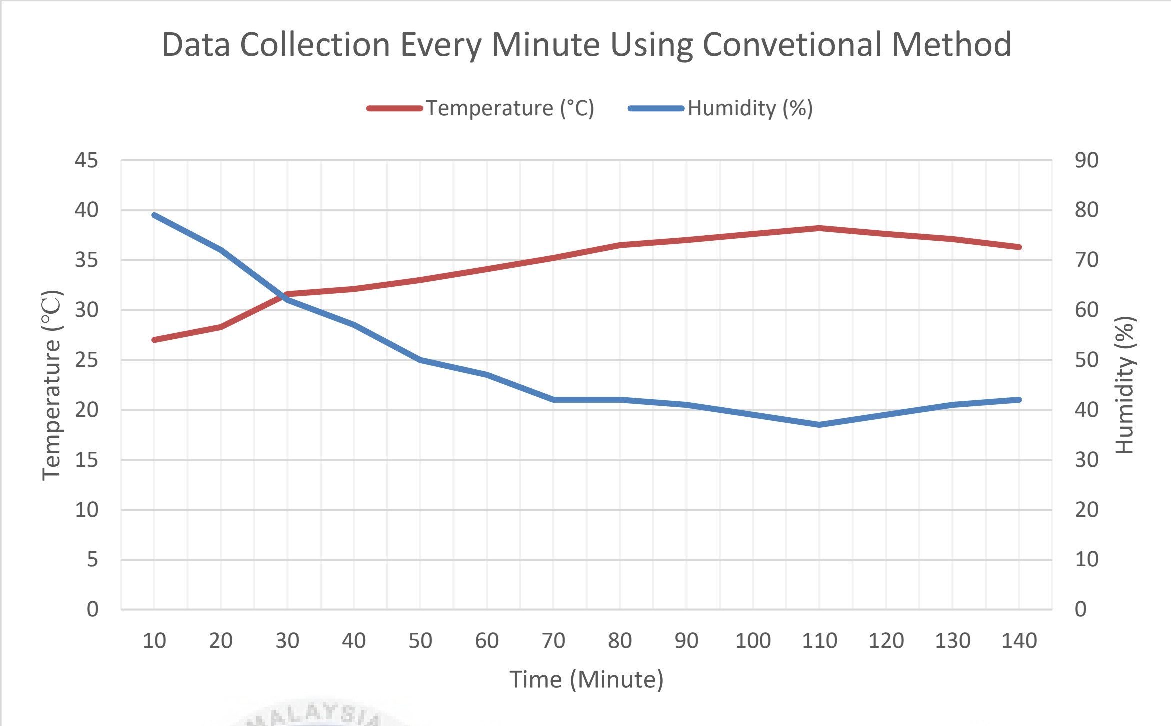

Figure 4.10: Graph Data Collection for Every Minute using Conventional Method

CHAPTER 5

CONCLUSION

5.1 Conclusion

This part will highlight the project's conclusion, the project's limitations, and the recommendations that may be made to improve the project in the future. This project presents the construction of a smart egg incubator that can be monitored and controlled according to parameters established using internet of things technology, which has been successfully designed and implemented in this work. The smart egg incubator is built with a component called dht11 to ensure that sensors detect ideal circumstances for the proper growth of the process embryo inside the incubator.

Furthermore, Egg incubators can be operated and monitored with IoT technology by using an interface software application called Blynk from any device connected to the internet, such as a personal computer or a smartphone. As the system for the project has been completed, the objectives of the project have been achieved which is to develop smart egg incubator with monitoring system which is be able to maintain the value of temperature and humidity to desired value thus will give the optimum condition for egg hatching and next objecticve to create a phone application that can monitor and set the temperature using IoT.

Suddenly, there are the limitation of the Smart Egg Incubator consist of cannot put too many eggs inside incubator at the same time and perilous if the incubator put under the hot day or rainy day. Next, further suggestions to improve the work could be done by replacing the fan which has a larger blade size and higher power so that the temperature rises to reach the optimum more faster. Lastly, the project that have been made must be test to ensure the requirement that been gathered earlier had been reached to give full satisfaction to the user who use Smart Egg Incubator.

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