Faculty of Electronics and Computer Technology and Engineering

DEVELOPMENT OF AN INCUBATOR SYSTEM TO HATCH EGG USING ARDUINO

NORANIZA BINTI OTHMAN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2024

DEVELOPMENT OF AN INCUBATOR SYSTEM TO HATCH EGG USING ARDUINO

NORANIZA BINTI OTHMAN

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

Faculty of Electronics and Computer Technology and Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI DAN KEJUTERAAN ELEKTRONIK DAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Development of an incubator system to hatch egg using arduino

Sesi Pengajian : 2023/2024

Saya NORANIZA BINTI OTHMAN mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	**TIDAK TERHAD**	

Disahkan oleh:

aniza

(TANDATANGAN PENULIS)

Ts. Dr. Abdul Halim bin Dahalan
Ketua Jabatan Teknologi Kejuruteraan
Fakulti Teknologi dan Kejuruteraan Elektronik dan Komputer (FTKEK)
Universiti Teknikal Malaysia Melaka (UTeM)
Jalan Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

(COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: No 9, JalAN Perkasa 1, Taman Seri Waja 85000 Segamat Johor

Tarikh: 6 Februari 2024

Tarikh: 6 Februari 2024

*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I declare that this project report entitled "Development of an incubator system to hatch egg using arduino" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : aniza

Student Name : NORANIZA BINTI OTHMAN

Date : 6 Februari 2024

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 (Telecommunications) with Honours.

Signature : ....

Supervisor Name : TS. DR. ABDUL HALIM BIN DAHALAN

Date : 6 Februari 2024

DEDICATION

This project is dedicated to my parents Othman Bin Selamat and Zalihah Binti Mansoor. Also, my family, whose love and understanding have been an anchor throughout my academic journey, for their unwavering support and encouragement. Your belief in my ability has strengthened my desire to achieve this goal.

In addition, I would like to thank my supervisor Ts. Dr. Abdul Halim Bin Dahalan for all his knowledge and wisdom, as well as for his patient and knowledgeable guidance. Your invaluable advice has influenced my intellectual development and pushed me to strive for greatness. I would like to thank the people around me who have been with me throughout this academic journey, giving me humour during times of stress. With your help, problems have become successes and milestones have become cherished memories.

Finally, I would like to dedicate this project to my own perseverance and the many hours of hard work I put into it. I hope this is very useful as evidence of knowledge gained, abilities developed and personal development achieved. I take the knowledge gained; the experience created from the diploma days. This achievement is not representing me alone, it is the result of my friend from the diploma that is Adam bin Hafit and the cooperation of all my undergraduate friends who helped to build me into the person I am today.

ABSTRACT

The poultry industry plays an important role in meeting the growing demand for chicken eggs. Inefficient egg hatching is a major aspect of poultry farming, and the development of an affordable and reliable egg incubator system is essential for small-scale poultry farmers. The goal of this project is to build a smart egg incubator with a temperature and humidity monitoring system using IoT. The incubator system uses ESP8266 microcontroller technology to automate and monitor the incubation process. The main features of the developed incubator system include energy efficiency, scalability and adaptability to varying egg sizes. The open source nature of Arduino facilitates accessibility, allowing users to customize and modify the system to meet their specific needs. To verify the performance of the incubator system, a series of experiments have been conducted using chicken eggs. Results show consistent and reliable hatching rates, comparable to commercial incubators. The affordability and simplicity of the Arduino-based egg incubator system make it a viable solution for promoting sustainable and accessible poultry farming practices, especially in resource-limited settings.

ABSTRAK

Industri ternakan ayam memainkan peranan penting dalam memenuhi permintaan yang semakin meningkat untuk telur ayam. Penetasan telur yang tidak cekap adalah aspek utama dalam penternakan ayam, dan pembangunan sistem inkubator telur yang berpatutan dan boleh dipercayai adalah penting untuk penternak ayam berskala kecil. Matlamat projek ini adalah untuk membina inkubator telur pintar dengan sistem pemantauan suhu dan kelembapan menggunakan IoT. Sistem inkubator menggunakan teknologi mikropengawal ESP8266 untuk mengautomasikan dan memantau proses pengeraman. Ciri-ciri utama sistem inkubator yang dibangunkan termasuk kecekapan tenaga, kebolehskalaan dan kebolehsuaian kepada saiz telur yang berbeza-beza. Sifat sumber terbuka Arduino memudahkan kebolehaksesan, membolehkan pengguna menyesuaikan dan mengubah suai sistem untuk memenuhi keperluan khusus mereka. Untuk mengesahkan prestasi sistem inkubator, satu siri eksperimen telah dijalankan menggunakan telur ayam. Keputusan menunjukkan kadar penetasan yang konsisten dan boleh dipercayai, setanding dengan inkubator komersial. Keterjangkauan dan kesederhanaan sistem inkubator telur berasaskan Arduino menjadikannya penyelesaian yang berdaya maju untuk mempromosikan amalan penternakan ayam yang mampan dan mudah diakses, terutamanya dalam tetapan terhad sumber.

ACKNOWLEDGEMENTS

All praise to God Almighty, on whom we ultimately depend for sustenance and guidance. Second, thanks to my supervisor TS. Dr. ABDUL HALIM BIN DAHALAN who has given me a golden opportunity and also for his valuable advice throughout this project. Without his continued support, I would not have been able to produce this report.

I would also like to say a thousand thanks to all my lecturers, friends, girlfriends who directly and indirectly contributed time, knowledge, ideas for me to complete this report. Not forgetting University Technical Malaysia Melaka (UteM) for providing me with all the resources and funds needed for the project. Overall, I would like to thank everyone who participated in this project and offered comments to help me improve it

Finally, I would like to show my gratitude to my parents, relatives and friends for always there for me and support me in all our endeavours.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

δ	-	Voltage angle
°C	-	Degree celcius
%	-	Percentage

LIST OF ABBREVIATIONS

V	-	Voltage
mV	-	millivoltage

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

In the development of technology, it has developed rapidly as well as hatching technology capable of creating artificial hatching devices known as hatching eggs or incubators, which can fully imitate the behavior of the mother hen during the incubation period. The hatchery consists of a natural hatcher to obtain a high-quality number of eggs in the same time. In addition, existing machines involve high costs for small farmers to own [1].

To solve the problem, the idea is to produce a machine that works like an incubating mother hen to hatch her eggs by making an automatic system and using cheap and easy-to-find components for potential breeders to use this technology. Hoping that with this incubator, chicken farmers can reduce the problem [2].

1.2 Problem statements

An incubator is one of the tools for hatching eggs. it is the same process when the mother hen incubates to hatch the egg. it takes 21 days to hatch the egg. inside the incubator has the same temperature as the incubating mother hen. At the same time there are solutions depending on the incubator used for poultry farmers.

a) the production of hatching egg quantity.

b) To save chicken farmer’s time.

c) The breeder lacks supervision while the mother hen is incubating.

1.3 Objective

Based on the problem statement below, the following goals have been established for this investigation:

a) To develop smart egg incubator with monitoring system.

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

1.4 Scope of project

This project will focus on controlling and monitoring IoT systems with Arduino boards. Next, we will integrate incubator behavior using IoT to monitor various parameters, such as humidity and temperature. This project fully utilizes the Arduino system and Blynk Software as follows.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

By reading and comparing these papers, we are better able to understand the idea of prediction. The purpose of this section is to examine the results of several tests and projects done by experts in the field of analysis and research. It will additionally show the hardware employed in the process. Because of their ability to create various applications, IoT technologies are becoming more and more widely used, but only a small part of them is available in the industry at the moment. The incubator also includes a smartphone application for communicating critical information to the chicken farmer. In addition, this approach is implemented to improve analysis and avoid unnecessary replication of the problem area of the study.

2.2 Previous Related Research

2.2.1 IoT-enabled design and execution of a chicken egg incubator for hatching

To increase product reliability by assisting breeders and the country in implementing progress that evaluates procurement properties and provides recommendations. The Internet of Things (IoT) expands poultry farmers by creating a smart incubation system to make the system’s usability for terms monitoring and administration by using smartphones rather than apps[3].

Blynk integrates with a web-based hatchery monitoring system to provide remote temperature and humidity control of a smart incubator for chicken keepers. Many farmers can connect to their home range from anywhere and anytime with this kind of technology. This smart incubator can be controlled and monitored using a remote sensing framework.

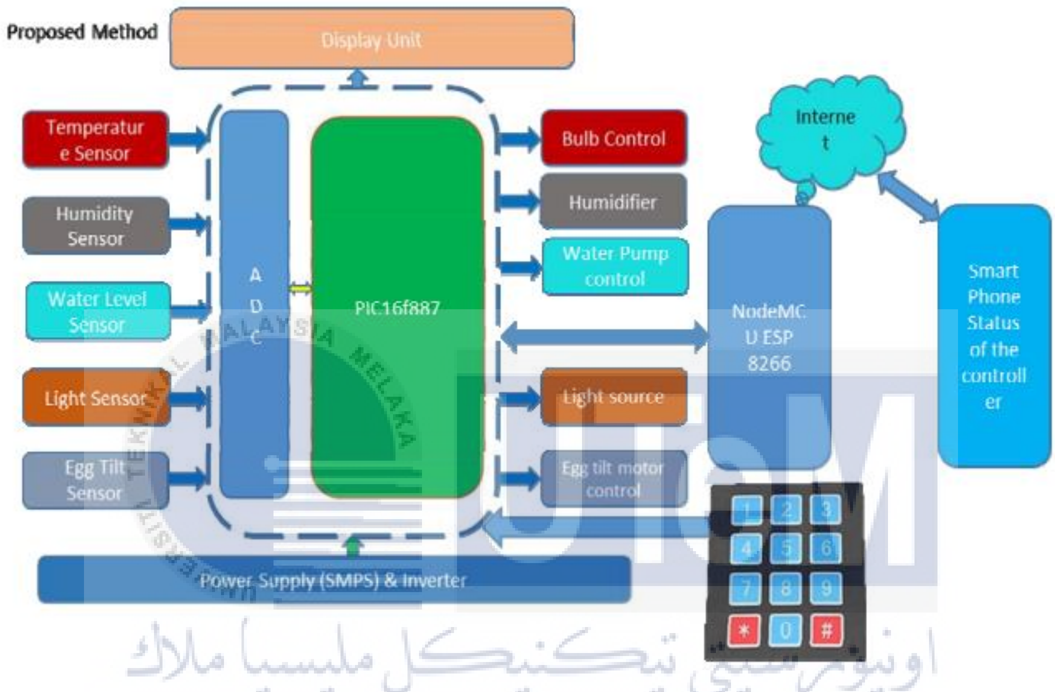


Figure 2.1 The diagram proposed method's block diagram of building blocks.

Figure at above for PIC16f887 and ESP 8266 are popular devices in the project. Since every component of a development package is an interface. Users can use this to operate the complete unit remotely. This CPU has a total of 64 pins. Each bolt is restricted to a specific area of the tool for a specific period of time. All of the incubator's settings are managed by the microcontroller, while the user utilises the ESP8266 (NodeMCU) to do remote control and monitoring via the Blynk app.

Humidity, temperature sensors, and egg sensors are used to monitor and control the project's components. DS18B20 is used to keep the temperature in a stable state in the device. Two sensors, one at the top and one at the bottom of the unit, they are used to adjust the heat uniformly. Due to the important challenges related to unit control, wireless sensors and heat exchange systems in general, fast safety and security solution to preserve data sensors are required. IoT structures can then significantly improve this situation. The Internet of Things (IoT) is a network of raw equipment, transport, architecture, and many integrated parts in programming, equipment, actuators and sensors, as well as the collection and exchange of data in these parts.

2.2.2 Egg incubator development using raspberry pi for precision farming

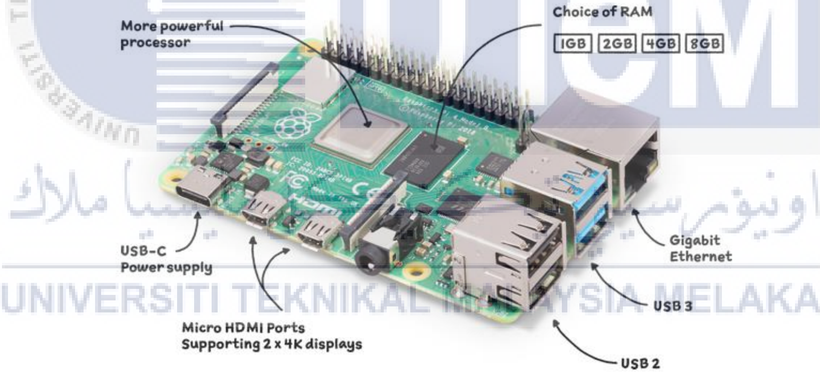


Figure 2.2 Model B Rasberry Pi

Raspberry Pi, an Arduino-based Internet of Things with a credit card-sized minicomputer device with a variety of sensor modules has been used in research. The goal of this research is to create a prototype apparatus for hatching eggs without the need for brooding [4]. Next, develop a monitoring system for the incubator. Finally, to improve the incubation process significantly.

Temperature, pH and conductivity sensors will be included, as well as a database, Arduino Software and a Web server developed on a Raspberry Pi Pocket PC. Egg conditions are predicted to improve as a result of the development of incubator support systems that may be used in poultry farmers. The development of an incubator system connected to the Internet will be the next phase of this research.

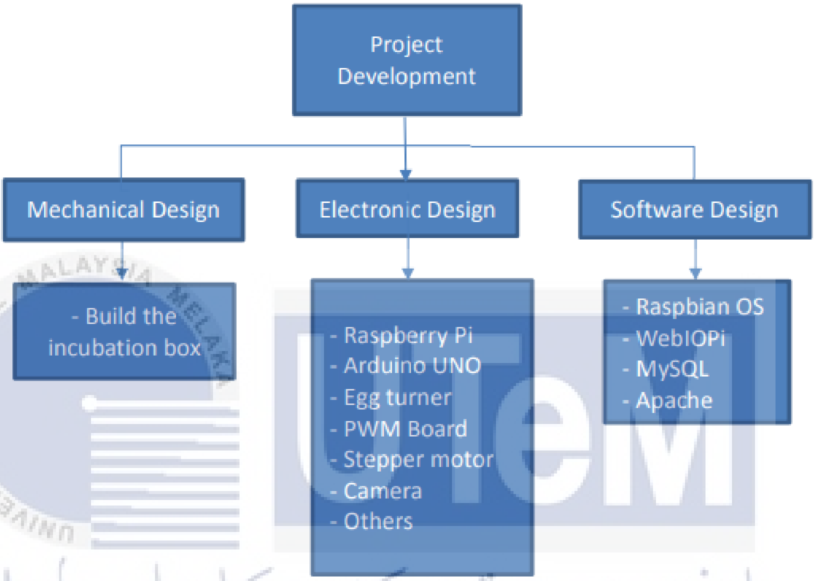


Figure 2.3 Development phases of PiBator

Research techniques refer to research steps that need to be developed so that the research can be focused, consistent, reliable and successful. Start by assembling the casing, hardware, and connection between the sensor circuit and the Raspberry Pi in software. It is critical for the project's success that the Raspberry Pi communicate with the sensor circuit through GPIO. To complete this task, Python was employed.

2.2.3 The development of automatic forced air egg incubator

This project about to design and construct an automatic forced air egg incubator outfitted with an automated temperature and humidity control system, as well as an automatic egg turner system, in order to properly incubate eggs. The aim of the project is the to large-scale production of poultry through the egg incubation process[5].

This is due to various issues of incubation process raises safety and care concerns during the incubation stage. It is consisting of eggs that have been exposed to disease and predators due to lack of supervision. In addition, there is difficulty in producing large quantities of poultry products at a rapid rate due to the natural incubation capacity, which can only accommodate a limited production quantity at a time. Natural incubation can only provide a limited number of eggs due to the limited area available under the hen, which can cause some eggs to be left behind and deteriorate. As a result, natural incubation is not suitable for the poultry industry.

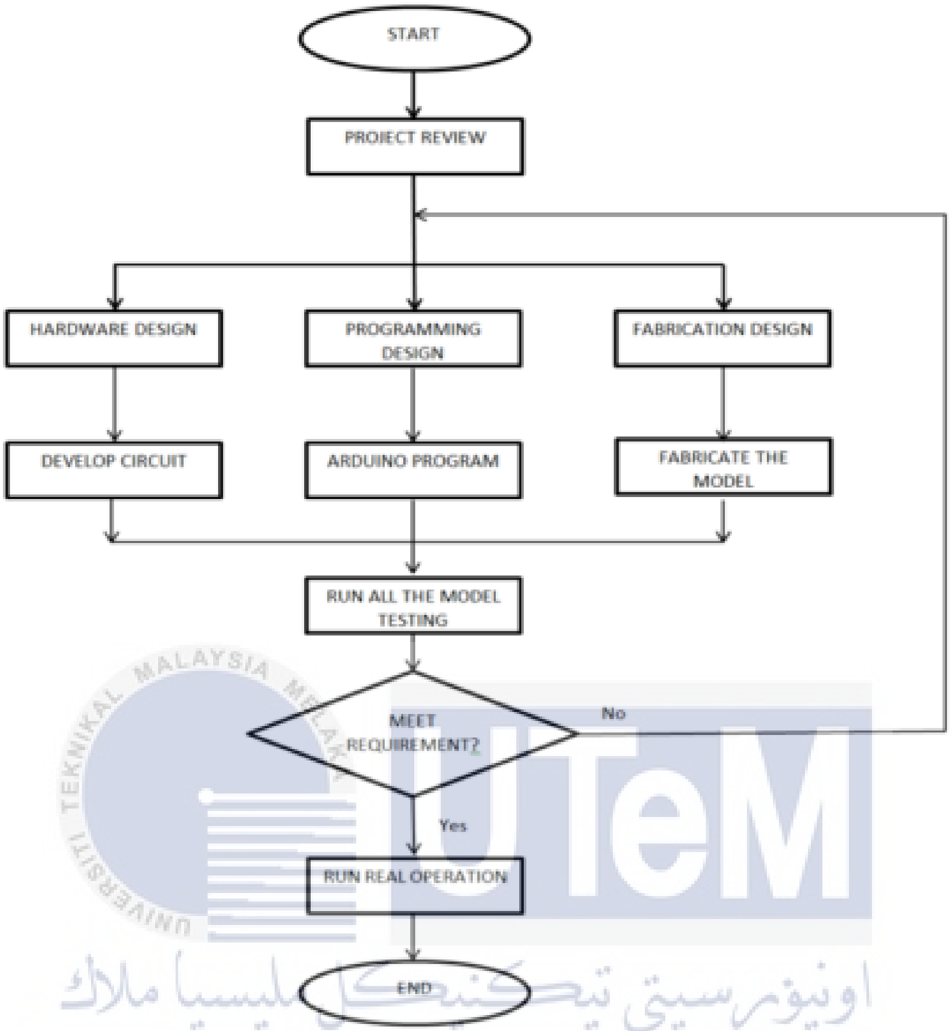


Figure 2.4 Project development flowchart

It depicts the entire project development flow chart, which is hardware design, programming design, and fabrication design are all examples of design work. Using Proteus software, all electrical and electronic components were identified for schematic diagram design during the hardware design stage. Meanwhile, design programming also runs simulations to see if the circuit works and runs as expected. Since the circuit works properly, it is built on a breadboard for testing and verification. The working circuit is then built into the built Printed Circuit Board. All circuits have been combined with hardware components at this point. If there is a problem, troubleshooting will be done. A prototype egg incubator was designed and produced after all three phases were fully functional.

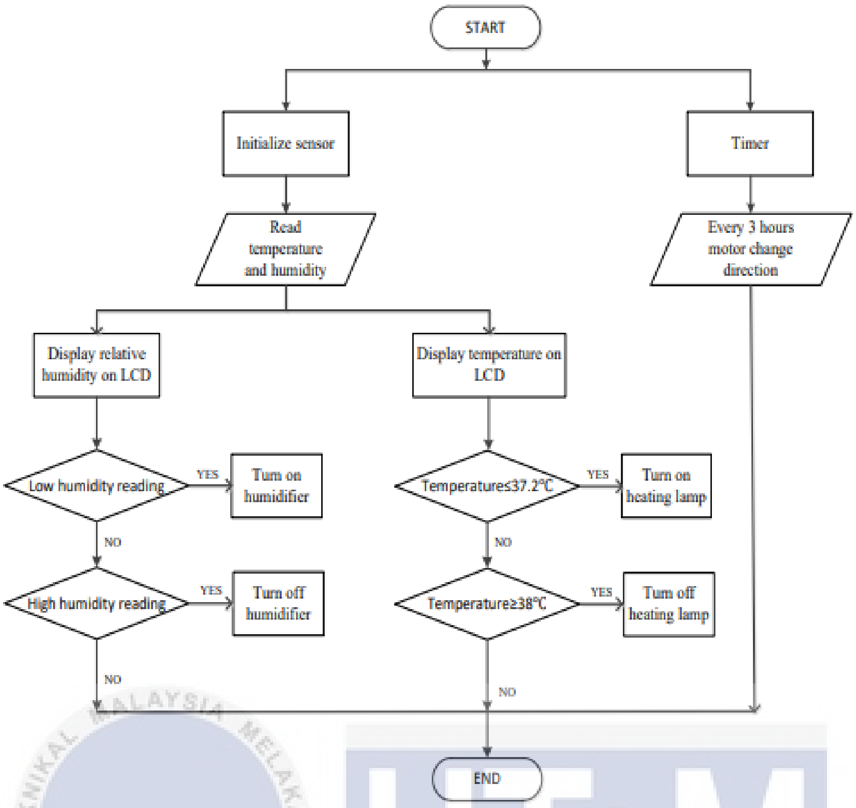


Figure 2.5 The flowchart of forced air egg incubator operation

The research technique refers to the steps of research that must be developed in order for the study to be focused, consistent, dependable, and successful. Problems are discovered and how they can be solved via the internet, as shown in Figure 2.5. The humidity and temperature sensors are set up before the programmed starts so that the current values can be displayed on the LCD. If the temperature falls below 37.2°C, the heating lamp will be engaged to heat the egg to a maximum of 38°C. If the temperature rises above 38°C, the light will be turned off. The humidifier will activate when the observed humidity drops below 65% and will turn off when the humidity rises above 75%. The blower fan will then be activated to distribute the steam evenly throughout the incubator. At the same time, the motor will be turned on to rotate the eggs every 3 hours, as programmed. This procedure will continue indefinitely until the egg hatches. The total hatching duration is dependent by the type of chicken, with chicken eggs typically hatching in 21 days.

2.2.4 Design and implementation of an IoT-based fuzzy control system for an egg incubator

The goal of this implementation is to implement and create an IoT-based fuzzy control system for egg incubation. Furthermore, the incubation method is used to track the number of days until the bird hatches automatically. The purpose of this study is to examine the performance of the installed egg incubation system through experimental means. For the result, the analysis demonstrates the egg incubation system to work effectively to add the rise chicken output [6].

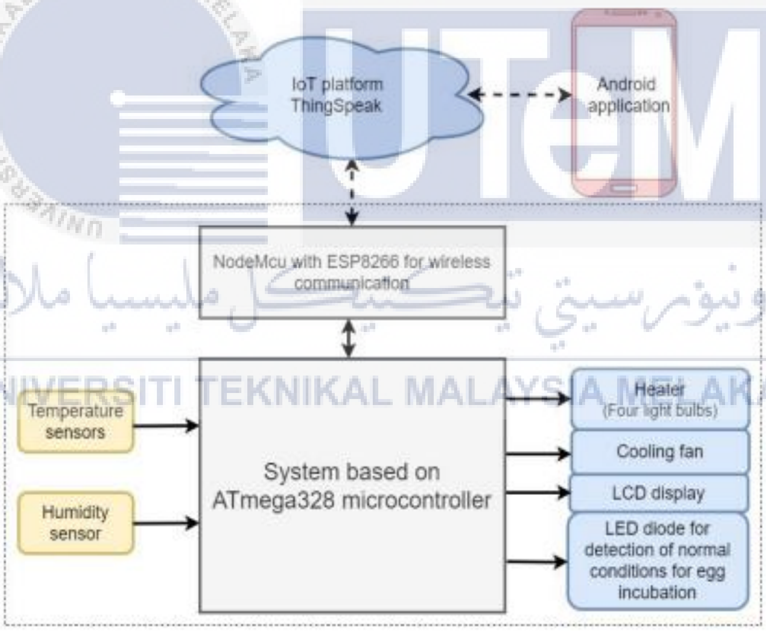


Figure 2.6 Block diagram of fuzzy control system by an IoT for egg incubator

Components include a sensor for data gathering, an ATMega 328 Microcontroller-based control system, an actuator for regulating the incubator's temperature, and a nodemcu esp8266 module for exchanging data with the cloud and android apps. The temperature is detected by two 10k thermistors, while for humidity is to measured DHT22. For the sensor's accuracy it is guaranteed the manufacturer within the parameter that mentioned. There are two methods for maintaining adequate humidity. One is to increase the humidity in the egg incubator by placing a container of water inside; at the higher temperature (37.7 °C), water will evaporate, creating more moisture in the air. Another option that will increase the humidity is to put in a second water heater. The first approach is used in this paper.

If the humidity in the egg incubator gets too high, the system will kick on the air conditioner. The egg incubator is periodically moved by turning on a cooling fan. Once every half an hour, a new ventilation duration is selected. When relative humidity is too high, the air conditioner turns on to bring it back down to acceptable levels. Once every half an hour, the ventilation system kicks on for three minutes before turning off again automatically to replenish the air.

Figure 2.6 shows that the cloud infrastructure relies on the Thing Speak Internet of Things platform. A companion Android app is also under development for improved data access. The sensors collect data on the current temperature and humidity, and the cloud user then sends the data in the form of a desired set point. It is suggested that the temperature be managed using a fuzzy controller. The next phase of the research will explain how to construct a fuzzy logic controller using empirical data to regulate the incubator's temperature.

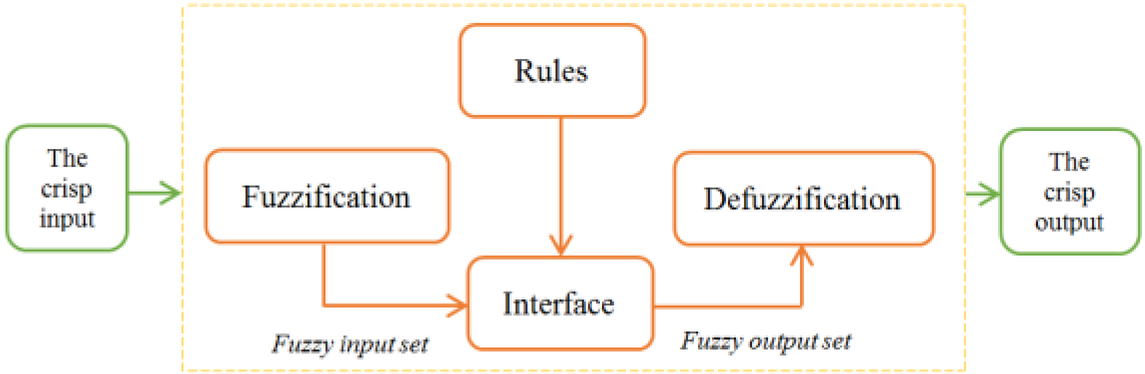


Figure 2.7 The functional block diagram of the improved fuzzy controller

Figure 2.7 the functional block diagram of the improved fuzzy controller. In this study, a fuzzy clutch is used to regulate the temperature of an egg incubator.

2.2.5 Design of an egg incubator based on an Arduino Microcontroller

The purpose of this research is to aid in the creation of affordable, environmentally friendly incubators for the hatching of Japanese quail eggs. This procedure was developed as part of a group effort to design a residential energy incubator that would be both inexpensive and effective at hatching day-old chicks from Japanese quail eggs[7]. Therefore, the incubator system is a controlled temperature and humidity environment for conducting experiments on the hatching of quail. There are various sorts of incubators. For this experiment, researchers used a forced-air incubator, which maintains more consistent temperatures and humidity levels inside the chamber. In addition, it allows for the right temperature and humidity to be kept constant, even when external conditions change.

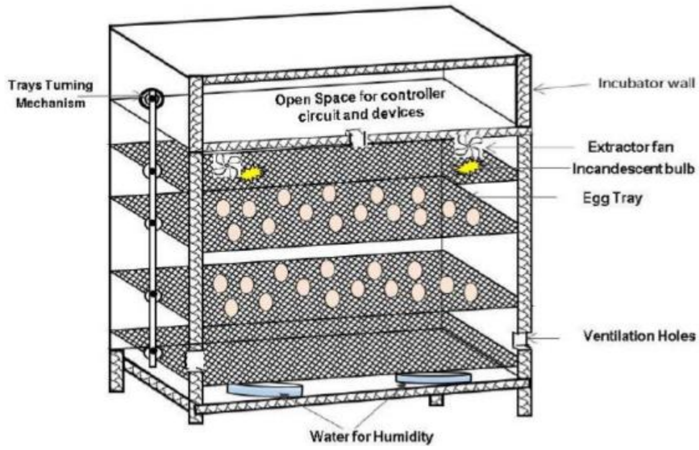


Figure 2.8 The incubator structure displaying some device or equipment

Figure 2.8 shows the incubator structure displaying some devices or equipment. It is made from wire and has 4 bulbs inside the incubator. In addition, a fan is also installed the incubator and there are several holes for ventilation on top and sides of the incubator

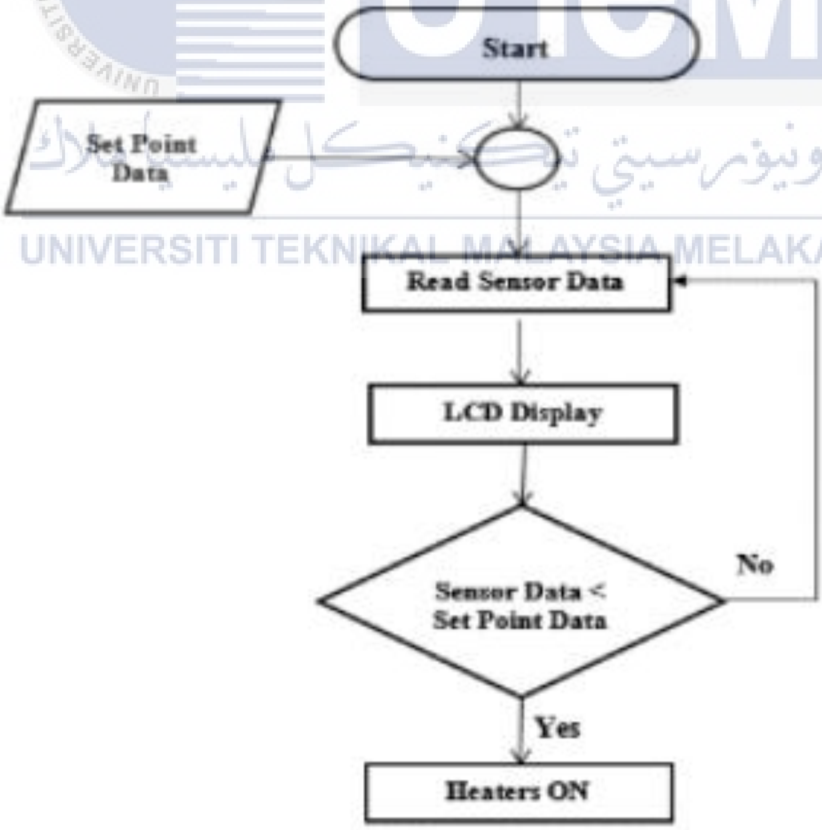


Figure 2.9 The program structure diagram

In this research, the parameters are checked automatically. With IOT technology, the choice of sensor and controller DHT 22 (Arduino) is important for this incubator. Although there are several of them available, Arduino is easy to program and use, allowing automatic control. Programming as an incubator controller, the Arduino microcontroller uses special header files such as DHT22 header and LCD header.

Then, the Arduino programming language (based on wire) and the Arduino Software (IDE), which includes its own compiler and is easy enough for beginners to use while being flexible enough for extension, must be learned in order to programmed the Arduino microcontroller. The microcontroller's control logic, together with the LCD and DHT22 sensor, must be programmed.

2.2.6 Design and Implementation of a Remotely Monitored Smart Egg Incubator

The goal of this study is to solve this problem by showcasing an automatic transfer switch that can transition the load to a backup power source that is prioritized above the grid supply. Thereby, constructing an automatic transfer circuit capable of transferring the load to any available power source [8]. In addition, it uses a microcontroller, creates a temperature and humidity regulator with a GSM module. The last is to make an incubator cabinet with an egg turning mechanism and a DC fan circuit.

This is due to various issues with the incubator's power supply being interrupted, the incubation process will be terminated, causing chicken farmers to incur huge costs. Because of this, the eggs may hatch before or after the expected day and the farmer may also forget the exact hatching day and be far away. Therefore, the farmer must be notified when the egg hatch with the presence of an application on the mobile phone. For optimal incubation, the temperature is set between 37oC and 40oC, and the humidity level is set between 30-60%. By following the correct method incubation can hatch in 21 days. The microcontroller then sends a code as a text message to the user informing him of the incubation state.

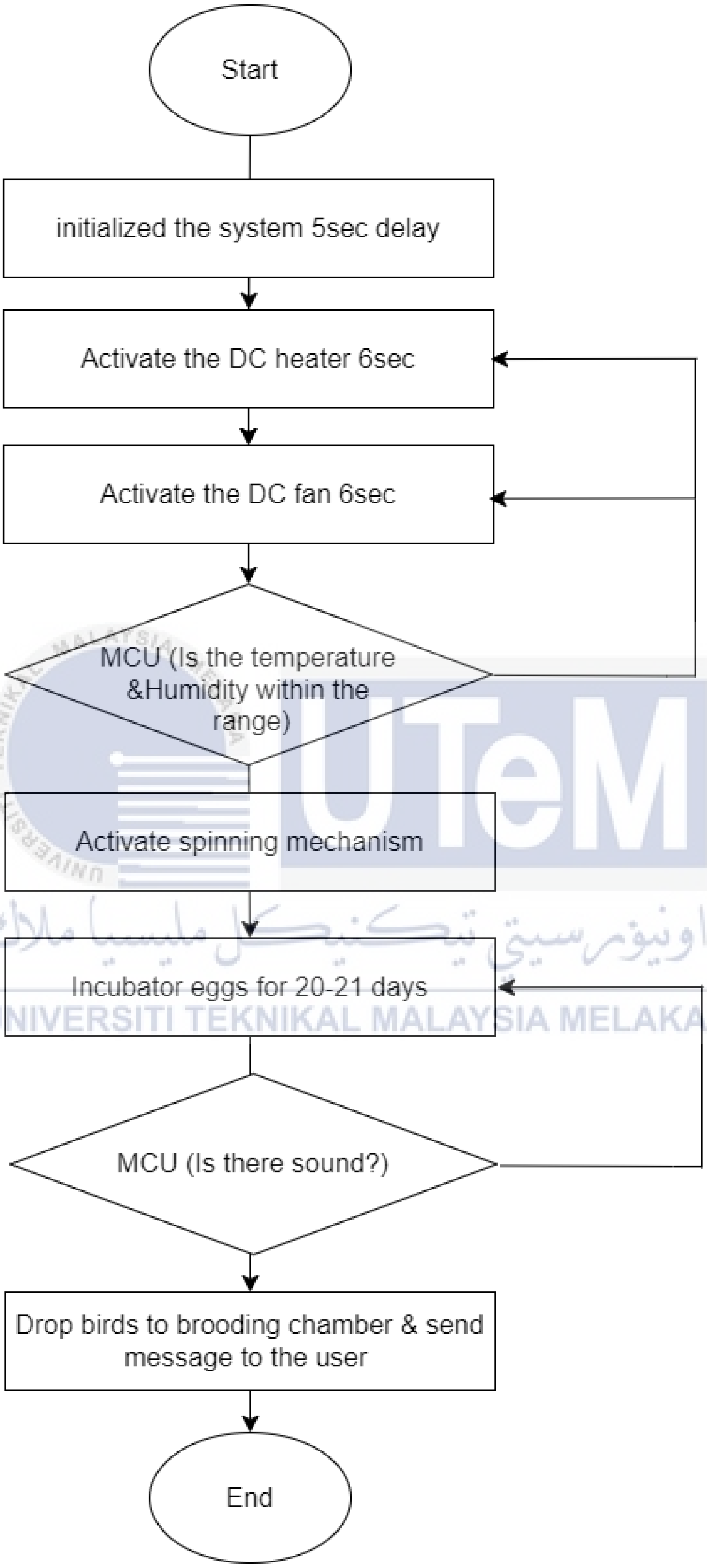


Figure 2.10 Flow chart Incubation process

Research techniques refer to research steps that need to be developed so that research can be focused, consistent, reliable and successful. Figure 2.10 is a flowchart depicting the incubation process, which highlights the issues at hand and how they can be resolved via the internet. Put the system on delay and then start it. The DC heater and fan should be activated for a total of six seconds. The MCU is next subjected to temperature and humidity testing. Next, turn on the rotating mechanism and incubate the egg for 20-22 days. Following that, the MCU procedure to determine the sound. Finally, when the bird drops the bird into the room stares and sends a message to the user.

2.2.7 GSM/IoT-based smart solar-powered egg incubator design and construction

Using sensor technology to make chicken farmers "smarter" and more connected to GSM/IoT, also known as "smart chicken farmers", the concern of chicken farmers is to improve the quality and quantity of hatching egg production[9]. It is used to create cost-effective products that use renewable energy sources, as well as to estimate the optimal hatch for a specific location of poultry farmers. The poultry industry is the main focus of this effort. Farmers with incubators experience low production due to poor performance in their hatcheries, which use monitoring and human control operations during incubation. Ideal hatching for eggs is predicted using temperature, humidity, bulbs, fans and turning motors. Chicken farming uses this predicted chicken to boost hatching quality eggs.

The program features a GSM/IoT platform that allows users to configure daily, weekly and seasonal irrigation profiles. GSM Shield has the added ability to act as a server, so it can host multiple web clients. If the temperature in a given area rises above a certain threshold, say 37 degrees Celsius, the user will be notified through text message. Furthermore, users can send SMS to the system at any time to inquire about the current temperature and humidity levels. When a request is received, the system accepts it and provides the current temperature and humidity probe.

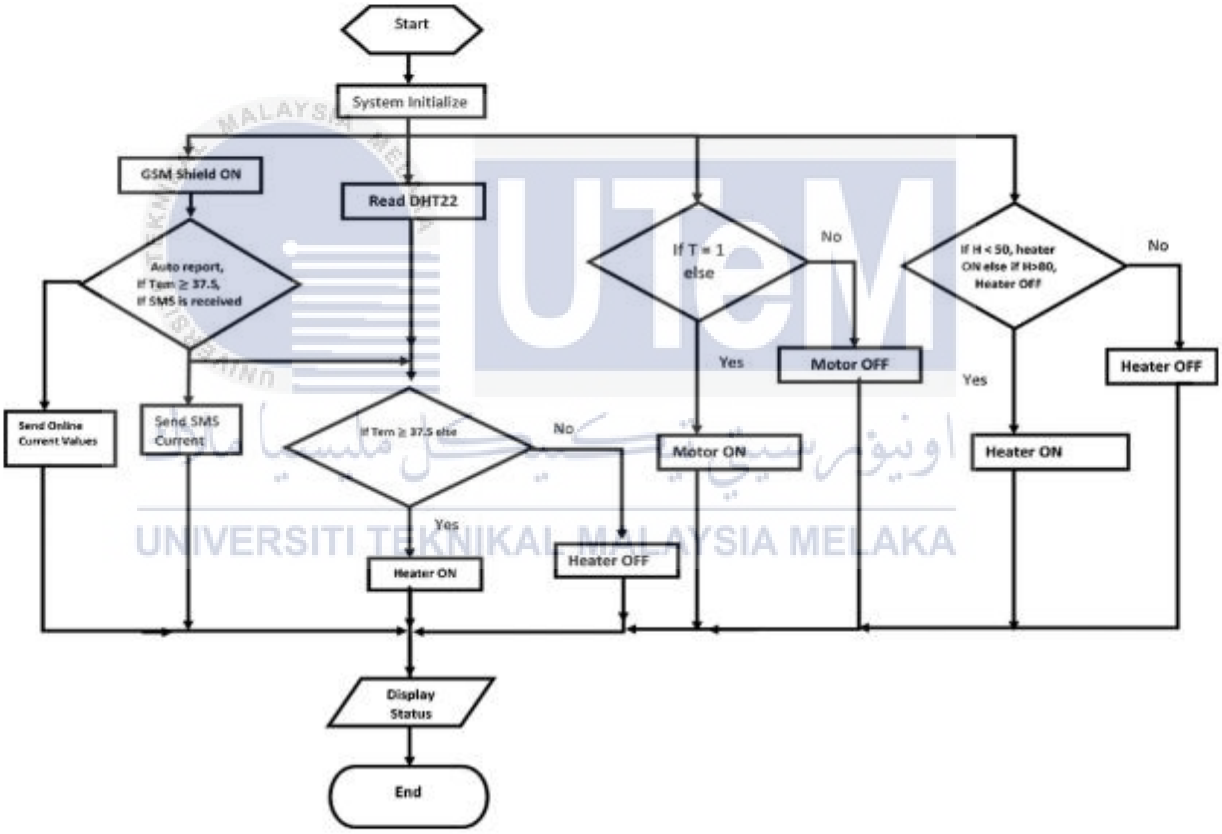


Figure 2.11 The GSM/IoT incubator flow chart

The working methodology is presented in this section. The process begins with the creation of an experimental layout for a fully-integrated smart incubator. The GSM/IoT incubator circuit was designed and wired. A red LED represents the heater and a green LED represents the spinner in the programmed; these components are represented by an Arduino UNO board, a GSM v2 shield, a real-time clock, LCD, a DHT 22 sensor, and corresponding LEDs.

Step two involves developing Arduino code to manage the Proteus parts. These essential and control variables include the RTC, LCD, GSM, and DHT22. After the declaration, the control code is written. The IOT incubator code's flowchart is shown in Figure 2.11. After importing the incubator code into Proteus IDE and clicking "run down," the simulation passed with flying colours. The current temperature and humidity data are shown on the LCD, while the simulation results are shown on the virtual terminal in the image.

Creating a functioning prototype of the IoT incubator is the third step. First, you should make sure the incubator is in good working order. The required temperature or heating range is from 37.5 to 38.5 degrees Fahrenheit. The incubator's targeted thermal characteristics, the incubator's heating subsystem, and the incubator's environment are all taken into account. The incubator can be tuned to a certain temperature, Tset. DHT22 programmable sensor constantly checks the inside temperature of the incubator.

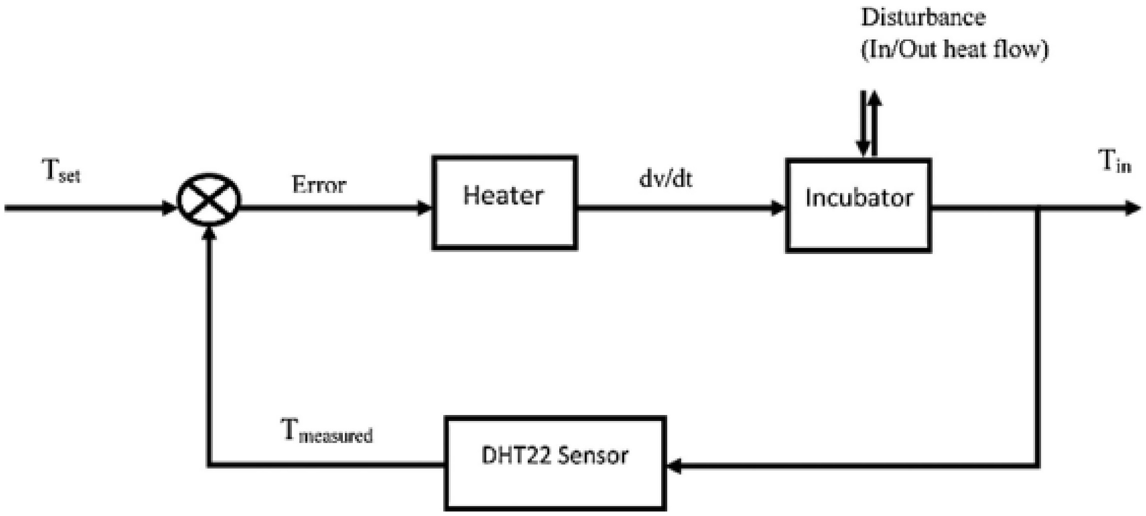


Figure 2.12 Incubator heat flow and feedback process block diagram

The heat circulation and feedback loop of the incubator are shown in the accompanying data flow diagram. The target incubator temperature, denoted by Tset, is optional. In the diagram, disruptions stand for the transfer of heat to or from the outside air (natural heat sources) via conduction and unventilated walls. The incubator's temperature (Tinc) is constantly monitored by the DHT22 programming sensor, which then compares the measured temperature to the desired temperature (Tset) and reports its findings back to the summer. If the measured temperature (Tinc) falls below the target temperature (Tset), an error signal is issued to the incubator's heater relay circuit. Controller shuts off heat when Tinc rises above Tset. During the incubation cycle, this process is repeated.

2.2.8 Automatic Electric Egg Incubator Development

The project's purpose is to build and test an electrically powered incubator based on the theory of forced draught with hatching chicken eggs using locally available materials. The purpose of the project is to produce low-cost incubators and boost day-old chick output for small and medium-sized poultry farmers.

Reasons for this can be found in traditional farming techniques, such as the effects of heat and humidity on animals in the first 18 days of life[10]. In addition, turn the egg using the gear motor electric tilting tray mechanism and the tray should be 40 degrees either horizontally every hour or every four minutes.

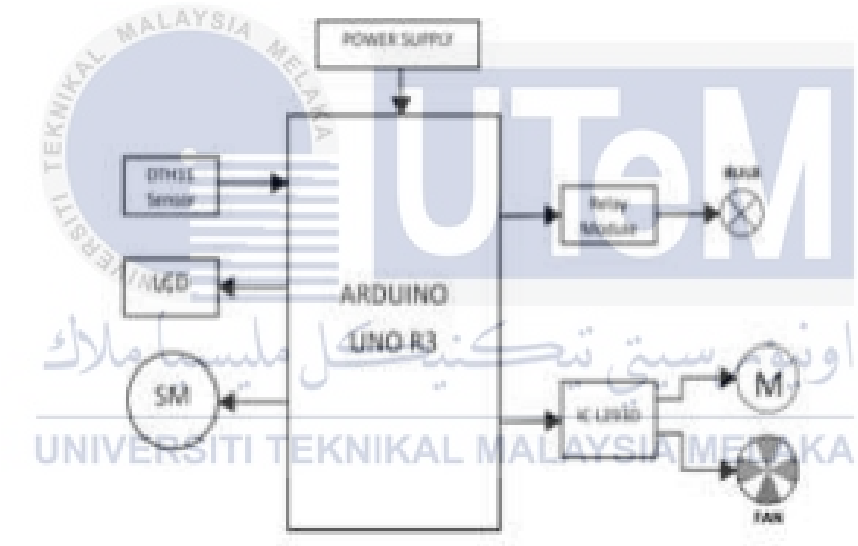


Figure 2.13 Block diagram of electric egg incubator

The above-described block-design incubators are predicated on the theory that the development and growth of microorganisms require a very specific environment. Incubators are based on the principle that organisms will flourish and reproduce if they are exposed to favorable environmental conditions such a steady supply of nutrients and a steady supply of air.

The design of the block above includes a pH sensor, DHT11 to measure humidity, LCD to see the temperature in degrees. All sensors are linked to Arduino Uno R3 as it is open source. Electricity is also used to power this Arduino controller. All this information is stored in the smartphone application. To automate the full system control, Arduino Uno and IoT are used. The mobile application offers manual control with the use of a LAN connection even when there is no internet connection. The result is reached by integrating data gathered from various sources to track and monitor IoT activity. The user is able to regulate and monitor the status of the eggs in the incubator by accessing the data saved on Thing Speak and displayed on the device application.

2.2.9 Development of smart egg incubator system for various types of egg (SEIS)

One of the technologies that provides opportunities, particularly for those who wish to be good farmers, is the egg incubator. There is a simple and quick approach to create a product. This idea will improve on the egg incubators that are currently on the market. The incubator's temperature and humidity will be precisely controlled by the gadgets for a wide range of egg types. To replace the role of the animal in caring for an egg until it hatches is the primary purpose of an incubator.

The goal of this research are incubators will assist farmers in producing items in a short period of time using a big number of eggs. Then, the egg incubators can be used in place of animal incubation periods and incubator will be large enough to prevent underproduction[11]. The concept of this incubating multiple types of eggs at the same time can be investigated.

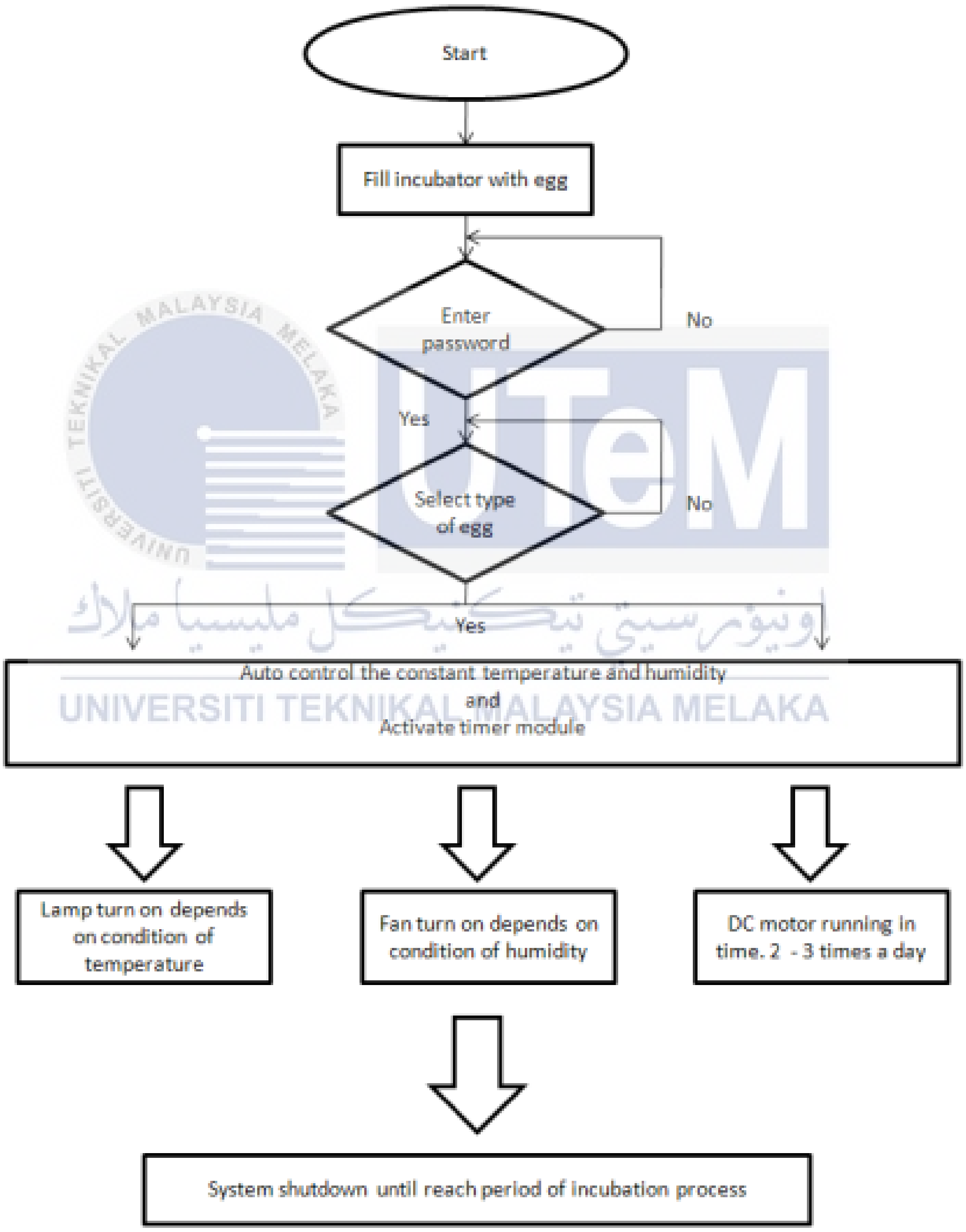


Figure 2.14 The project flow chart

Figure 2.14 illustrates the project's flow chart. First, the chicken breeder must enter the correct password. This is for protection of the system against other interruptions and to keep the system running continuously. After that, the user will be prompted to select an egg type. Depending on the selected type, the system will function differently. Various forms of egg data were entered during system development. There is a different incubation period until hatching for each type of egg. Three types of eggs were selected for the development of this project. In addition to chicken eggs and duck eggs, there are also quail eggs. To provide sufficient heating for the eggs, they should be turned 2 or 3 times daily. It is critical to ensure that the bulb heats all locations of the egg. An incubator's humidity is kept at a comfortable level with the help of a water container, a little amount of fresh air, and a fan controller.

2.2.10 Design and construction of automated eggs incubator for small scale poultry farmers

The goal of this research is to create a cutting-edge, reasonably priced, and straight forward incubator that can aid micro- and small-scale avian farmers in hatching and rearing more day-old chicks. This is because of several different problems faced by poultry growers. The issue of how to incubate eggs laid by mother hens is one such issue. The heat from the parents' bodies is transferred to the egg by touch rather than through the air around it, which is the main difference between natural and artificial incubation[12]. Chicken growers can now use incubators to hatch eggs without the mother's knowledge or consent thanks to incubation technology.

At the same time, we can see from day to day the egg hatching process. The eggs take 21 or 22 days to hatch. An embryo is a chick that develops inside an egg, and a close examination of the various phases of embryonic development will reveal many interesting facts. The effects of heat, air, and humidity on egg incubation will be visible.

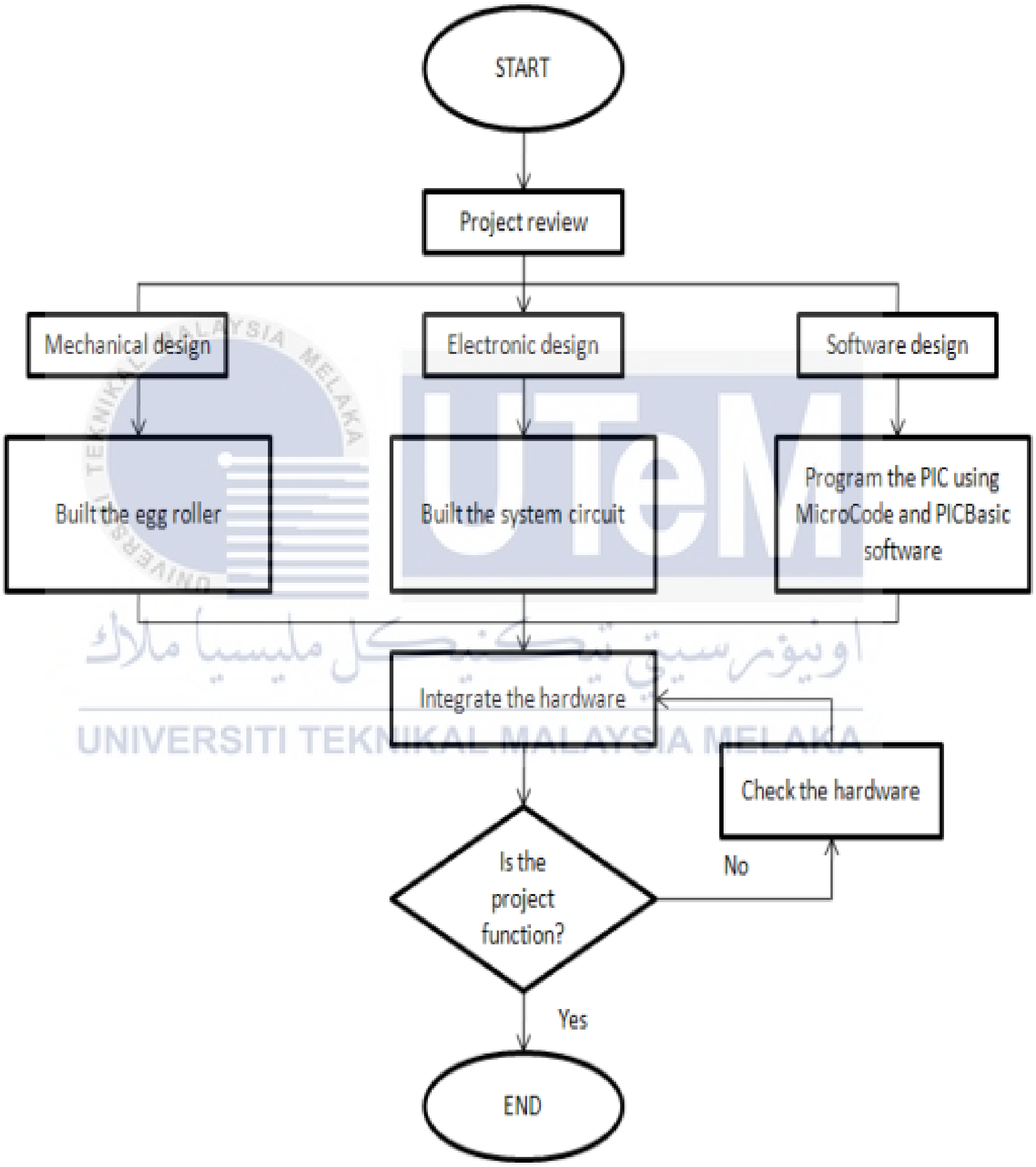


Figure 2.15 Flow chart of an incubator

Figure 2.15 is a schematic representation of how an incubator operates. The design process in this diagram is broken down into mechanical, electronic and software phases. In order to construct an automatic egg incubator system, one needs integrate a number of individual components. Then, incorporate the hardware. Finally, check the project is working or not. If not check the hardware, if otherwise can use the project.

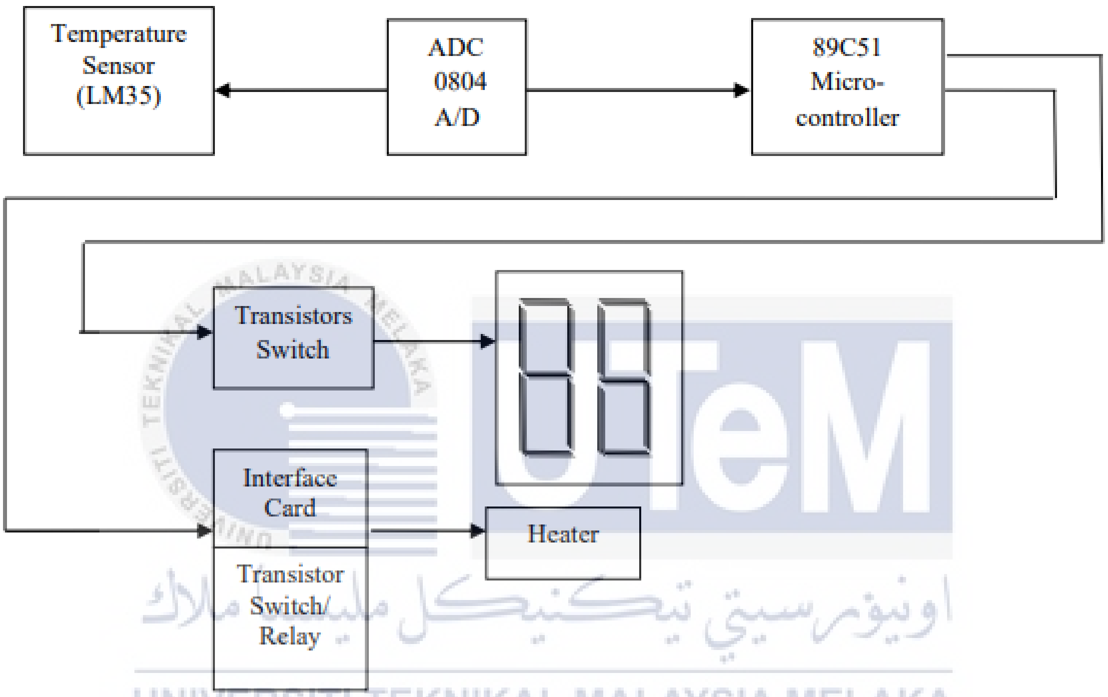


Figure 2.16 The system of block diagram with component units

From the figure above, temperature sensor must be linear temperature sensor then adjust current at the LM35. After that, the system's display is a common cathode ssd, monition display. To accommodate the ssd's unique biassing needs based on the I/O logic, a static switch must be put up for ports 2 and 3 using PNP silicon bipolar junction transistors. Coil resistance of 400, maximum current rating of 10 amps, and maximum voltage of 12 volts are all requirements for the electromagnetic relay. The microcontroller then needs a precise manual power up reset at pin 9 in case the system ever needs to be reset.

2.3 Summary table

Table 2.1 Summary table regarding to previous related work

Reference	Description	Advantage/Method
IoT-enabled design and execution of a chicken egg incubator for hatching [3].	This paper focuses on creating an incubator with sensors such as temperature and humidity. As well as integrating all sensors with PIC16f887 and ESP8266 microcontrollers. It can collect data and send it to a wireless IoT platform using the Blynk app. To find the best hatching eggs, data is analyzed used.	Reduce the expenses of chicken farmers, full and accurate readings of the incubator's temperature, relative humidity, and egg development. All the advantages of integrating IoT in poultry farming.
Development Of an Egg Incubator Using Raspberry Pi for Precision Farming [4].	By developing system incubator device support, this project uses parameters such as humidity and temperature. In addition to the Arduino network, this work makes use of Raspberry Pi-based modules for a database server and a web server.	This project builds system incubator device support using parameters such as temperature and humidity sensors. A database, web, and Arduino board for the Internet of Things. The Raspberry Pi is used to construct the server.

The Development of Automatic Forced Air Egg Incubator [5].	The purpose of this paper is for automatic design an automatic forced air egg incubator with temperature, humidity and automatic egg turner in order to properly incubate eggs.	This project builds incubator system device support that uses parameters such as temperature, humidity, fan, bulb, the LCD displays the incubator's internal temperature and humidity, and a spinner is needed to turn the egg.
Design and implementation of fuzzy control system for egg incubator based on IoT technology [6].	The goal of this initiative is to improve product efficiency with help facilitate chicken farmers and farmers in at the same time it takes advantage of technology assessment of manufacturing properties proposal.	This project uses a humidity sensor, a temperature sensor, a fan, and bulb to monitor and control behavior or other aspects. Apart from utility Wireless Sensors. The network, ATmega328 microcontroller is used as a CPU.
Design and construction of an EGG Incubator based on an Arduino Microcontroller [7].	The aim of the study is to use an Arduino microcontroller to make an incubator to make it easier for chicken farmers to hatch eggs. The goal of this research is to lower the cost and energy of chicken farmers. This is a modern way to hatch eggs using an incubator with a variety of sophisticated and easily available components.	Arduino microcontroller, DHT11 sensor to control logic microcontroller, lcd, temperature, tray to put the egg the egg, bulb and fan.

Design and Implementation of a Remotely Monitored Smart Egg Incubator [8].	The aim of the thesis is to creating a simple, cost-effective and practical control of hatching quality eggs. It is tracking temperature, humidity, motor to turn the egg and fan. All of these are essential for egg hatching to occur in the incubator. Temperature and humidity can be controlled at the proper temperature and humidity.	Because of its open nature, a large variety of pins and interference, and a large incubator space, MCU has been chosen as controller based on Figure 2.10.
GSM/IoT-based smart solar-powered egg incubator design and construction [9].	The purpose of this study is to show the characteristics of the incubator using smart solar powered, which is implemented with gsm/IoT, temperature, humidity and motor. The system provides automatic egg hatching, and nutrients can be checked. Corrections can be made after monitoring is completed, it can be controlled accordingly, resulting increased production.	To complete the project, the parties Arduino and GSM/IoT. With that it can send messages to inform about the situation in the incubator. Temperature, dht11 is humidity and motor used.

Development of an Automatic Electric Egg Incubator [10]	The goal of this project is to propose an approach for automatically regulating parameters. Poultry farmers can also use IoT technology to remotely monitor and manage the condition of the eggs in the incubator.	This system can accurately and automatically monitor technology devices that use certain sensors in real time and consistently, and then communicate data devices accurately and automatically. Temperature and humidity are just a few variables that must be taken into account in real time.
Development Of Smart Egg Incubator System for Various Types of Egg (Seis) [11].	The primary objective of this undertaking is to develop incubators suitable for a wide variety of eggs, including those of chickens, ducks, turtles, and so on. Same as other incubators but only the hatched eggs are slightly different. The number of days for hatching also varies. Meanwhile, the temperature and humidity are also different for one type of egg.	DHT11 for humidity, temperature, motor for roll the egg every a few minutes and fans to controlled the temperature. This is the component that the research does.
Design And Construction of Automated Eggs Incubator for Small Scale Poultry Farmers [12].	The aim of the thesis is to creating simple, cost-effective and practical control egg hatching. It is tracking temperature, humidity, motor to roll the egg. It is very important for successful egg hatching. In the meantime, the LM35 microcontroller, ADC, and interface card regulate the sensor temperature.	Because of its open nature, a wide variety of pins, interrupts and Microcontroller has been chosen as guard.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter we create a project-based method as a mechanism to put research into action and make the idea a reality. Next, this process is involved in achieving the project's goal of ideal quality. Existing IoT-based control that is strategized will be defined in complexity in this chapter, including its research and the addition of looks that support it. It will also go through the hardware and software that will be implemented in the platform. As a result, the three main tasks shown in Figure 3.1 planning, scheduling and structure deployment, will be implemented.

Figure 3.1 The methodology of significant steps

To achieve the purpose of the project, some analysis of tools from technical articles and books has been accomplished. To start, this activity can be carried out by conducting a literature review. Its goal is to compile all relevant incubator research and data. Next, we learn about programming language to write back at framework code. This research conducted me with information that I require work.

3.2 Planning

The purpose for command the Gantt chart of the timetable. A letter must follow the schedule. The project can also run smoothly without the entire process failing owing to insufficient planning. Furthermore, planning is necessary for achieving the required results throughout Bachelor Degree Projects 1 and 2.

3.2.1 **Flowchart depicting the PSM's general flow**

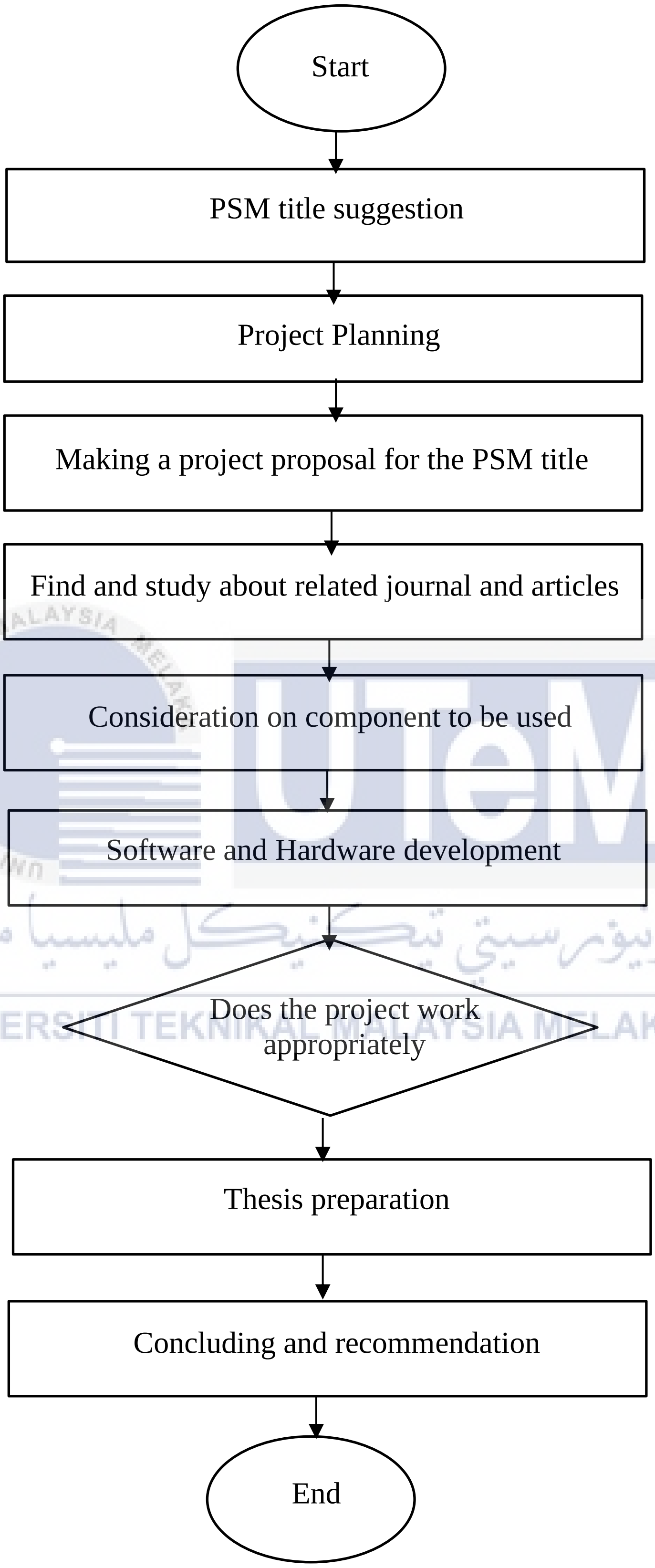


Figure 3.2 Flowchart depicting the PSM's overall flow

3.2.2 Gantt Chart

Because they are based on Gantt charts, templates should be followed. It must communicate both the task at hand and the approach for complete the Gantt Chart. When finished, continue working on the project until it is completed within the time frame provided. It is also to forecast the time required to complete the entire project and obtain the desired results.

Table 3.1 Gantt Chart

WEEK / ACTIVITIES	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
PSM 1 Briefing														
Start searching journal														
Progress work 1														
Project research														
Research literature review														
Report														
Progress work 2														
PSM 1 Report submission														
PSM 1 Presentation														

3.3 Project Methodology

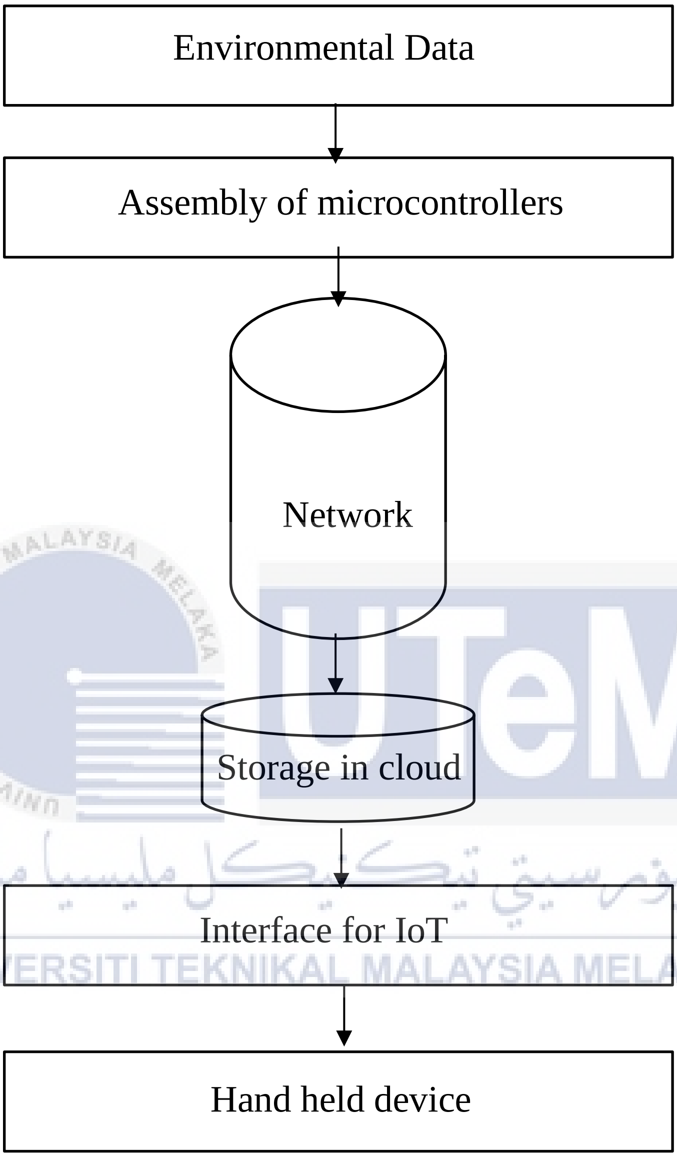


Figure 3.3 System information flow diagram based on the Internet of Things

The flowchart illustrates the transmission of data from the input stage to the environment and, finally, the portable device. For the six mains of modules need to choose from the Environmental data, the assembly of Microcontrollers, Network, Storage in Cloud, Interface for IoT and Hand-held Device. There are all covered as part of the procedure.

a) Environtmental Data

The function of DHT22 sensor are to controls tempertaure and humidty. It is to measure the humidity and temperature in percentages and degrees Celsius.

b) Assembly of Microcontrollers

This module acts as system hardware, overseeing the collection of data through the sensors it contains. The microcontroller's job is to connect to cloud storage, and it incorporates a Wi-Fi module with a range of 300 meters.

c) Network and Cloud storage

The network is in charge of moving data to cloud storage. So that it may be evaluated and calculated before being shown on IoT Interface.

d) Interaction with the internet of things

Blynks App is a mobile application that allows users for quickly and easily access for monitoring and managing their hardware projects that make use of iOS or Android. Blynk obviously supports the majority of Arduino boards, ESP8266, Raspberry Pi variants, Parctic Core, and a few more popular single-board and microcontroller computers. In the same way that Arduino supports Ethernet and WiFi, you can also use a computer to manage the devices via USB.

e) Handheld Devices

To monitor the data or mobile application might be employed. Sensor data is shown via this user interface apps. These apps are designed to run on smartphones having an LCD or data display.

3.4 Experimental setup

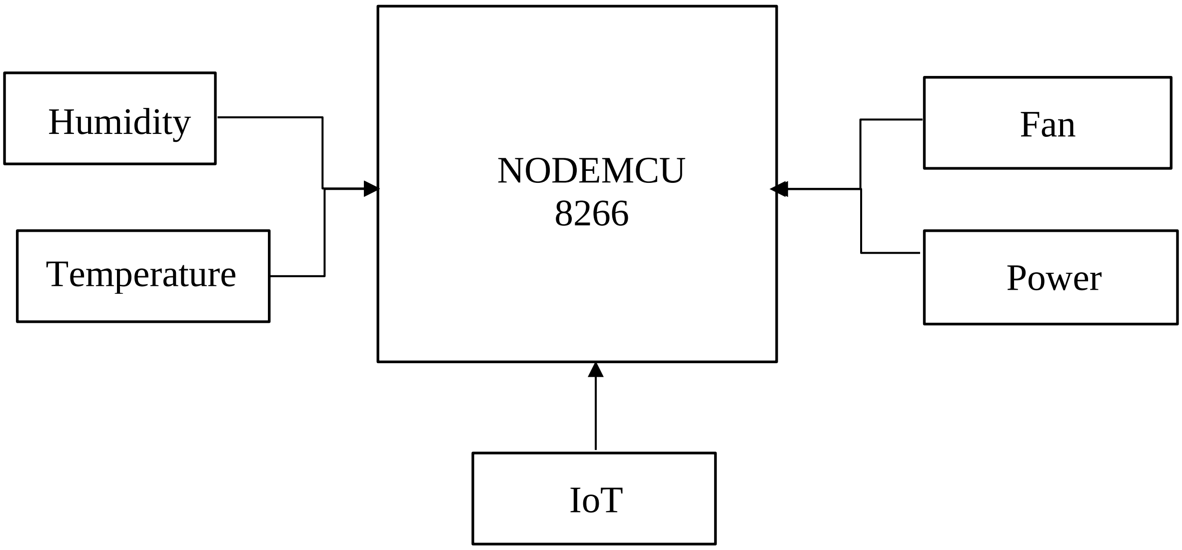


Figure 3.4 Schematic of project blocks

Present an analysis of project progress refer to the schematic of the project's blocks of an IoT-based Automated Hatching Egg. The system is divided into three parts: data monitoring, data control, and data storage. ESP8266 is used to address the need for all these measurements to be synchronized. Temperature and humidity sensors are used to monitor the environment.

The temperature and humidity of the plants are also managed with the use of fans. Because the incubator operates at a temperature of 36 to 37 Celsius [13]. It can hatch on schedule when the temperature and humidity are exactly right. Blynk can simply keep tabs on the output data thanks to the cloud storage and remote access made possible by the Wi-Fi connection.

3.4.1 Flowchart project

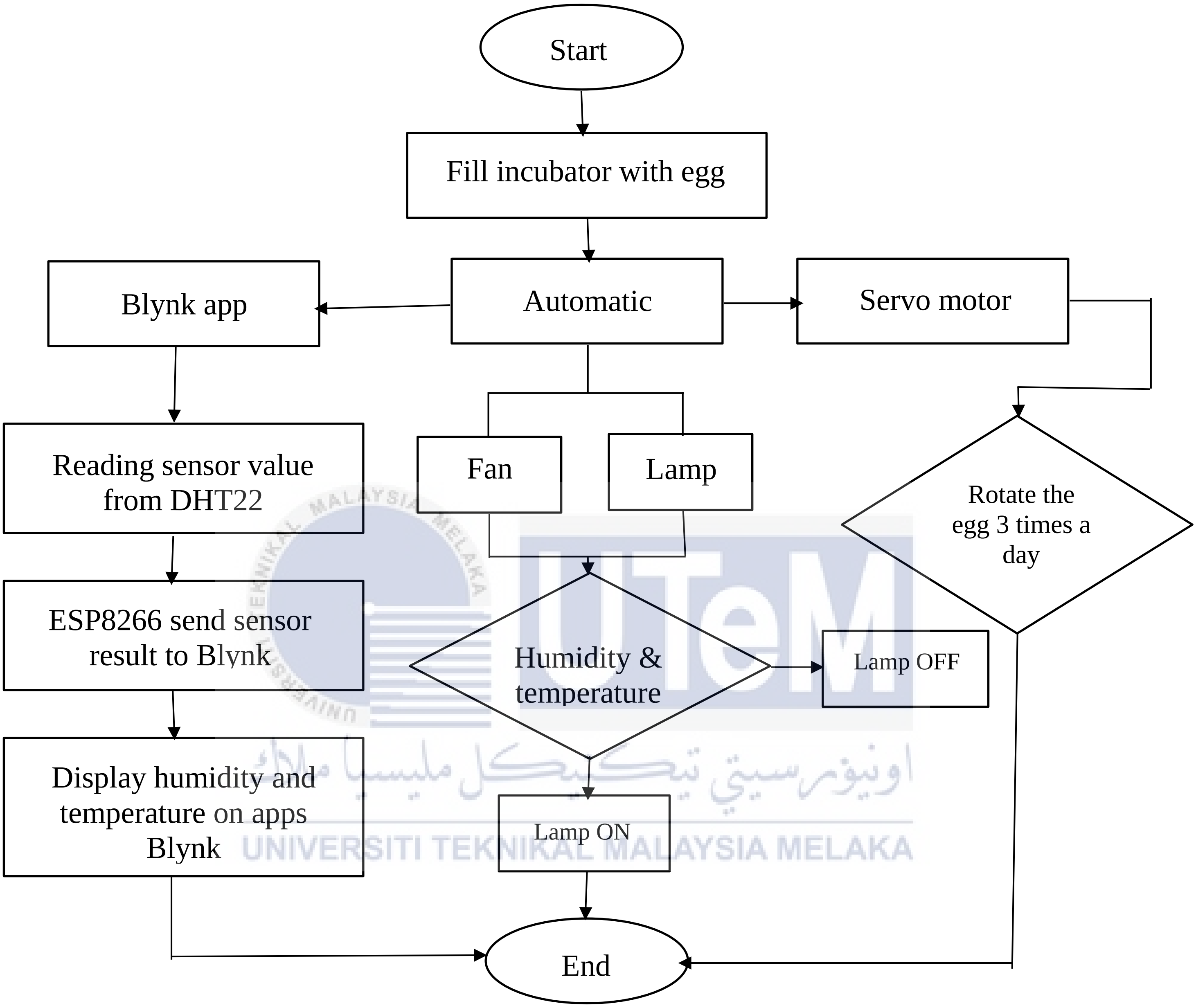


Figure 3.5 The flowchart general flow PSM

3.4.2 Parameters

Humidity: Air relative humidity can be measured, monitored, and detected via humidity sensors. It can measure both temperature and humidity as a result of this Relative humidity is defined as the ratio of actual to maximum humidity at that air temperature. When the humidity increases, temperature of an air. The capacitive electrical measurements are used in moisture/droplet sensors.

Temperature: The control unit must measure the air temperature. The DHT22 sensor will be used for this purpose. The picked because the temperature range -40°C untill 125°C and the humidity range 55% untill 65%, which is required for the egg to hatch.

3.4.3 List of the equipment

1. **NodeMCU ESP8266**

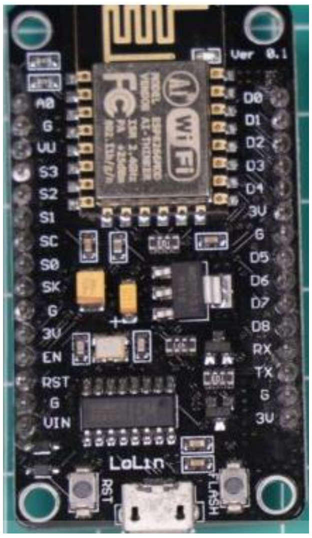


Figure 3.6 Example of NodeMCU ESP8266

Figure 3.6 represents the main controller used in the thesis. The NodeMCU ESP38266 microcontroller family is a low cost, low-capacity microcontroller and no Bluetooth but WIFI. The ESP8266 series has an RF balun, power amp, antenna switch, low-noise amplifier and filter and a single core Xtensa L:106 CPU. A simple piece of hardware, such as ESP8266, can be configured in any type of approach and is comfortable to use. ESP8266 incidentally, comes with various programming applications. Arduino IDE, Platform IO IDE (VS Code), Micro Python, Expressive IDF, LUA and JavaScript are just a few examples of applications.

Table 3.2 Pin Configurations

Etiket	GPIO	Input	Output	Açıklama
D0	GPIO16	no interrupt	no PWM or I2C	Boot aşamasında HIGH. DeepSleep uyandırma için.
D1	GPIO5	OK	OK	Genelde SCL (I2C)
D2	GPIO4	OK	OK	Genelde SDA (I2C)
D3	GPIO0	pulled up	OK	FLASH butona bağlı, LOW olursa boot çöker.
D4	GPIO2	pulled up	OK	Boot'ta HIGH. on-board LED'e bağlı. LOW olursa boot çöker.
D5	GPIO14	OK	OK	SPI (SCLK)
D6	GPIO12	OK	OK	SPI (MISO)
D7	GPIO13	OK	OK	SPI (MOSI)
D8	GPIO15	pulled to GND	OK	SPI (CS) HIGH olursa boot çöker.
RX	GPIO3	OK	RX pin	Boot'ta HIGH
TX	GPIO1	TX pin	OK	Boot'ta HIGH Boot'ta debug çıkışı. LOW olursa boot çöker.
A0	ADC0	Analog Input	X	

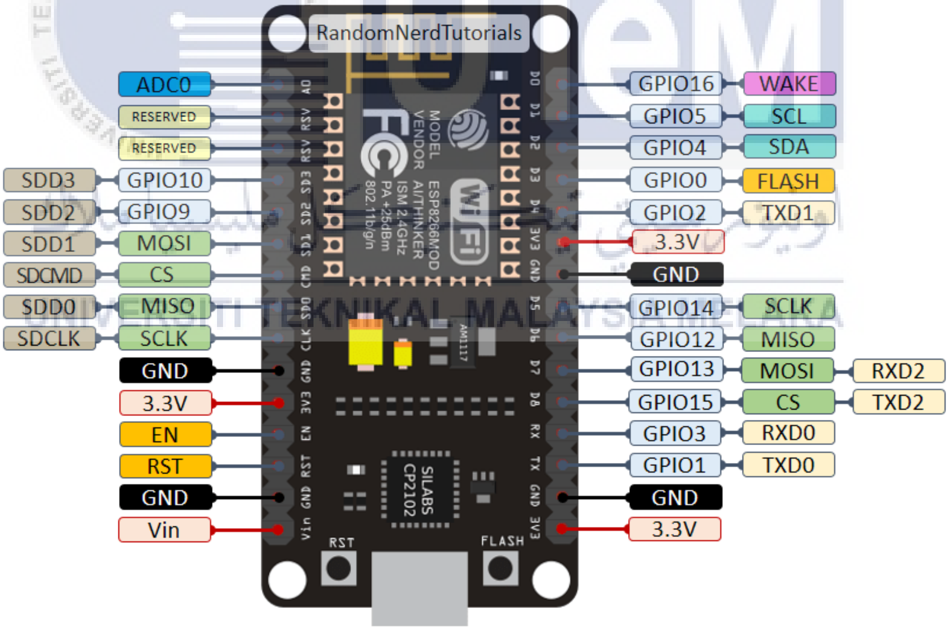


Figure 3.7 Example of NodeMCU ESP8266 and function

Table 3.3 Specifications of NodeMCU ESP8266

Categories	Items	Parameters
Wi-Fi	Certification	Wi-Fi Alliance
	Protocols	802.11 b/g/n (HT20)
	Frequency Range	2.4 GHz ~ 2.5 GHz (2400 MHz ~ 2483.5 MHz)
	TX Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: –91 dbm (11 Mbps)
		802.11 g: –75 dbm (54 Mbps)
		802.11 n: –72 dbm (MCS7)
	Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware	CPU	Tensilica L106 32-bit processor
	Peripheral Interface	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/ADC/PWM/LED Light & Button
	Operating Voltage	2.5 V ~ 3.6 V
	Operating Current	Average value: 80 mA
	Operating Temperature Range	–40 °C ~ 125 °C
	Package Size	QFN32-pin (5 mm x 5 mm)
	External Interface	-
Software	Wi-Fi Mode	Station/SoftAP/SoftAP+Station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Software Development	Supports Cloud Server Development / Firmware and SDK for fast on-chip programming
	Network Protocols	IPv4, TCP/UDP/HTTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

2. DHT22 sensor

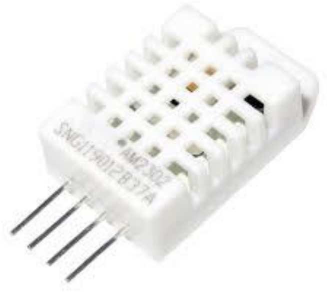


Figure 3.8 The DHT22 Sensor

The DHT22 sensor digital sensor is a low-cost option. It is using a capacitive temperature sensor to measure the temperature of the atmosphere, and the data shows an electronic signal. It is straightforward, but data collection requires careful planning. Every two seconds, new data is available. The temperature and humidity sensors were installed in the incubator to monitor and manage the environment[14].

<u>DHT11 technical specifications:</u>

- Voltage range: 3V until 5V
- The current consumer goods are 0.3mA and 60uA
- • The serial data output
- The temperature ranges are -40°C untill 125°C
- The relative humidity ranges from 0% to 100%.
- The precision is 1 °C and 1% for temperature and humidity, respectively.

3. Fan

Figure 3.9 Fan Ventilation

To improve air circulation, place a tiny fan inside the incubator. A fan will help to evenly spread heat and humidity, preventing hot or cold patches. To avoid damage, make sure the fan is not blowing directly on the eggs.

4. Thermostat

Figure 3.10 Thermostat

A thermostat works similarly to a valve in that it opens and closes in response to temperature. Until a certain minimum temperature is reached, the thermostat disconnects the engine from the radiator. The engine loses heat to the radiator without a thermostat and takes longer to warm up.

5. **Sino timer**

Figure 3.11 Timer Sino

The Sino timer is the same as the timer switch that is used when electrical equipment must be turned on and off on a daily or weekly basis.

6. Incandescent Lights

Figure 3.12 Incandescent lamp

An incandescent lamp is a type of artificial light source that produces light by discharging an electric current and then heating it.

7. Motorized egg roller tray

Figure 3.13 Motorized egg roller tray

Roll the egg tray with a motor to rotate the eggs 3 times a week. In addition, it also prevents the embryo inside the egg from dying or sticking to the egg shell.

8. Jumper Wire

Figure 3.14 Jumper Wire (Male to Female)

Figure 3.15 Jumper Wire (Male to Male)

3.5 Setup of the software

The Arduino IDE is used to generate the proper work prompt controller, and Blynk serves as an interface for programmers that use our numerous widgets. Blynk can also be remotely monitored for extra tasks as needed by the user.

3.5.1 Arduino IDE

Figure 3.16 The Arduino IDE software

The Arduino Software with IDE, commonly known as the Arduino Software, has a message area, a toolbar, a text terminal, and a code editor with menus and standard job buttons. It attaches to the hardware of the Arduino and uploads the programme.

3.5.2 The Blynk server

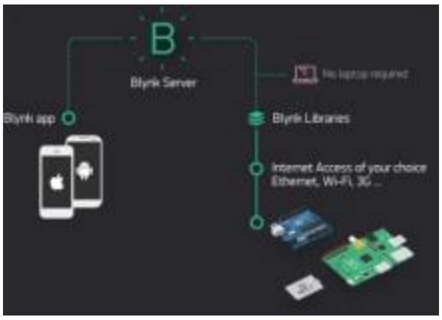


Figure 3.17 Blynk application

Figure 3.18 User interface

3.6 Summary

Lastly, this chapter examines the approach and process that will be used to construct an incubator that will employ Arduino-based IoT technology to construct an IoT-based industrial control and monitoring system. The goal of this strategy is to construct a planned and well-organized process that can be finished in a reasonable amount of time [15]. Arduino NodeMCU ESP8266 is a system principal of component. For example, the powered of Blynk IoT.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis for this project. As described in chapter 3 on the methodology of how the project is produced once the hardware has been described, decisions and analysis need to be made. With the decision taken by the data as programmed to get the desired result. Therefore, results are essential to know whether the results will be the same when the project is fully completed.

4.2 Results and Analysis

Decisions and analysis will be made in this chapter after all the designs and prototypes have been designed as discussed in chapter 3. The data taken needs to be more careful to get an accurate and correct analysis without any errors that could cast doubt on this product. Data and analysis will be shown after the description related to the prototype. Picture 4.2.1 below is the design that has been designed and all components and hardware have been connected according to the provisions of this project. The picture below will show the type of sensor and component that used. After that, an explanation related to how this project works will be explained after the prototype pictures are show.

Figure 4.1 Prototype design

For this system, when the temperature is 35 degrees the bulbs in the incubator open. After that, the microcontroller which is esp8266 is processed before sending to dht 22. After processing, dht22 will provide the data and send it to the user and the user can view the data using the blynk application. An internet connection must first be established between the esp32 and user d so that data can be transmitted continuously.

For the situation in the incubator, when the switch is turned on by the user to hatch the eggs, 2 bulbs, fan, thermostat and Sino timer are automatically turned on. Before inserting the eggs to hatch, the incubator should be heated for one hour. Therefore, the temperature in the incubator should be 37 degrees - 39 degrees Celsius and the humidity 55%-65%. It should be rolled 3 times a day. In this study, it was rotated at 8 am, 12 noon and 5 pm. When the temperature is 37 degrees Celsius, the light stays on until 38.9. After the thermostat shows a temperature of 39, the bulb will automatically turn off and the temperature will drop to 37 and the incubator will turn the bulb back on in the incubator. On days 3, 14 and 18 make the candling process which is to check whether the egg has an embryo or not. It is a 21-day process for the egg to hatch. From the incubator can only see the temperature on the thermostat. When you want to see the temperature and humidity inside the incubator, you need to insert ESP8266 and DHT22 into the incubator. After that, the user can read and see the temperature and humidity from the display of the blynk app.

There are 2 analyzes that will be presented below, one of which is an analysis of the state of the project and an analysis of 21 days of egg hatching.

4.3 Analysis for project status

There are 2 instances below where the results shown are the output for this project included with the output in blynk. So, the user can know the status of this project whether it is in good condition or not and whether the system is running well even if the user is not in the area.

Figure 4.2 Result manual

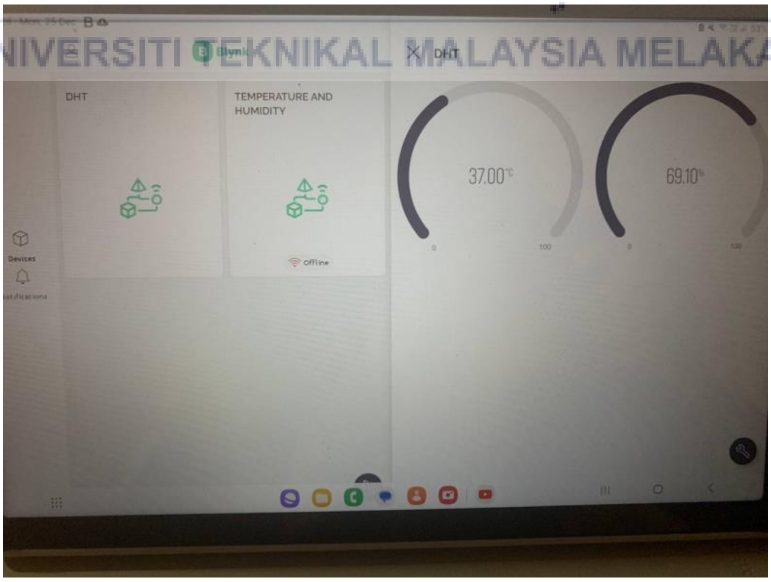


Figure 4.3 Result from IoT (Blynk)

Table 4.1 Data collection every minutes using IoT method

TEMPERATURE	HUMIDITY
37.3	55.1
37.3	55.1
37.3	55.4
37.4	55.4
37.4	55.4
37.5	55.5
37.5	55.6
37.5	55.5
37.6	55.3
37.6	55.6
37.7	55.8
37.8	56
37.8	56.2
37.8	56.1
37.8	56.6
37.8	56.8
37.8	57.1
37.8	56.9
37.8	57.4
37.9	57.6
37.9	57.9
37.9	58.1
37.9	58.6
37.9	59.2
37.9	59.3
37.9	59.5
38	59.1
38.1	60.4
38.2	60.3
38.2	60.1

38.3	60.8
38.3	60.4
38.3	60.9
38.4	61.4
38.4	61.5
38.4	61.1
38.4	61.9
38.5	61.4
38.5	62
38.5	62.3
38.5	62.8
38.5	63.1
38.6	63.7
38.6	63.2
38.6	63.8
38.7	63.9
38.7	64.2
38.8	64.6
38.8	64.1
38.8	64.8
38.8	64.9
38.8	64.7
38.9	64.6
38.9	64.9
38.9	64.8
38.9	65
37.9	59.2
37.9	59.3

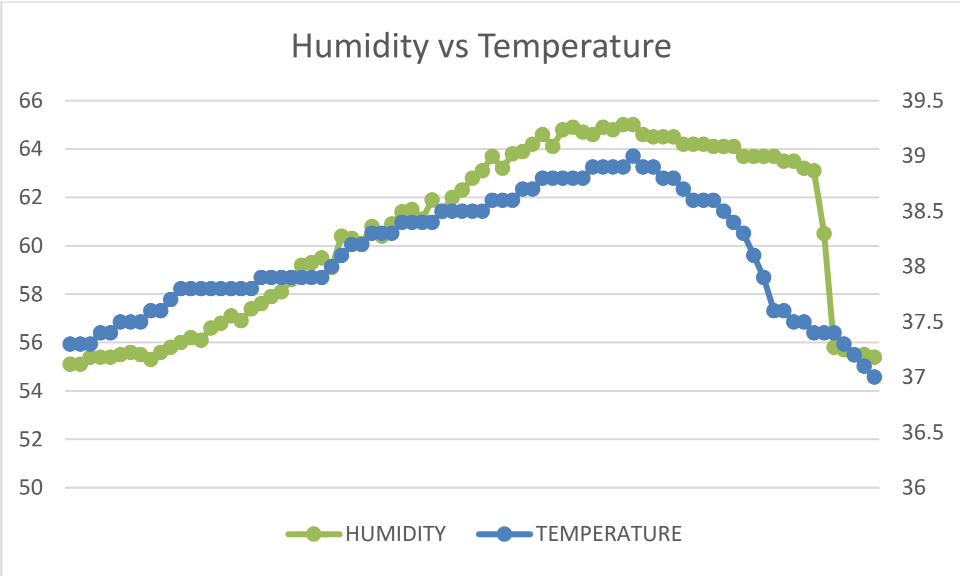


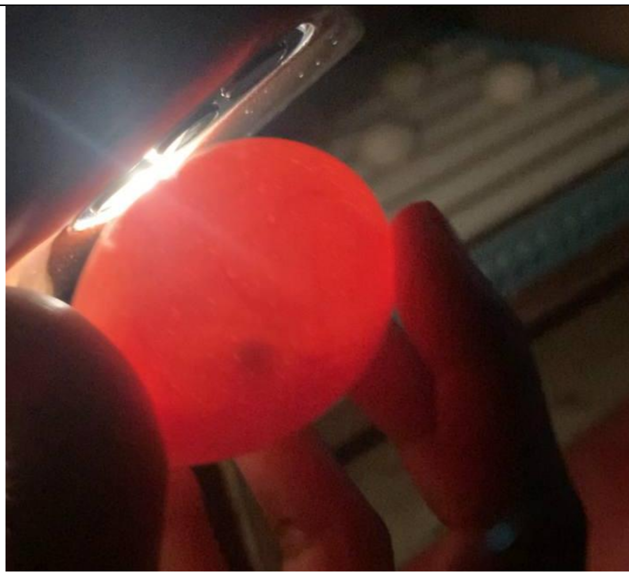
Figure 4.4 Graph data collection every minutes using IoT method

4.4 Analysis for the eggs hatch for 21 days

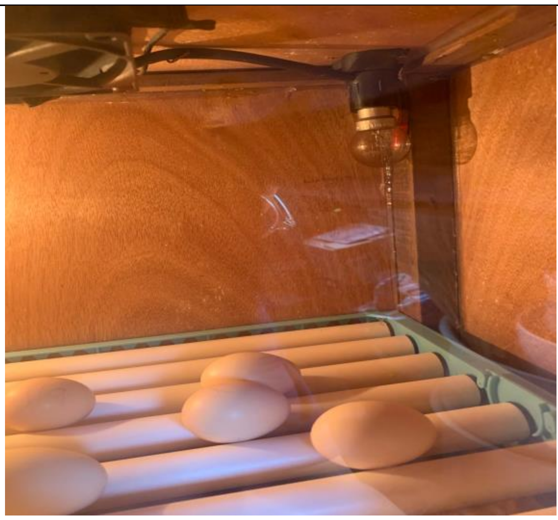
For figure 4.4.1 is an egg hatching incubator that can place as many as 60 eggs arranged on the egg tray. length=55.88cm, width=40.64cm, and height=48.26cm. Analysis to see if during the 21 days the hatching of the egg occurs how many seeds can hatch. The purpose is to make it easier for chicken farmers to hatch eggs in small quantities and to prevent the eggs from being eaten by animals such as monkeys and lizards.

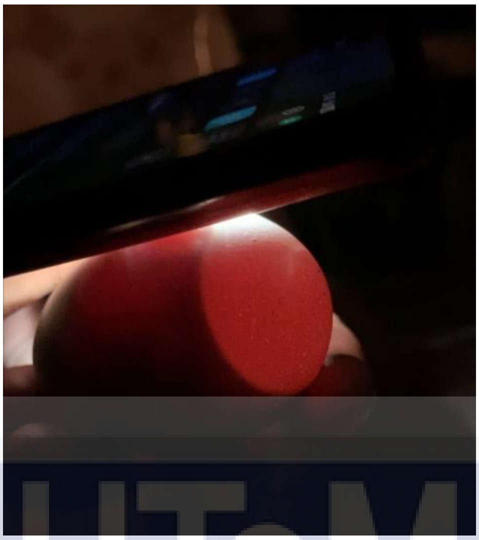
Table 4.2 Egg Hatch for 21 days

Days	Description
Day 1 (09/09/2023)	• Heat the incubators for 2 hours • Before put the egg, check the embryo using flash light.  (a)

	 (b) Figure 4.5 (a) Arrange the egg at automatic chicken egg turner. (b) Check embryo. • Put the egg at 4 o'clock. • Put a container of water for humidity.  Figure 4.6 Water for humidity
Day 2 (10/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Rain for 1 hour around at 1-2 pm.
Day 3 (11/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.

	• Rain for 1 hour around at 2-3 pm. • Full the water at the container.
Day 4 (12/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.
Day 5 (13/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Do candling egg for set the embryo into the egg.  Figure 4.7 Candling egg • 3 of 6 we see the embryo into the egg. • The right bulb in the incubator burned out. (Around 5:40 pm)
Day 6 (14/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Replaced with a new bulb. (Around 9:45am)

	 Figure 4.8 Bulb burn • See veins on the outside of the egg.
Day 7 (15/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • The weather is quite hot for today.
Day 8 (16/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.
Day 9 (17/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • The weather is rain form 2:10pm to 3:20pm.
Day 10 (18/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Refill full the water at the container for humidity. • Raining from 3pm to 5pm.
Day 11 (19/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • The weather is quite hot.
Day 12 (20/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Rain 5pm to 8am.
Day 13 (21/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Rain 5pm to 8am.

Day 14 (22/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.
Day 15 (23/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • Candling egg for second time. Function candling time is to see the embryo.  Figure 4.9 Candling egg • Raining 6pm to 7pm.
Day 16 (24/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.
Day 17 (25/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm.
Day 18 (26/09/2023)	• Roll the eggs 3 times which is 8am, 12pm and 5pm. • 1 of 6 egg has been cracked. (Around 6pm)  Figure 4.10 The egg crack

Day 19 (27/09/2023)	• Roll the eggs only 8am. • The egg found to be cracked have already hatched but died. Because they fell into a container of water. It’s around 39°C and 59%.  Figure 4.11 The first chicken die • The second egg hatches at afternoon and know the temperature when it hatches. It’s around 37.1°C and 55%. In the state of the incubator light is open.  Figure 4.12 Second egg hatch • The third egg hatches at evening around 4pm. The temperature is 38.2°C. In the state of incubator light is off.

<table>
<tr><td></td><td>
Figure 4.13 Third egg hatch</td></tr>
<tr><td>Day 20 (28/09/2023)</td><td>• 3 eggs left that didn’t hatch.

Figure 4.14 The egg left to hatch
• The second egg already standing upright.
• While, the third chick is still weak.

Figure 4.15 The chicken still weak</td></tr>
</table>

Day 21 (29/09/2023)	• 3 eggs left that didn’t hatch but it successful because half the egg hatches. • So, 3 eggs that do not hatch are considered spoiled eggs.

4.5 Summary

This chapter discusses the analysis and results obtained. Referring to the chapter 3 related to methodology, where all the components discussed there have been used and built in this chapter 4. As a result of the installation of the project prototype, it was successfully designed according to the requirements discussed in chapter 3. Not forgetting also, the correct installation of the circuit is also a factor in the success of the analysis and the results obtained. After all the analysis has been done, the conclusion is that this product can be used safely and can sell the project to chicken breeders.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This chapter will summarize and conclude this entire report and the project that has been built. Comments and suggestions will also be included in this chapter so that it can be improved in the future.

Chicken farmers will become more modern and efficient by using ESP8266, and various sensors to create chicken egg hatching incubators with Internet of Things. The integration of the latest technology, dht 22 and the Blynk app, significantly improves the overall functionality of the system and the user experience.

An ESP8266 microprocessor is used as the central processing unit to make sure everything works with each other without any problems. When the eggs are put into the incubator, the temperature should be 37-39C. For remote monitoring and control, the integration of the Blynk app provides an intuitive interface for poultry farmers to easily view temperature and humidity from a mobile phone.

Egg hatching incubators along with IoT have provided a solid answer to the problems faced by chicken farmers. Using microcontrollers and applications that are easy to use for chicken farmers and save time. Therefore, this innovative egg incubator system not only meets the set objectives but also promises to improve efficiency and sustainability in the poultry industry through the integration of advanced technology.

.

5.2 Potential for Commercialization

Egg hatching projects using incubators have enormous potential for commercialization, especially when the demand for eggs increases. There are various applications of technology for hatching eggs in various sectors, such as agriculture. For example, it can save chicken farmers time to wait for the eggs to hatch from the mother's womb. It is not that all the eggs will hatch. In addition to this application, the hatching project can also generate income through data licensing and partnerships with private sector organizations. However, it is important to balance the potential for commercialization with the need to ensure that the hatching data is accessible and usable for the various parties involved, especially for breeders who are new to chicken breeding. Therefore, egg hatching projects using incubators focusing on capable farmers and equitable access have the potential to generate significant economic benefits in addition to encouraging chicken farmers who have just tamed to defend chickens.

5.3 Future Works

As this product is not finalized yet, there are some suggestions that can be considered to improve the overall functionality of this product in the future.

Based on the weakness, there are several solutions that can be done to overcome the problem. One of the recommendations is to require cooperation and research from agricultural experts. It is essential for continuous improvement of incubator design, functionality and performance. By cultivating partnerships with these key stakeholders, development teams can gain invaluable insights and expertise that will inform iterative improvements and innovations. Furthermore, conducting comprehensive research studies, experiments and field tests is essential to verify the effectiveness, reliability and suitability of the system across various applications. This collaborative approach ensures that IoT-based egg incubators meet industry standards, address specific user needs, and leverage cutting-edge advances in poultry technology.

In addition to that, there is also a recommendation to store temperature and humidity data throughout the egg hatching process. Platforms for cloud computing must be integrated for the system to store, analyze and manage data effectively in a formal environment. Incubation systems can improve operational transparency and efficiency by providing easy access to real-time information through the use of cloud infrastructure. Furthermore, the scalability benefits of cloud integration allow the system to grow and change easily to meet the needs of a wide range of poultry farms. In addition, the use of cloud-based solutions improves the data security process, guaranteeing that personal data is protected by strong authentication and secure encryption algorithms. All things considered, cloud integration and data storage are important elements that support reliability, efficiency and system compliance to contemporary technical norms in agricultural applications.

REFERENCES

[1] B. Kommey, D. Akudbilla, G. Doe, and C. O. Amponsah, “A low-cost smart egg-incubator,” *Sustainable Engineering and Innovation*, vol. 4, no. 1, pp. 22–33, Feb. 2022, doi: 10.37868/sei.v4i1.id152.

[2] M. Jun *et al.*, “Design modification of a cost-efficient microcontroller-based egg incubator,” *Indian J Sci Technol*, 2021, doi: 10.17485/IJST/v14i14.2289.

[3] C. Venkatesan, A. R. Suhas, S. Satheeskumaran, and S. A. Nawaz, “Design and implementation of chicken egg incubator for hatching using IoT,” 2021.

[4] F. Ali, “DEVELOPMENT OF AN EGG INCUBATOR USING RASPBERRY PI FOR PRECISION FARMING,” *research gate*, Feb. 2016, [Online]. Available: https://www.researchgate.net/publication/291466866

[5] * Raja *et al.*, “THE DEVELOPMENT OF AUTOMATIC FORCED AIR EGG INCUBATOR,” *e-Academia Journal*, pp. 2289–6589, May 2019, [Online]. Available: http://journale-academiauitmt.uitm.edu.my/v2/index.php/home.html

[6] E. Mujčić and U. Drakulić, “Design and implementation of fuzzy control system for egg incubator based on IoT technology,” *IOP Conf Ser Mater Sci Eng*, vol. 1208, no. 1, p. 012038, Nov. 2021, doi: 10.1088/1757-899x/1208/1/012038.

[7] F. Kyeremeh and F. Peprah, “Design and Construction of an Arduino Microcontroller-based EGG Incubator,” *Int J Comput Appl*, vol. 168, no. 1, pp. 15–23, Jun. 2017, doi: 10.5120/ijca2017914261.

[8] O. M. Fredrick, U. Tanimu Umar, A. Nnabueze Edmund, and Z. Z. Ohunene, “Design and Implementation of a Remotely Monitored Smart Egg Incubator,” *Int J Sci Eng Res*, vol. 12, no. 11, 2021, [Online]. Available: http://www.ijser.org

[9] F. Peprah, S. Gyamfi, M. Amo-Boateng, E. Buadi, and M. Obeng, "Design and construction of smart solar powered egg incubator based on GSM/IoT," *Sci Afr*, vol. 17, Sep. 2022, doi: 10.1016/j.sciaf.2022.e01326.

[10] P. V M, R. C. Prasad, S. S. B, and K. G. Kumar R, "Development of an Automatic Electric Egg Incubator," *International Journal of Advances in Engineering and Management (IJAEM)*, vol. 3, pp. 2395–5252, 2021, doi: 10.35629/5252-03080105.

[11] ABU MUSA BIN MOHD ADID, "DEVELOPMENT OF SMART EGG INCUBATOR SYSTEM FOR VARIOUS TYPES OF EGG (SEIS) ABU MUSA BIN MOHD ADID," *Bachelor of Electrical Engineering (Hons.) (Electronics)*, Nov. 2008.

[12] A. A. Sunday, O. A. Ogunbode, E. Godwin Babatunde, and A. Muyideen Olalekan, "DESIGN AND CONSTRUCTION OF AUTOMATED EGGS INCUBATOR FOR SMALL SCALE POULTRY FARMERS," *International Journal of Technical Research & Science*, vol. 5, no. 8, pp. 1–9, Aug. 2020, doi: 10.30780/ijtrs.v05.i08.001.

[13] A. Lourens, R. Molenaar, H. Van Den Brand, M. J. W. Heetkamp, R. Meijerhof, and B. Kemp, "Effect of Egg Size on Heat Production and the Transition of Energy from Egg to Hatchling," *Poult Sci*, 2006.

[14] M. B. Ramli, H. P. Lim, M. S. Wahab, and M. F. M. Zin, "Egg Hatching Incubator Using Conveyor Rotation System," *Procedia Manuf*, vol. 2, pp. 527–531, 2015, doi: 10.1016/j.promfg.2015.07.091.

[15] IEEE Staff, "IoT Based Poultry Environment Monitoring System," *International Conference on Internet of Things and Intelligence System (IoTaIS)*, 2018.

APPENDICES

Appendix A Arduino Program Code

```
#define BLYNK_PRINT Serial
#define BLYNK_TEMPLATE_ID "TMPL6k19TpMDB"
#define BLYNK_TEMPLATE_NAME "DHT"
#define BLYNK_AUTH_TOKEN "3jQpOFddhvGOt1Rd_sffgAVVDpb_yMoP"
#include "DHT.h"
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
char ssid[] = "OSZA_FM@2.4@unifi"; //wifi name
char pass[] = "osza202060"; //wifi password
int tempthreshold = 30; //temperature to trigger threshold
int humidthreshold = 20; //humidity to trigger threshold
DHT dht(14,DHT22);
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600); //Serial baud connction
  Blynk.begin(BLYNK_AUTH_TOKEN,ssid,pass); //Connecting to Blynk
  dht.begin();
}

void loop() {
  // put your main code here, to run repeatedly:
  delay(3000);
    Blynk.virtualWrite(V0,dht.readTemperature());   //reading   and   writing
temperature to Blynk
  float t = dht.readTemperature();
  Serial.print(F("% Temperature: "));
  Serial.print(t);
  Serial.print(F("°C "));
   Blynk.virtualWrite(V1,dht.readHumidity()); //reading and writing humidity
to Blynk
  float h = dht.readHumidity();
  Serial.print(F("Humidity: "));
  Serial.println(h);
  if(dht.readTemperature() > tempthreshold){
    Blynk.logEvent("temp_high"); //triggering event for notification at Blynk
for high tempeature
  }

  if(dht.readHumidity() > humidthreshold){
    Blynk.logEvent("humid_high"); //triggering event for notification at Blynk
for high humidity
  }
Blynk.run ();

}
```