Faculty of Electronics and Computer Technology and Engineering

DEVELOPMENT OF AN IOT BASED EGG INCUBATOR MONITORING AND CONTROL SYSTEM BY USING MICROCONTROLLER

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Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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DEVELOPMENT OF AN IOT BASED EGG INCUBATOR MONITORING AND CONTROL SYSTEM BY USING MICROCONTROLLER

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A project report submitted
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DEDICATION

This project report is dedicated to my dear father, Krishnan Subramaniam, whose unwavering support has been a constant pillar throughout the entire journey of my research. His encouragement and guidance have been invaluable, and I am grateful for his belief in my abilities.

To my beloved mother, Sivakkulathey Turesamy, I extend my deepest appreciation. For months, she has attentively and lovingly encouraged me, providing the truest attention that fueled my work with genuine self-confidence.

I also extend my gratitude to my friends, who have been more than just companions on this academic venture. We've monitored each other's progress, shared insights, and celebrated milestones together. This project is a testament to the collective effort and camaraderie that defined our shared pursuit of academic excellence.

To all those who have worked hard to support and contribute to the completion of this project, I offer my heartfelt thanks. Your efforts have made a significant impact, and I am sincerely grateful for your collaboration.

ABSTRACT

Several sectors, including chicken farming, conservation efforts, and scientific research, depend heavily on the egg hatching process. For successful hatching, the right climatic conditions must be present inside egg incubators. This study suggests creating a microcontroller-based monitoring and control system for egg incubators that is based on the Internet of Things (IoT). By providing remote monitoring and management of the incubator's environmental variables, including temperature and humidity, the technology seeks to increase the productivity and efficiency of egg incubation. The suggested system transmits data to a cloud server, which may be accessed by a mobile application, using an ESP32 microcontroller with Wi-Fi connectivity. The main goal of this research is to determine how well the IoT-based system maintains the necessary environmental conditionsfor the best egg incubation. The system is made to keep a close eye on the incubator's surroundings, notice any changes from the intended parameters, and alert the user right away.The implementation has an alarm feature to notify the user in the event of serious deviations,ensuring prompt intervention to protect the viability of the eggs. By including IoT capabilities in the monitoring and control procedures, this study advances the technology used to incubate eggs. The suggested solution benefits industries that depend on successful egg hatching by streamlining managerial chores as well as increasing productivity and efficiency.

ABSTRAK

Beberapa sektor, termasuk penternakan ayam, usaha pemuliharaan, dan penyelidikan saintifik, sangat bergantung pada proses penetasan telur. Untuk penetasan yang berjaya, keadaan iklim yang betul mesti ada di dalam inkubator telur. Kajian ini mencadangkan mewujudkan sistem pemantauan dan kawalan berasaskan mikropengawal untuk inkubator telur yang berasaskan *Internet of Things (IoT)*. Dengan menyediakan pemantauan dan pengurusan jauh pembolehubah persekitaran inkubator, termasuk suhu dan kelembapan, teknologi ini berusaha untuk meningkatkan produktiviti dan kecekapan pengeraman telur. Sistem yang dicadangkan menghantar data ke pelayan awan, yang boleh diakses oleh aplikasi mudah alih, menggunakan mikropengawal ESP32 dengan sambungan Wi- Fi. Matlamat utama penyelidikan ini adalah untuk menentukan sejauh mana sistem berasaskan IoT mengekalkan keadaan persekitaran yang diperlukan untuk pengeraman telur yang terbaik. Sistem ini dibuat untuk memerhatikan persekitaran inkubator, melihat sebarang perubahan daripada parameter yang dimaksudkan, dan memaklumkan pengguna dengan segera. Pelaksanaan ini mempunyai ciri penggera untuk memberitahu pengguna sekiranya berlaku penyelewengan yang serius, memastikan campur tangan segera untuk melindungi daya maju telur. Dengan memasukkan keupayaan IoT dalam prosedur pemantauan dan kawalan, kajian ini memajukan teknologi yang digunakan untuk mengeram telur. Penyelesaian yang dicadangkan memberi manfaat kepada industri yang bergantung kepada kejayaan penetasan telur dengan memperkemas kerja-kerja pengurusan serta meningkatkan produktiviti dan kecekapan.

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First and foremost, I extend my deepest gratitude to my supervisor, TS. DR. HAFEZ BIN SARKAWI, for his invaluable guidance, words of wisdom, and unwavering patience throughout the entire duration of this project. His mentorship has been instrumental in shaping the course of my research.

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Finally, a sincere appreciation to all the staff at UTeM, fellow colleagues, and classmates, as well as the faculty members. I extend my gratitude to all other individuals who may not be explicitly listed here but have been cooperative and helpful in various capacities. This project's accomplishment is a collective effort, and I am truly grateful for the support and encouragement received from each of you. Thank you for being an integral part of this journey.

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CHAPTER 1

INTRODUCTION

1.1 Background

To ensure the development and hatching of healthy chicks, egg incubation is a procedure that necessitates exact environmental conditions, including temperature and humidity. Egg incubation has typically been carried out manually, which is labor-intensive and prone to mistakes made by humans. With the development of technology, there has been an increased interest in creating automated egg incubation systems to speed up the hatching process and produce more healthier chicks.

One of the most promising technologies for developing automated egg incubators is the Internet of Things (IoT). To monitor and manage the incubation process, the IoT-based egg incubator system connects a network of sensors, microcontrollers, and other devices. Through the internet, these devices can communicate with one another and a central control unit, allowing for remote monitoring and management of the incubation process.

The goal of this project is to create an Internet of Things (IoT)-based monitoring and control system for egg incubators. The system will be able to track and manage temperature, humidity, and other environmental factors, and it will give users access to real-time data via a web-based interface. The suggested approach will increase hatching success rates while lowering human error rates, making it a cost-effective and effective method of incubating eggs.

1.2 Addressing Egg Hatching Rate Through Egg Incubator Project

The goal of the egg incubator project is to address the problem of low egg hatching rates by offering eggs a productive and controlled environment in which to develop and hatch. The incubator creates ideal conditions for the development of the eggs and increases hatching success rates by utilising cutting-edge temperature and humidity regulating technology. In order to adapt and maintain the appropriate settings during the incubation phase, the project also includes monitoring and automatic feedback methods. The egg incubator project's overall goals are to increase the productivity and sustainability of chicken farming while also increasing egg production efficiency and hatching rates through this endeavour.

1.3 Problem Statement

In chicken farming, the hatching of eggs is a key process that necessitates continuous monitoring of environmental factors including temperature and humidity. Manual monitoring can lead to low hatching rates and large losses for farmers because it is frequently tedious and prone to error. In order to automate the process and notify the farmers in case any deviations from the predetermined parameters occur, an effective and dependable monitoring and control system for egg incubators is required.

1.4 Project Objective

The main aim of this project is to propose a systematic and effective methodology to hatching high rate of eggs. Specifically, the objectives are as follows:

a) Develop an IoT-based egg incubator monitoring and control system.

b) Implement sensors to monitor temperature, humidity, and egg turning in real-time.

c) Develop a user-friendly interface to display the status of the incubator and allow for control adjustments.

1.5 Scope of Project

The scope of this project are as follows:

a) The project aims to develop a system that can monitor and control egg incubation through IoT technology and microcontroller.

b) The system will collect data on temperature, humidity, and other relevant parameters to ensure optimal incubation conditions for eggs.

c) The system will use a microcontroller to control and regulate the temperature, humidity, and other conditions within the incubator.

d) The system will use IoT technology to enable remote monitoring and control of the incubator via a web-based application.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The Development of an IoT based Egg Incubator Monitoring and Control System by Using Microcontroller project seeks to develop and put into use a sophisticated Internet of Things (IoT)-based method for monitoring and managing egg incubators. This system will make use of microcontrollers to enable remote monitoring and control of important variables like temperature and humidity while also assuring the ideal circumstances for effective egg incubation. The suggested system will improve comfort and efficiency through seamless connectivity and data interchange, enabling users to remotely access real-time data, receive alarms, and alter settings as necessary. With automation and connectivity, this project marks a substantial improvement in egg incubation technology, increasing hatch rates and streamlining the management process[1].

2.2 Egg Incubator

A device called an egg incubator is made to create the ideal environment for artificial egg hatching. It is frequently employed in the breeding of birds, poultry, and even reptiles. An incubator's main job is to maintain the environment's temperature, humidity, and ventilation to mimic a natural nest and encourage healthy egg growth and hatching[2].

Due to the fact that various species require distinct temperature ranges for optimal development, an egg incubator's temperature control is essential. Thermostats in the majority of contemporary incubators keep the temperature steady within a predetermined range. To ensure that the eggs have the appropriate amount of moisture, the humidity levels are also controlled. This is crucial for avoiding dehydration or excessive wetness, which might result in malformations or failure hatching[2].

Incubators come in a variety of shapes and sizes, from compact tabletop ones for home use to massive industrial units for business use. In Figure 2.1 shown a example of egg incubator. In most cases, they come with features like automatic egg turning mechanisms, temperature and humidity warnings, and digital screens for setting monitoring. Several high-tech incubators even include programmable settings, enabling users to design unique temperature and humidity profiles for particular species [2].

Figure 2.1 Egg incubator

Overall, egg incubators have transformed the hatching process by offering a regulated and ideal environment. They have greatly improved artificial hatching's success rate and have developed into a crucial tool for the poultry and breeding industries. Incubators are constantly evolving thanks to technological breakthroughs, providing breeders all over the world with greater convenience and efficiency[2].

2.2.1 Monitoring Egg Incubator By Using Microcontroller

Using a microcontroller to monitor an egg incubator has many benefits in terms of accuracy and efficiency. It is possible to programme a microcontroller, like an Arduino or a Raspberry Pi, to collect data in real-time from a variety of sensors and give fine control over the incubation process. Let's talk about the advantages of utilising a microcontroller to monitor an egg incubator in the first paragraph[3].

First, a microprocessor enables accurate humidity and temperature control inside the incubator. The microcontroller can be equipped with sensors to continuously check these conditions, ensuring that the conditions are right for effective egg incubation. In order to keep the atmosphere for the eggs stable, the microcontroller may then change the heating and humidifying systems accordingly. By eliminating the need for ongoing manual monitoring and adjustment, this level of automation lowers the possibility of human mistake and ensures that the environment for the growing eggs is consistent[3].

Second, a microcontroller can send notifications and real-time feedback regarding the operation of the incubator. In Figure 2.2 shown example of monitoring egg incubator by using microcontroller and lcd to monitor temperature .The microprocessor is able to identify any departures from the required range by continuously monitoring the temperature, humidity, and other important data. The microcontroller can provide notifications through an inbuilt display or wireless connection if any anomalies are found, prompting the user to take quick action. The likelihood of any negative effects on the eggs is greatly decreased by this proactive monitoring, improving the likelihood of a successful hatch[3].

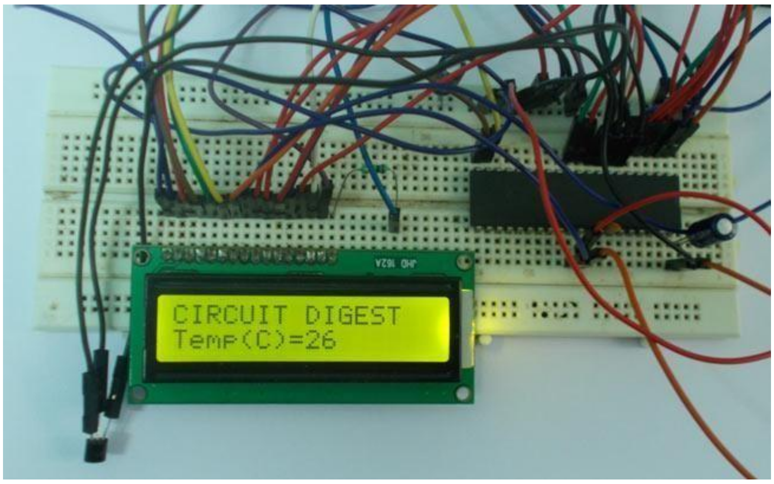


Figure 2.2 Monitoring egg incubator by using LCD

Last but not least, a microcontroller provides the opportunity for data logging and analysis. The ambient data gathered throughout the incubation phase can be encoded into the microcontroller and stored and recorded. Later, this information can be retrieved and examined to learn more about the incubation circumstances and the elements that contribute to a successful hatching. It is possible to make modifications to future incubation procedures by reviewing prior data, which will increase hatch rates and overall efficiency[3].

2.2.2 Control Egg Incubator By Using Microcontroller

Precision, automation, and monitoring capabilities are just a few advantages of utilising a microcontroller to operate an egg incubator. It is now possible to maintain the ideal circumstances for effective egg incubation thanks to the inclusion of a microcontroller in the design. To provide the eggs with a stable and controlled environment, the microcontroller can be programmed to manage and alter variables including temperature, humidity, and turning frequency[4].

The microcontroller can monitor and regulate the heat source using temperature control to maintain the desired temperature range needed for egg incubation. In Figure 2.3 shown manual control for egg incubator. The environment for the eggs is more stable and dependable because there is no longer a need for manual temperature adjustments. Similar to this, the microcontroller may regulate humidity levels by turning on or off a humidifier as necessary to stop the eggs from losing too much moisture[4].

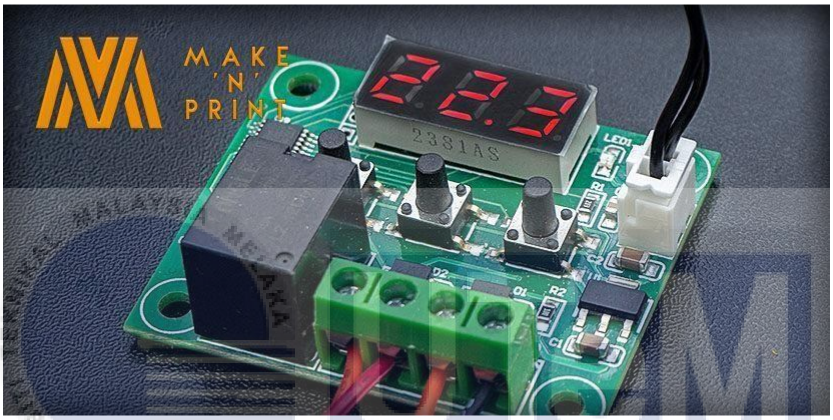


Figure 2.3 Manual control egg incubator

In conclusion, the method of controlling an egg incubator with a microcontroller is precise, automated, and monitored. The microprocessor creates a constant and ideal environment for the eggs by controlling temperature, humidity, and rotating frequency. Monitoring environmental variables enables variations to be quickly addressed, improving the likelihood of successful hatch rates[4].

2.2.3 IoT Control and Monitor Egg Incubator by Using Microcontroller

Microcontroller-based IoT (Internet of Things) control and monitoring of an egg incubator is an intriguing application that automates and streamlines the hatching process. The egg incubator may be watched and managed remotely thanks to IoT technology, giving the user convenience and real-time data.

The microcontroller serves as the system's central nervous system, tying together various parts like temperature and humidity sensors and communication modules. The user can set and modify the ideal temperature and humidity levels for the best egg incubation using the microcontroller. In Figure 2.4 shown the working prisible of Iot with microcontroller. The system's IoT capabilities allow for simple modification of these parameters via a user-friendly interface on a smartphone, tablet, or PC[5].

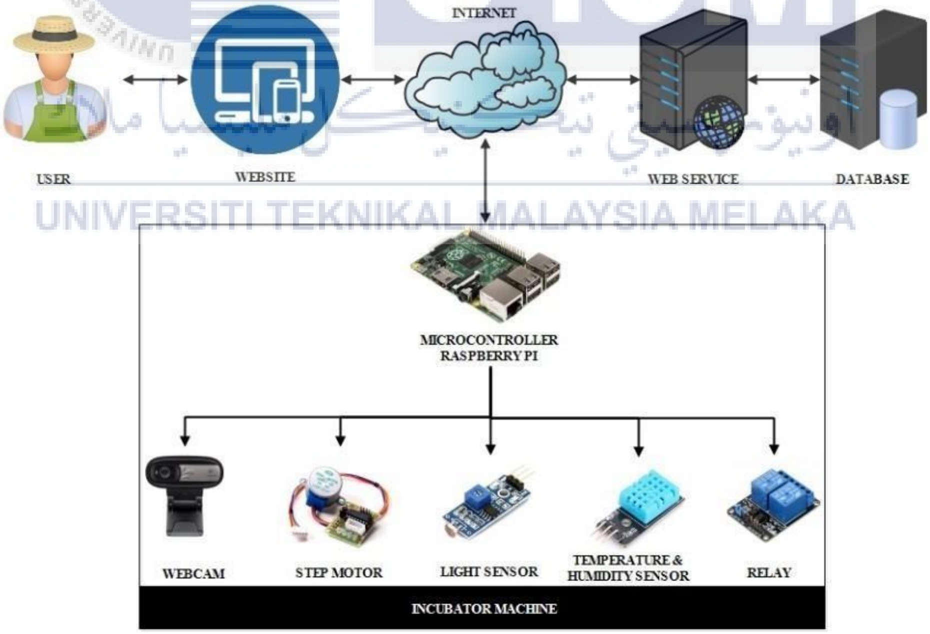


Figure 2.4 IoT control and monitor egg incubator by using microcontroller

The microcontroller also continuously assesses the incubator's environmental conditions and gives real-time input. The system has the ability to immediately notify the user if any deviations from the desired levels take place. Users may watch the incubation process remotely from any location, giving them peace of mind and the freedom to make any necessary adjustments in good time[5].

Finally, the incorporation of IoT technology and a microcontroller in an egg incubator provides simple control and real-time observation of critical environmental variables. With this setup, the hatching process is automated and made more efficient, and users have the freedom to remotely control the incubation settings. Egg incubators become more dependable, user-friendly, and conductive to successful hatching with IoT-enabled control and monitoring.

2.3 Previous Research Project.

2.3.1 Simple Egg Incubator [1]

Simple egg incubators can be made with the materials provided. It produces a heat source within the incubator by using a styrofoam box as the main construction, a light bulb socket that links to a regular extension cord, and an incandescent light bulb of the right wattage. To support the screen, hardware cloth, or fabric used to cover the incubator and allow for optimum ventilation, a frame can be built out of scrap wood. To keep track of the temperature and humidity levels, a thermometer with a humidity gauge (hygrometer) can be installed inside. A shallow cup, like a repurposed sour cream container, can also be used to hold water, giving the eggs the moisture they require. Altogether, these components can be assembled to create a basic egg incubator for hatching eggs. In Figure 2.5 shown simple egg incubator[1].

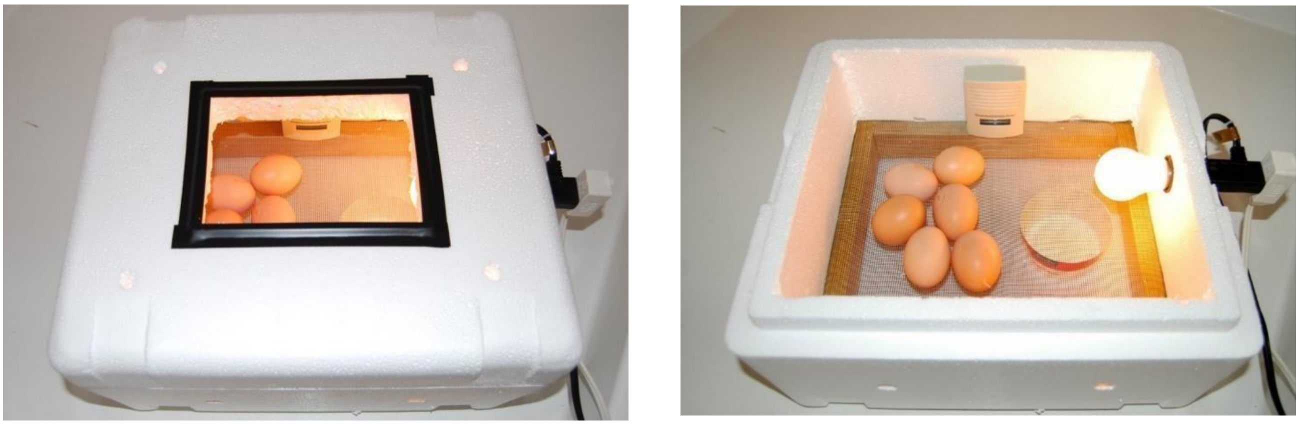


Figure 2.5 Simple egg incubator

This project has several disadvantages to consider.First of all, maintaining a precise range of 99 to 102 degrees Fahrenheit for a period of 21 days to allow for egg hatching proves to be difficult. Second, changing humidity during the winter months is challenging since it must be initially set at 40–50% for the first 18 days before being raised to 60–70% for the last 3 days. Last but not least, manually flipping the eggs several times a day adds more work because it demands continuous focus and effort. Together, these elements make the project difficult and sometimes labor-intensive[1].

2.3.2 W3001 Temperature Controller Egg Incubator [4]

In egg incubators, the W3001 temperature controller is frequently used to manage and maintain the ideal temperature for a successful egg hatch. Users can select the preferred temperature and check the current temperature using the digital controller. The W3001 controller is a well-liked option for small-scale egg incubation since it is portable and simple to operate. In Figure 2.6 shown W3001 temperature controller that manually contol the temperature of egg incubator[4].

Figure 2.6 W3001 temperature controller egg incubator

This project has a few disadvantages worth considering. First off, a less precise temperature control system could result in fluctuations in the required temperature range. Second, there is no humidity control option. The system also requires manual rotation, which can be time-consuming and provide problems for people with restricted mobility or for people who find it difficult to adhere to the rotation schedule consistently[4].

2.3.3 Pic 16F877-based Egg Incubator [2]

The advanced Pic 16F877-based egg incubator was created to offer the best conditions for a fruitful egg-incubation process. The main control unit of the incubator is the well-known Pic 16F877 microcontroller, which provides precise humidity and temperature control as well as a number of additional functions to guarantee the development and hatching of eggs. The incubator's programmable features allow it to be tailored to meet particular egg types and incubation needs, making it a useful tool for both amateur and professional breeders[2].

The inside environment of the Pic 16F877-based egg incubator is precisely monitored and controlled using a mix of temperature and humidity sensors. It has an intuitiveinterface that makes it simple for users to set and modify parameters including temperature, humidity levels, and rotation intervals. These inputs are processed by the microcontroller, which then regulates the ventilation, cooling, and turning of the eggs as necessary. This automation reduces human error while giving the eggs a consistent and stable environment during the incubation period[2]. In Figure 2.7 shown the pic based egg incubator

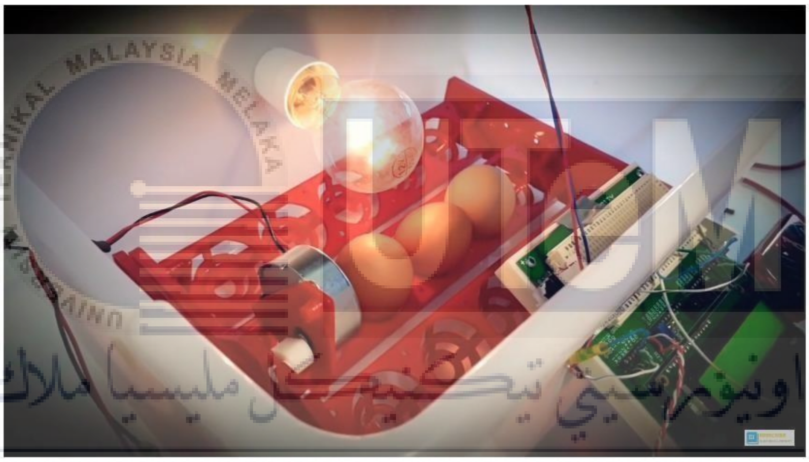


Figure 2.7 Pic 16F877 based egg incubator

The egg incubator project has some significant drawbacks. First of all, it has a restricted processing capacity, which could limit its ability to handle big volumes of data or complicated calculations effectively. Second, the project has few ways to grow, making it potentially difficult to add new features or scale the system up in the future. Last but not least, the incubator project's complicated programming may present a barrier for developers, necessitating advanced abilities and expertise to successfully code and maintain the system. These drawbacks draw attention to potential limitations in processing power, scalability, and technical know-how for this particular egg incubator project[2].

2.3.4 Internet of Things: Control and Monitoring System of Chicken Eggs Incubator Using Raspberry Pi[3]

Agriculture has undergone a change thanks to the Internet of Things (IoT), which has made strides in many other industries. One such project uses the Raspberry Pi, a well-liked single-board computer, to create a control and monitoring system for a chicken egg incubator. Throughout the incubation phase, this system uses IoT technology to provide remote control and continuous monitoring of critical parameters. For successful incubation, it has sensors to measure temperature, humidity, and egg flipping. The Raspberry Pi serves as the focal centre for data collecting and processing thanks to the sensors' connection to it. Users can access information using a web or mobile application from anywhere thanks to the internet-based transmission of the gathered data to a cloud platform. Additionally, the system has remote control capabilities that let users change temperature and humidity levels to maintain optimal conditions for egg incubation. In Figure 2.8 shown iot based raspberry pi egg incubator[3].

Figure 2.8 Internet of things based control and monitoring system of chicken eggs incubator using Raspberry Pi[3]

There are a few significant drawbacks to this project, which uses a Raspberry Pi to manage and monitor a chicken egg incubator via the internet of things (IoT). First off, IoT devices come with inherent security hazards because they can be attacked and used by unauthorised people. Second, the incubator's operation could potentially be affected by any interruptions or outages to the system's reliance on internet connectivity. Last but not least, individuals with less technical expertise may find it difficult to create and maintain such a system due to its technological complexity, which necessitates knowledge of both IoT and Raspberry Pi programming[3].

2.3.5 Temperature and Humidity Controller For Incubator Using Arduino[5]

Using Arduino, a project called "Temperature and Humidity Controller for an Incubator" attempts to develop a system that can control and maintain particular temperatures and humidity levels inside an incubator[5]. The ambient conditions inside the incubator are monitored and managed by this project using an Arduino microcontroller, a number of sensors, and a number of actuators. In order to maintain the desired settings, the Arduino board gathers data from the temperature and humidity sensors and modifies the output of the heating and cooling elements. The system can be set up to give real-time data monitoring, automatic corrections, and alarms in the event that predetermined parameters are violated[5]. In Figure 2.9 shown the egg incuator by using arduino.

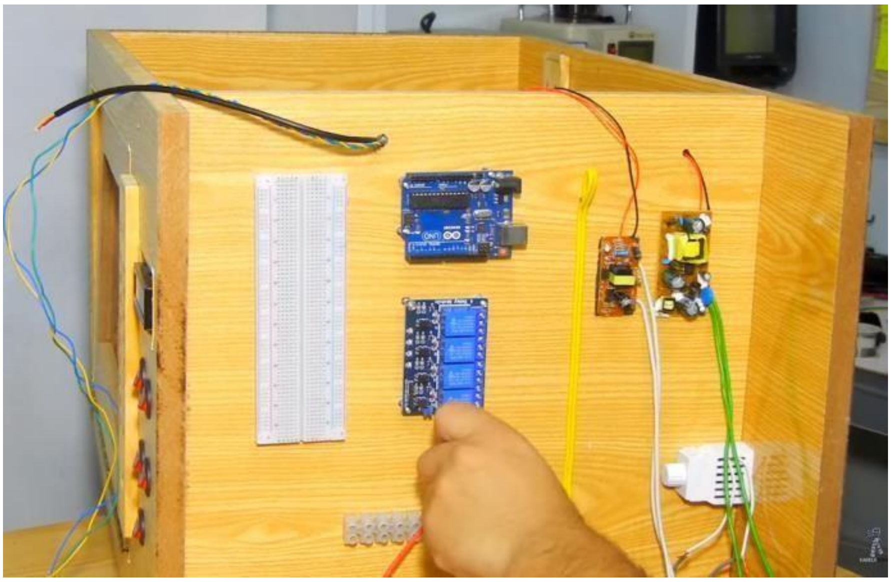


Figure 2.9 Temperature and humidity controller for incubator using Arduino

Using Arduino to create a temperature and humidity controller for an incubator has a number of drawbacks. Its processing power is its first limitation and may limit its capacity to tackle challenging jobs or vast volumes of data. Additionally, Arduino's lack of built-in connectivity can be a disadvantage because connecting to other devices or networks may need special setups or other components. Furthermore, the project's restricted scalability makes it potentially difficult to expand or adapt the system to meet new demands or improvements. These drawbacks draw attention to the project's limitations in terms of processing power, connectivity alternatives, and its capacity for expansion and adaptation[5].

2.3.6 Hen Egg Smart Incubator for Hatching System Based on Internet of Things [6]

When hens incubate eggs, a production issue arises for hen breeders when a large number of eggs hatch. This essay discusses the creation of an intelligent incubator system for hen eggs. Based on Arduino, LabVIEW, Google Firebase, and MIT App Inventor, this incubation system has automatic temperature, humidity, and egg rotation[6]. Additionally, the device enables farmers to remotely monitor the intelligent incubator. An intelligent temperature and humidity control system can increase the success rate of hatching since successful hen egg hatch rates are normally approximately 87.55 percent, with 0.41% of eggs hatching improperly, 1.84% of eggs hatching but dying at birth, and 10.20 percent not hatching. This system's goal is to make it accessible to researchers and farmers so that they can use it instead of selling it. The objective of this system is not to offer it for sale, but to make it available for researchers and farmers so that they can replicate it and carry out experiments. In order to do this, the system was kept as simple as possible[6]. In Figure 2.10 shown the block diagram using on Arduino, LabVIEW, Google Firebase, and MIT App Inventor.

Figure 2.10 Block diagram of smart incubator[6]

There are a few drawbacks to the Internet of Things (IoT)-based Hen Egg Smart Incubator for Hatching System. First off, it requires careful configuration and integration of a number of different components due to its complicated setup. It may be difficult for users, especially those with little technological know-how, to set up and run the incubator efficiently because of its complexity. Second, a number of IoT-related technologies, including sensors, networking protocols, and data analysis tools, are crucial to the project's success. Relying on these particular technologies can increase the chance of compatibility problems or obsolescence, which might limit the incubation system's long-term sustainability and scalability.

2.3.7 Intelligent Egg Incubator [7]

The Intelligent Egg Incubator is a piece of contemporary farming equipment made to speed up and automate the hatching of bird eggs. It attempts to increase poultry production and give farmers consistent revenue. The project uses electronic equipment and a microcontroller to regulate the incubator's temperature, lighting, humidity, and ventilation. Based on temperature measurements from sensors, the system automatically modifies the environment, turning on/off the bulb and fan as necessary. Circuits, sensors, a power source, and microcontrollers are all part of the hardware. The project's goals are to conduct research on existing egg incubators, design and create an appropriate Internet of Things-based egg incubator dubbed "Inkubator Pintar," and assess its effectiveness[7]. The goal of this project is to improve egg incubation and make it more effective and successful. In Figure 2.11 show the schematic diagram which can control temperature by red and blue light ,red for warm and blue for cool temperature.

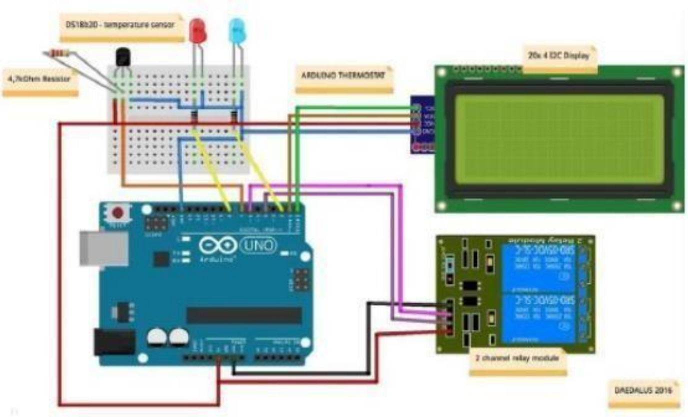


Figure 2.11 Schematic diagram-temperature controlled bulb[7]

There are a few drawbacks to the intelligent egg incubator idea to take into account. Its first drawback is that it has a small capacity, which prevents it from holding a lot of eggs at once. Users that need a larger number of eggs to be incubated simultaneously may find this to be a constraint. Second, if the incubator is exposed to harsh weather, like hot or rainy days, it could be dangerous. These circumstances could have a negative impact on the incubator's temperature and humidity levels, endangering the success of the incubation process. To reduce these hazards, it is essential to take preventative steps and make sure the incubator is situated in a favourable environment.

2.3.8 Design and Intelligent Egg Incubator of a Microcontroller[8].

This study describes a low-cost, automated hatching mechanism for duck eggs that regulates relative humidity and temperature to create a comfortable environment. Over the course of six months in 2020, the study was carried out in the Bangladeshi village of Charsita, Lakshmipur. The project entailed monitoring and controlling temperature and humidity levels using an icebox and an ATmega328p microcontroller based on information obtained from the DHT22 sensor[8]. It was discovered that a consistent temperature of 35.6 °C to 37.8 °C and relative humidity of 60% to 80% were the best circumstances for egg hatching. An LCD (16*2) and matrix keyboard (4*4) were built into the device to enable simple control and monitoring. The study seeks to offer straightforward hatching processes and records the sensor and system testing[8]. In Figure 2.12 shown the prototype of this project that design by Atmega 328p microrocontroller.

Figure 2.12 The prototype of this project

Its limited application, which refers to its limited utility or relevance in multiple circumstances, is this project's fundamental flaw. The project specifically focuses on creating a microcontroller-powered intelligent egg incubator. The drawback of this innovation is its narrow range of use, despite the fact that it may have some benefits like improved control and monitoring capabilities. The intelligent egg incubator might only serve a particular market or sector, which could restrict its applicability or influence in more general contexts.

2.3.9 Design and Implementation of a Microcontroller Based Forced Air Egg Incubator[9].

In order to achieve a cost-effective design, a microcontroller-based low-cost incubator has been created using materials and resources that are readily available locally. built-in incubator combines the hatcher and setter into one. The incubator is made up of three main components: the casing, which guarantees hygienic and effective thermal isolation; forced air, which maintains a constant temperature throughout the egg; an automatic system for turning the egg tray; and a microcontroller-based control unit, which keeps track of and regulates the incubation parameters, including temperature, humidity, ventilation, and egg turning. An additional liquid crystal display with twenty characters and four lines is used to show settings during configuration and the state of the system while it is in use. Hen and duck eggs have been tested in the incubator[9]. In Figure2.13shown the structure of egg incubator.

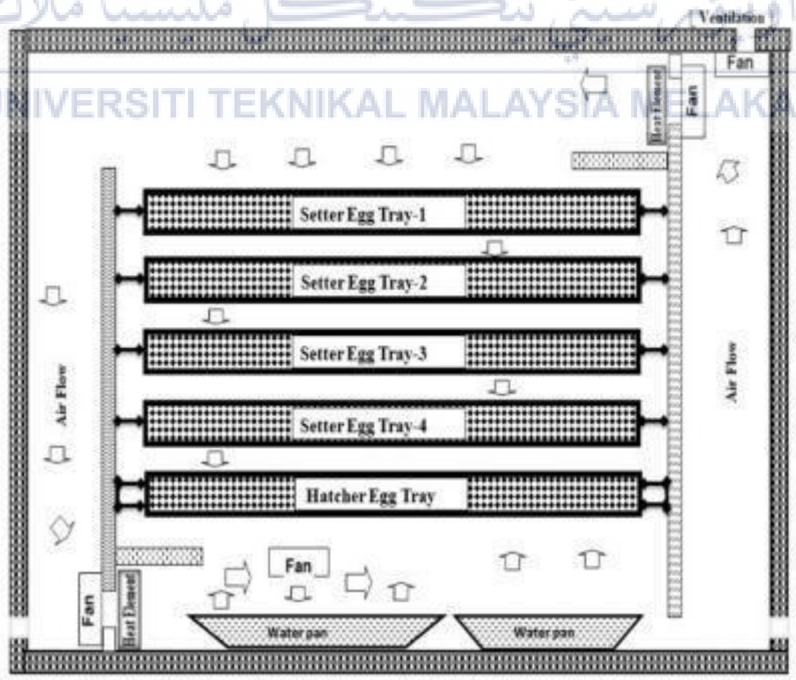


Figure 2.13 Structure of the incubator[9]

The forced air egg incubator idea using microcontrollers has the drawback of requiring meticulous temperature and humidity control. This implies that any changes or departures from these conditions could have a negative effect on the incubation process and perhaps result in an unsuccessful hatching. Another drawback is the system's limited scalability, which means it might be difficult to expand the project to handle more eggs or boost production capacity.

2.3.10 Devolopment of The Smart Chicken Eggs Incubator Based on IoT The Object Oriented Analysis and Design Method[10].

One of the Internet of Things's applications in the area of animal husbandry, specifically with regard to the hatching of chicken eggs, is the Smart Chicken Eggs Incubator.Breeders use artificial incubators to hatch chicken eggs, but there are still human processes used for monitoring the incubator's environment, including temperature, humidity, and egg changes. These manual processes cause complications while hatching chicken eggs. This study describes the creation of a Smart Chicken Eggs Incubator System prototype using the Internet of Things, which consists of three subsystems: web-based applications, Telegram bots, and embedded systems. The Smart Chicken Eggs Incubator System's web application software was created utilising the Object-Oriented Analysis and Design (OOAD) methodology. Based on sensor data sent during the egg hatching process, the web apps created can be used to keep an eye on the incubator's conditions. Real-time monitoring of the incubator's temperature, humidity, egg transfer, and other variables is possible while using the Telegram bot[10]. Message notifications are also available if the incubator's settings move outside of the predetermined range. The 21-day prototype testing involved 3,402 records of data input at intervals of 5 minutes, and the results showed that 9 to 10 minutes is the ideal duration for each entry. Internet of Things, OOAD, Web Apps, Smart

Chicken Eggs Incubator System, and Telegram Bot are some related keywords[10]. In Figure 2.14 shown a blockdiagram[10].4

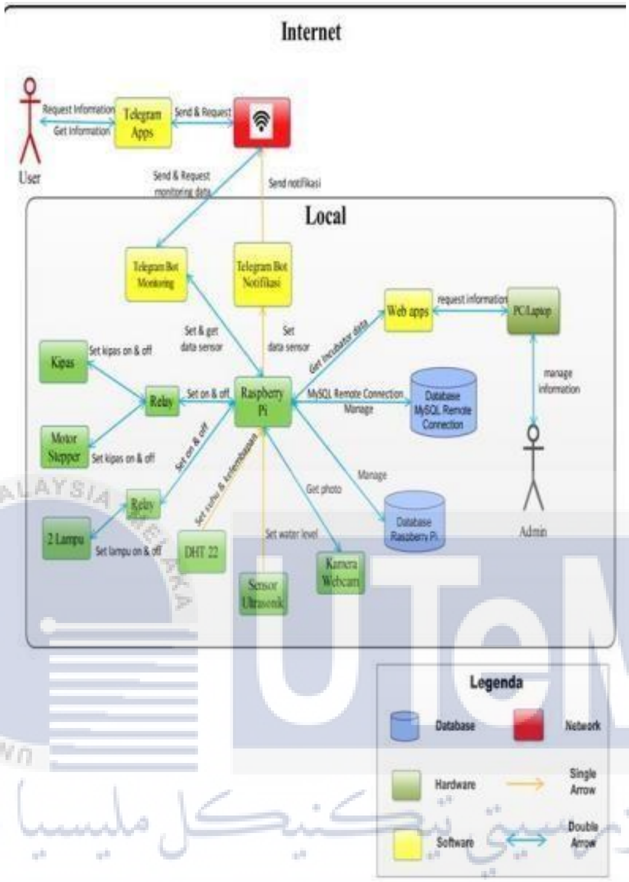


Figure 2.14 Blockdiagram[10]

The delay in data entry is a drawback of the smart chicken egg incubator project, which was created utilising IoT and the object-oriented analysis and design method. This indicates that there is a lag or omission in the data entry procedure into the system. Since the incubator depends on precise and timely data for optimal performance, this can reduce its efficiency. The delay in data entry could cause errors or inefficiencies in monitoring and controlling the incubation process, which could have an impact on the overall success rate of hatching chicken eggs.

2.3.11 Design and Implementation of Fuzzy Contro System for Egg Incubator Based on IoT Technology.[12]

More and more industries are employing automatic systems these days, minimising or completely eliminating the need for human intervention. In the chicken poultry sector, mechanical egg-incubating technologies are gradually replacing the usage of mother hens. These devices enable farmers to automatically incubate eggs without requiring human assistance. By maintaining the ideal levels of temperature and humidity, these systems function[12]. In this manner, the foetuses inside the eggs develop without the mother hen's presence. The egg incubation devices not only significantly increase poultry output but also aid in the regularity of income generation, allowing the farmers to move into potential rural entrepreneurship. In this paper, the design and implementation of an IoT-based fuzzy control system for incubating eggs are discussed. In order to maintain ideal settings for various egg types, the microcontroller is programmed to function as a fuzzy logic control system for managing microclimate conditions in the egg incubator. The cloud receives wireless data from the temperature and humidity sensors. The established egg incubation system also makes it possible to automatically track the number of days until birds hatch. This enables remote monitoring of the microclimate within the egg incubator from any location. The egg incubator is created for the experimental work analysis of the established egg incubation system. Based on the findings of the experimental study, it can be concluded that the egg incubation system functions effectively and aids in increasing poultry output. In Figure 2.15 shown the onnection of sensor to Atmega328.[12

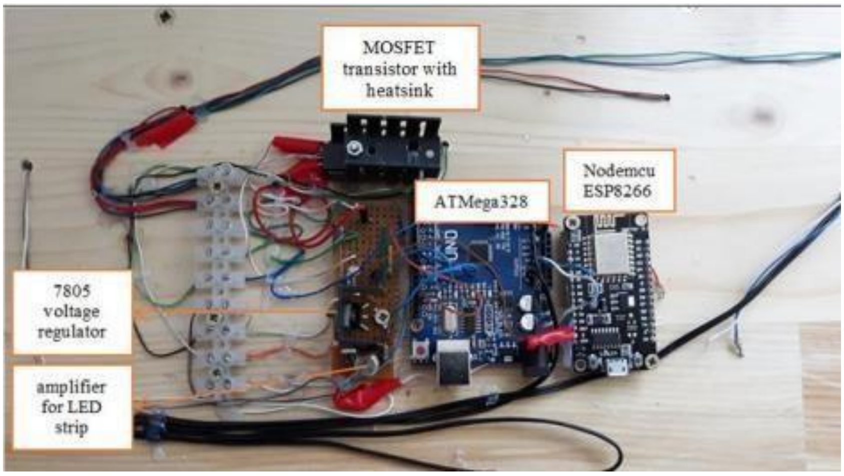


Figure 2.15 Sensor connection to ATmega328

There are certain drawbacks to the project that involves designing andimplementing a fuzzy control system for an egg incubator using IoT technologies. The project's poor adaptability, for starters, suggests that it might not be easily adjustable or adaptable to various contexts or particular needs. Second, potential technical problems that can develop during system development or use could cause hiccups or malfunctions. Despitethese issues, the project intends to develop an effective and automated egg incubator systemusing fuzzy control and IoT technologies, providing benefits including enhanced temperature regulation and remote monitoring capabilities.

2.3.12 Development of Fertile Egg Detection and Incubation System Using Image Processing and Automatic Candling[14].

The construction of an incubator system for autonomous temperature and humidity control utilising an Arduino microcontroller interface and code is described in this study.programming in LabView. The suggested system also contains crucial tasks for hatching eggs, such as turning eggs using a crank-rocker mechanism and a hatchingchamber, as well as candling, which involves identifying infertile eggs using simple picturecollection.

It concentrates around combining every aspect of egg incubation into a singleapparatus. It runs on its own without requiring constant checking and adjusting to achieve the best parameters. The user can access real-time information on the daily state of the incubator's parameters by using its monitoring tools. The incubator performed best at an optimal temperature of 36 degrees Celsius with a humidity level between 40% and 60%. Thepace of its automatic candling programme is 1.129 seconds. Last but not least, the proposedsystem has a 69.44% hatch rate percentage and a 91.43% accuracy percentage for identifyingfertile eggs. In Figure 2.16 shown the physical design of egg incubation[14].

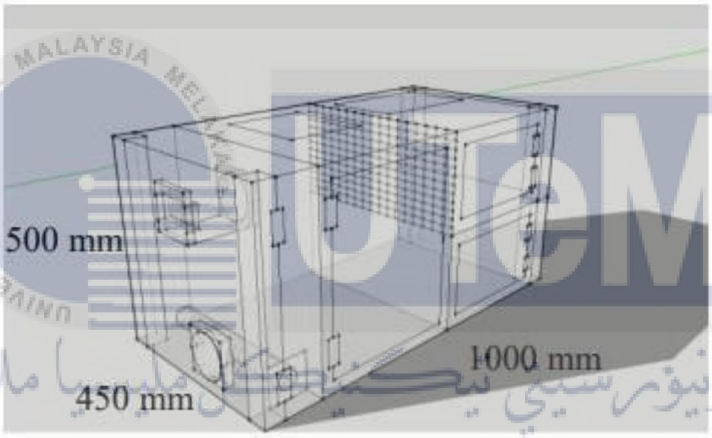


Figure 2.16 Physical design of the proposel incubation system

This project, which focuses on the creation of a system for automatically candling using image processing to locate fertile eggs, has a few significant drawbacks. First off, a lack of ventilation can potentially make it difficult for the incubation system's correct airflow and oxygen supply, which are essential for the eggs' healthy development. Second, the absence of a monitoring system renders it impossible to efficiently monitor and track crucial factors like temperature, humidity, and the general incubation process. These flaws could create difficulties and restrict the system's ability to provide ideal circumstances for successful egg incubation and hatching.

2.3.13 Temperature Monitoring System for Baby Incubator Based on Visual Basic[15]

An incubator room is made to maintain a warm temperature for the baby's comfort. It is inconvenient and time-consuming to have the incubator room's temperature monitoring system separate from the officer's workspace. The goal of the project was to create a temperature detector for a baby incubator that could be directly monitored in a staff room and maintained a steady temperature. The design employed an LM35 sensor as a temperature detector, which was installed in a 100 × 80 centimetre chamber. The LCD and computer in the staff room both displayed the temperature that was detected. An Arduino Uno microcontroller transformed the temperature (°C) into an ADC (Analogue Digital to Converter) value. To measure the temperature, several LM35 sensors were put in the various rooms. The LM 35 sensor was chosen in light of its ability to be directly calibrated in Celsius, linear scale factor of 10mV/°C, and temperature range of -55°C to 150°C. Figure 2.17 shown the LM35 sensor schematic diagram[15].

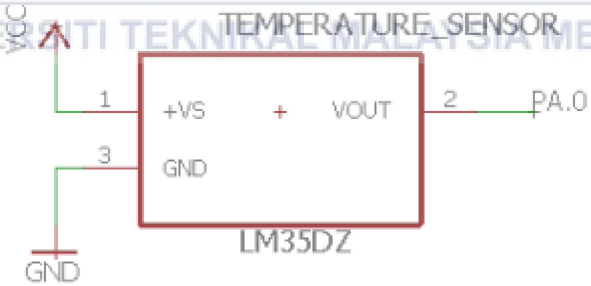


Figure 2.17 LM 35 sensor schematic diagram.

This project uses Visual Basic to create a temperature monitoring system for a baby incubator, however it has some noticeable drawbacks. First off, it lacks remote monitoring features, making it impossible for carers or medical experts to receive real-time temperature information from a distance. This constraint may make it difficult for them to keep an eye on the incubator's temperature and quickly address any changes or problems. The project can also encounter difficulties with maintenance and troubleshooting. The efficiency and dependability of the temperature monitoring system may be jeopardised in the absence of a reliable mechanism for handling technical issues or performing regular maintenance.

2.3.14 Design of Monitoring of Egg Incubator Machine Based on IoT of Things Wint ESP8266 and Web server[17]

In most cases, egg incubator technology still makes use of basic wooden boxes filled with chaff and sand, which are then placed inside with the eggs to be hatched using a manually operated electric or oil lamp.Through this study, an egg incubator that can be managed via a web server will be created. The instrument created is an Internet of Things-enabled temperature and humidity detector for an egg incubator.The DHT-22 temperature sensor and the NodeMcu ESP8266 microcontroller were used to create the egg incubator monitoring system, which was successfully developed at a temperature range of 370°C to 380°C and a humidity level of 40% to 53%.A Web Server connected to the internet network on Web Server Ubidots can be used to remotely control this egg hatching monitoring system in real-time using smartphones. In Figure 2.18 shown the prototype of incubator machine[17].

Figure 2.18 Incubator machine[17]

There are a few drawbacks to the project of creating an IoT-based egg incubator machine using the ESP8266 and a web server. It may first run into space issues because incubator devices normally need a specific amount of room to fit the eggs and offer adequate air. Implementing the IoT components and making sure they fit in the limited area can be difficult. Second, the project can encounter issues with temperature precision. Successful egg incubation depends on maintaining accurate temperature control, and the deployed IoT components might not offer the maximum level of accuracy needed for the best outcomes. To obtain the greatest results, these drawbacks should be taken into account when designing and implementing the monitoring system.

2.3.15 Design and Implementation of a Remotely Monitored Smart Egg Incubator[19]

The microcontroller-based automated smart egg incubator can help with large-scale generation of chicks for poultry establishment. It involves an automatic transfer switch that shifts the load to any available source while prioritising the grid to ensure a consistent supply of electricity. A DHT22 sensor is integrated into the automatic temperature and humidity monitoring system of the incubation system to achieve temperature regulation, ensuring that the temperature and humidity are within the desired value. The egg spinning device, which rotates the egg at a 45° angle every hour, was created by connecting an egg tray to a DC motor. The eggs may hatch at around 21 days due to variations in temperature and humidity. A sound sensor detects a day-old chick's sound and uses it to alert the farmer of the farm's status. An LCD shows the temperature and humidity of the incubator as well as the overall temperature and moisture level in the farm. The system is adaptable and less stressful to usebecause a GSM module for remote monitoring sends temperature and humidity updates to the farmer upon request[19]. The outcome demonstrates that the system could control the temperature between 37 and 39 degrees Celsius, which was suitable for the egg to hatch. Because the device allows for temperature and spinning time adjustments through its presetbottoms, it may be utilised for a variety of egg kinds. In Figure 2.19 shown the proteus stimulator displaying on LCD[19].

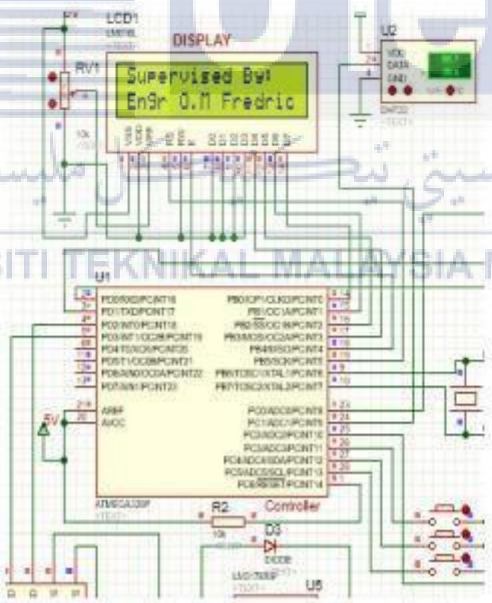


Figure 2.19 Proteus simulator displaying on LCD[19]

There are a few drawbacks to the remotely monitored smart egg incubator idea that should be taken into account. First off, it might not be adaptable enough to meet certain egg needs. Due to the fact that the design and implementation are based on specified settings, it might not be able to meet the special requirements of some species or eggs. The incubator's level of involvement and monitoring capabilities may also be constrained. Although the remote monitoring option is convenient, it might not provide real-time or complete data on the incubation process, which could make it difficult to control and alter things to their bestability. When assessing the success and usefulness of the smart egg incubator project, severaldrawbacks should be taken into account.

2.4 Comparison of Research Paper

Table 2.1 Comparison of research paper

NO	TITLE	REFERENCE	DISADVANTAGE
1	simple egg incubator	[1]	• Temperature control precision may not be as accurate • No humidity control • Need to rotate the manually
2	W3001 Temperature Controller Egg Incubator	[4]	• Temperature control precision may not be as accurate • No humidity control • Need to rotate the manually
3	Pic 16F877-based Egg Incubator	[2]	• Limited processing power • Limited expansion options • Programming complexity

4	Internet of Things: Control and Monitoring System of Chicken Eggs Incubator Using Raspberry Pi	[3]	• Security risks • Reliance on internet connectivity • Technical complexity
5	Temperature and Humidity Controller For Incubator Using Arduino	[5]	• Limited processing power • Lack of built-in connectivity • Limited sclability
6	Hen egg smart incubator for hatching system based on internet of things	[6]	• Complexity of setup • Dependency on specific technologies
7	intelligent egg incubator	[7]	• Cannot put too many egg inside incubator • Perilous if the incubator put under the hot day or rainy day.
8	Design and intelligent egg incubator of a microcontroller.	[8]	• Limited applicability
9	Design and implementation of a microcontroller based forced air egg incubator.	[9]	• Reliance on careful temperature and humidity control • Limited scalability

10	Devolopment of the smart chicken eggs incubator based on iot the object oriented analysis and design method.	[10]	• Time gap for data entry
11	Design and implementation of fuzzy contro system for egg incubator based on iot technology.	[12]	• Limited adaptability • Potential technical issues
12	Development of fertile egg detection and incubation system using image processing and automatic candling.	[14]	• No ventilation • No monitoring system
13	Temperature monitoring system for baby incubator based on visual basic	[15]	• Lack of remote monitoring capabilities • Maintence and trubleshooting
14	Design of monitoring of egg incubator machine based on IOT of things wint ESP8266 and Web server	[17]	• Space problem • less accuracy in temperature

15	Design and implementation of a remotely monitored smart rgg incubator	[19]	•lack of flexibility for specific egg requirements •limited interaction and monitoring

2.5 Summary

In conclusion, there is a lot of potential for improving the effectiveness and success rate of egg incubation procedures with the creation of an IoT-based monitoring and control system. An incubation system that is more automated and precise has been made possible by the incorporation of numerous sensors and the use of a microcontroller for control and monitoring chores. There are still some restrictions that need be taken into account, such as the requirement for optimising the control algorithms and assuring compatibility withvarious egg kinds. To overcome these constraints and enhance the system's overall performance and dependability, more research and development is necessary. Despite this, there is still interest in and funding for automated monitoring and control of egg incubationdue to its advantages.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Agriculture has been transformed by the growth of Internet of Things (IoT) technology, which has impacted many other industries. IoT-based technologies have been used in the poultry farming industry to increase egg incubation productivity and efficiency. In this part, we want to create and put into use a microcontroller-based monitoring and control system for egg incubators.

3.2 Block Diagram of the System

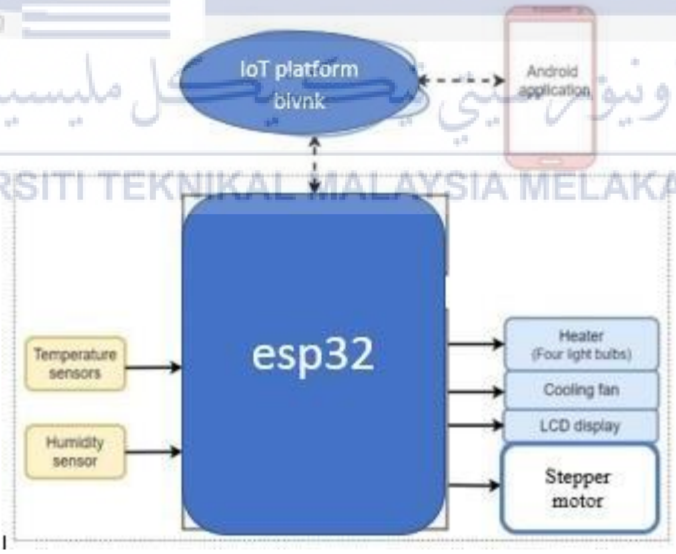


Figure 3.1 Block diagram

This system is made up of a number of parts, including sensors, an ESP32 microcontroller-based control system, actuators, and an Android app. In Figure 3.1 show the block diagram of the project. Two thermistors are used to monitor temperature, and a DHT11 sensor is used to measure humidity and temperature. The technology guarantees precise sensor readings within predetermined bounds.Due to the greater temperature, water is utilised for evaporation in the egg incubator to maintain the desired humidity level. A cooling fan is activated to lower the humidity to the appropriate range if it rises above the user-set value. Additionally, the ventilation fan is turned on every 30 minutes and runs for 3 minutes before shutting off automatically.

3.3 Flowchart of the System

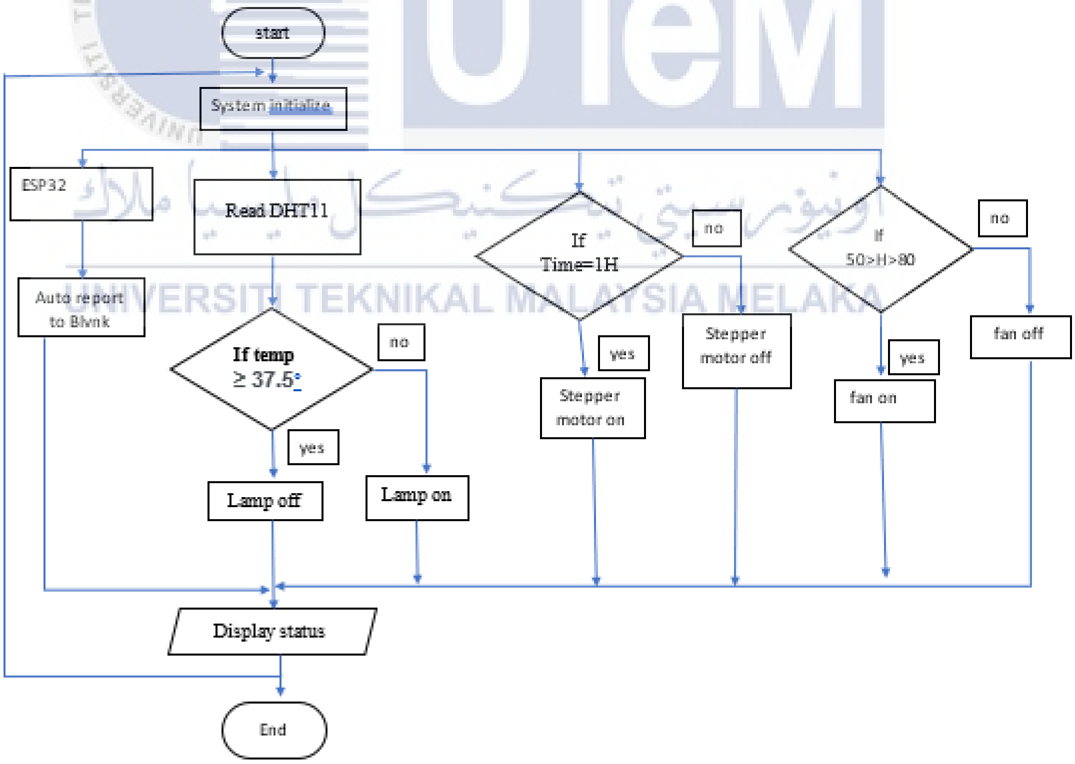


Figure 3.2 Flow chart

From Figure 3.2 above flow chart , we can conclude the DHT11 sensor will read the temperature more than and equal to 37.5 degree will off the lamp, while less then 37.5 degree the lamp will on. in Other than that if , each and every 1 hour the motor will on. Moreover the humidity fan will on when the humidity level detect 80% while less 50% the fan will off. Finally from ESP32 we can control and monitor the egg incubator.

3.4 Circuit Diagram of the System

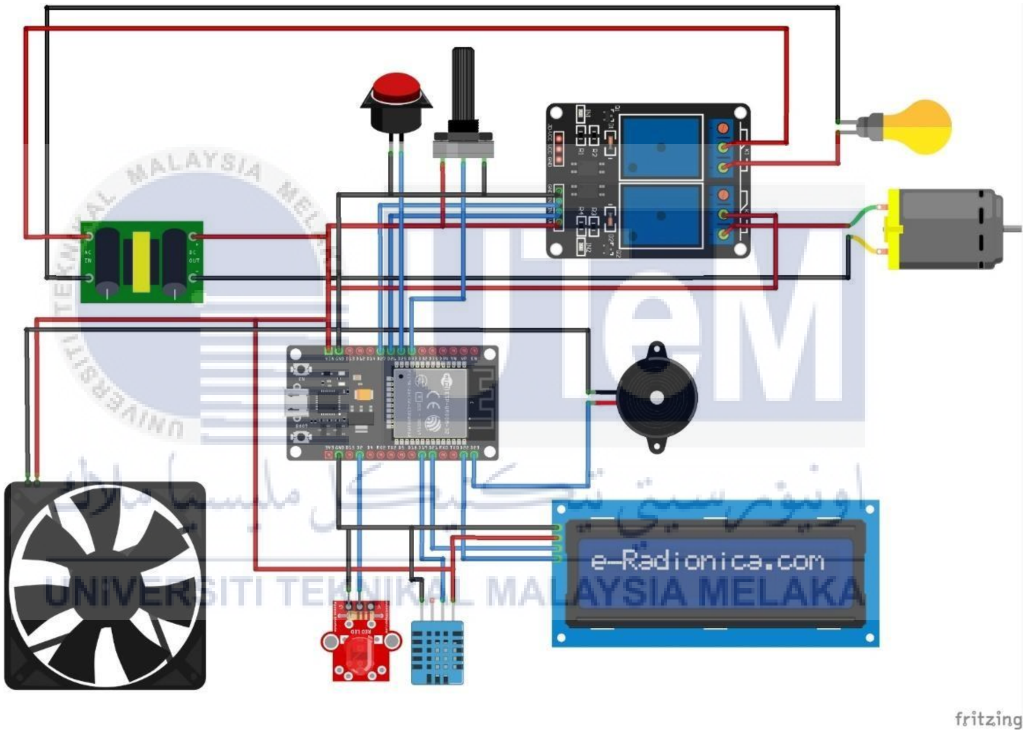


Figure 3.3 Schematic diagram

Several crucial elements make up the schematic diagram for the creation of an IoT-based egg incubator monitoring and control system employing a microcontroller. First, the central processing unit is a microcontroller like an ESP32. To keep track of the conditions inside the egg incubator, it is connected to a number of sensors, including temperature and humidity sensors.

An actuator, such as a fan or lamp, is also attached to the microcontroller and can be regulated to manage the environment's temperature and humidity levels. In order to enable remote monitoring and control of the egg incubator, the microcontroller is also connected to an IoT module, such as a Wi-Fi module. The system can send data to a cloud platform or mobile application for monitoring purposes thanks to this IoT module. The Figure 3.3 shown schematic diagram, how several parts can be integrated to monitor and manage the egg incubator using a microcontroller, which offers an effective and automated solution.

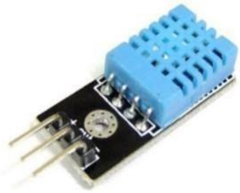
3.5 List of Equipment

3.5.1 Hardware

Table 3.1 shows the list of hardware component that used in this project.

Table 3.1 Hardware

NO	HARDWARE	PICTURE	QUANTITY	PRICE(RM)	DESCRIPTION
1	Step down transformer		1	68	Decreases the voltage from a higher level to a lower level while maintaining the frequency of the input signal.
2	Power supply 5v		1	9	Convert voltage, current, and frequency required to power electronic devices.
3	Servo motor SG-90		1	10	To rotate the egg

4	DHT-11		1	5	To detect temperature and humidity
5	ESP32		1	50	Main microcontroller
6	LCD 16*2		1	13	Display screen
7	AC bulb		2	5	Use for temperature
8	Fan		2	30	Use for humidity
9	Relay coil		1	4	Switching function

3.5.1 Software

Table 3.2 shows the list of software that used in this project.

Table 3.2: Software

Software	Picture	Description
Arduino software		Software to code program.
Thing speak		To adjust and analysis data(IOT)

3.6 Summary

The methodology described above offers a foundation for the creation of an IoT-based monitoring and control system for egg incubators. We can develop an effective and automated system for incubating eggs by utilising the capabilities of a microcontroller, integrating numerous sensors and actuators, and putting communication protocols into place. This method increases hatching success rates while also allowing for remote monitoring and control, which is more convenient for chicken breeders.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

Microcontroller-based IoT-based egg incubator monitoring and control systems represent a significant development in the poultry farming industry. The efficacy and dependability of this automated incubation system are demonstrated by the projected hatchability %. Due to the system's capabilities, incubation chicken eggs can be done in a streamlined and effective manner. This cutting-edge device makes use of the IoT's power and combines it with a microcontroller to provide real-time monitoring and control of critical environmental factors within the incubator. The project's potential to revolutionize egg incubation procedures and improve the general productivity and success of chicken businesses is highlighted in this introduction, which also demonstrates the project's promising character.

4.2 Calculation

Equation 1 is used to compute the incubated eggs' % fertility:

$$\text{Fertility per cent} = \frac{\#\ of\ fertile\ egg}{\#\ of\ incuvated\ \text{eggs}} * 100 \qquad (1)$$

From equation 1 the fertility of the incubated eggs becomes:

$$\text{Fertility per cent} = \frac{6}{10} * 100 \qquad = 60\%$$

The percentage of hatchability can be calculated according to the following equation 3:

$$Hatchability\ percentage = \frac{\#\ of\ hatched\ \ egg}{\#\ of\ fertile\ eggs} * 100 \qquad (3)$$

From equation 3 the hatchability of the eggs can be calculated as follows:

$$Hatchability\ \% = \frac{4}{} * 100 \qquad = 67\%$$

4.3 Prototype

The project prototype was completed through a series of stages that included necessary elements. The prototype includes the following components: a 240V lamp, a 12V fan, a DC motor, an I2C LCD, a potentiometer, a DHT11 humidity and temperature sensor, a push button, a solid-state relay, and an ac power source to power the ESP32 with a shield. The system is intended to run off of AC power. It is imperative that these parts are securely connected before turning on the power supply. The prototype enclosure was painstakingly built to provide a clean appearance and concealment of wires and components. Figure 4.1 and Figure 4.2 shows the view of the project.

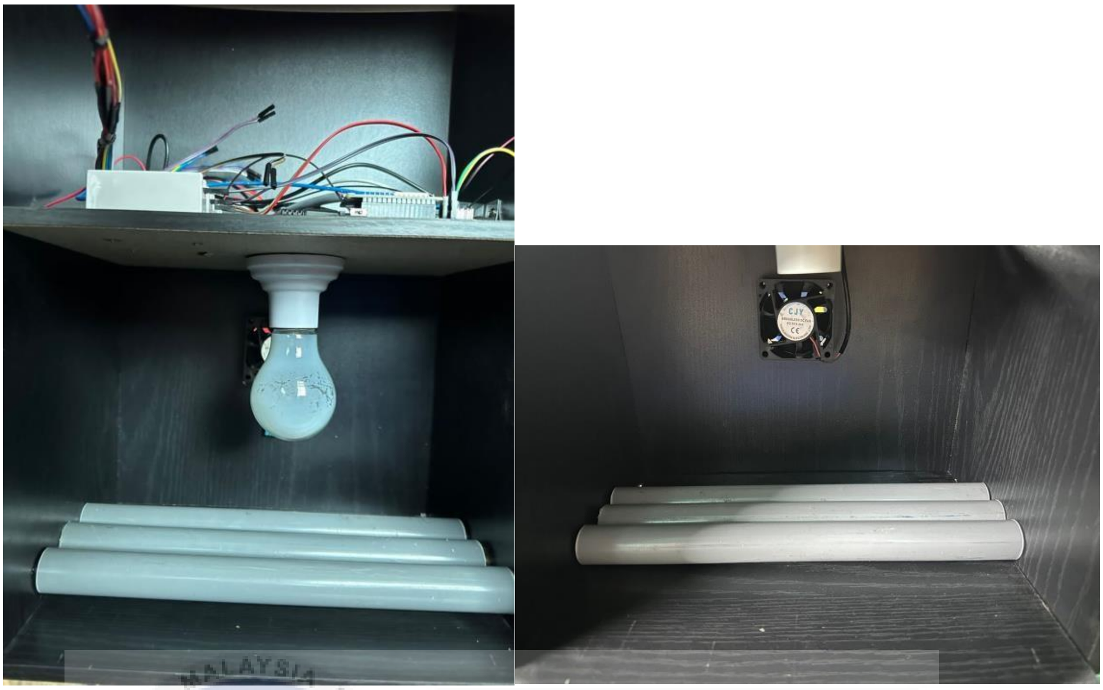


Figure 4.1 Inside view of project

Figure 4.2 Show top view of prototype

4.4 Result

The DHT11 temperature and humidity sensor is specially monitored by the ESP32, which is configured to send sensor data to Blynk on a regular basis. The lamp turns on when the temperature is less than or equal to 37.5 ° Celsius, and turns off when it is higher. The DC motor is additionally programmed to turn once per hour. The fan controls the humidity by turning on when the humidity drops below 50% and off when it rises above 80%. This all-inclusive system makes sure that the climate is automatically controlled. The motor rotates at predetermined intervals, and the lamp and fan are adjusted according to the temperature and humidity levels.

4.4.1 Result Prototype

The ESP32 is programmed to periodically report sensor data to Blynk. Figure 4.3 show the wireless connection to ESP32

Figure 4.3 Show the wifi connecting

Figure 4.4 show the temperature setting for egg incubator

Figure 4.4 Show temperature setting

Fugure 4.5 show egg incubator on

Figure 4.5 Show egg incubator on

Figure 4.6 show the monitoring and control system in Blynk app.

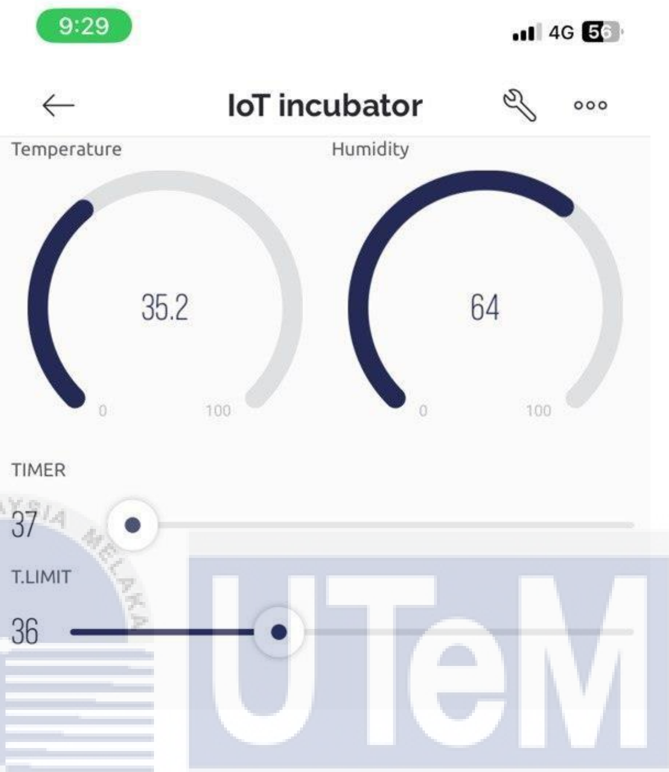


Figure 4.6 Show the Blynk monitoniring and control system

4.5 Summary

The expected percentage is impressive and a strong indicator that the automated incubation system will get good rate of hatch rate chicks. Consequently, it can be utilised to incubate chicken egg[22].

CHAPTER 5

CONCLUSION

5.1 Conclusion

In conclusion, there is great potential for revolutionising the egg incubation process with the creation of an Internet of Things (IoT)-based monitoring and control system for egg incubators. This approach tackles the labor-intensive and error-prone nature of manual incubation by utilising technology to automate and optimise the environmental conditions essential for effective hatching. The system provides remote monitoring and management of critical variables like temperature and humidity through the integration of sensors, microcontrollers, and other IoT devices. Users are given thorough insights into the incubation process thanks to real-time data accessibility through a web-based interface, enabling quick modifications and interventions as needed. Implementing this automated method leads to higher hatching success rates, a decrease in human error, and ultimately healthier and more plentiful chick production. A cost-effective and efficient option is also provided by the IoT-based incubation system, opening the door for developments in the poultry sector and promoting the sustainable growth of poultry farming practises. The incorporation of IoT technology in egg incubation marks a significant advancement in modernising and optimising a crucial area of poultry production with the potential to improve productivity and streamline operations.

5.2 Potential for Commercialization

More than just a practical fix for chicken farmers, our development of an iot based egg incubator monitoring and control system by using microcontroller symbolises a revolution in the way we think about egg incubation. Our system offers a way forward for increased sustainability and efficiency in chicken farming operations, while also streamlining the hatching process through the seamless integration of advanced IoT technologies with precision control mechanisms. Our solution is flexible, scalable, and compatible with current farm management systems, enabling it to meet the demands of farmers at different scales, ranging from modest garden operations to large-scale commercial hatcheries. Furthermore, our technology is at the vanguard of the agricultural industry's embrace of digitalization and data-driven decision-making, providing farmers with actionable insights and real-time monitoring capabilities to maximise productivity and optimise their operations.

Furthermore, the growing demand for products that are ethically sourced and environmentally conscientious is only one of the emerging market trends and customer preferences that our development of an iot based egg incubator monitoring and control system by using microcontroller is prepared to capitalise on. Our solution not only satisfies but surpasses standards for sustainable farming methods by lowering energy usage, minimising waste, and providing remote accessibility. This puts us in a position to be a major force in poultry production going forward, promoting innovation and expanding the agricultural industry. Our Smart Egg Incubator system is more than simply a product; with its vast economic potential and numerous advantages, it is a catalyst for positive change in the way we produce food sustainably for future generations.

5.3 Future Works

In the future ,there are several suggestions for further development and enhancement of my project:

1. Environmental Sensors: To guarantee ideal circumstances for egg incubation, extend sensor capabilities to incorporate other environmental parameters like CO2 levels, air quality, or ambient light intensity.

2. Remote Monitoring Cameras: Install cameras inside the incubator for remote visual monitoring of the eggs using a mobile application. This will enable users to observe the incubation process up close.

3. Emergency Alert System: Establish an emergency alert system that will automatically send users an SMS or email in the event of a major incident, such as a power outage, temperature variations that exceed safe bounds, or equipment failures.

4. Energy Efficiency Optimisation: Use energy-efficient components whenever possible, schedule tasks during off-peak hours, and incorporate features like sleep modes for components to maximise the system's energy efficiency.

5. Integration with Smart Home Systems: Provide voice control functionality and a smooth integration into pre-existing smart home configurations by enabling integration with well-known smart home systems like Google Home or Amazon Alexa.

We may improve our project usefulness, performance, and market potential by pursuing these future projects. These improvements will result in a more resilient, intuitive, and creative solution that will meet our customers' changing needs and guarantee the product's profitability.

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APPENDICES

APPENDIX A Project Coding

```
#define BLYNK_TEMPLATE_ID "TMPL6Oxovhh6L"
#define BLYNK_TEMPLATE_NAME "IoT incubator"
#define BLYNK_AUTH_TOKEN "IGl530dq8vVu2x_OUkI5TAcbRv7BiNcg"
#define BLYNK_PRINT Serial

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

char ssid[] = "abc";
char pass[] = "123456789";

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);

#include "DHTesp.h"
#define DHTpin 19
DHTesp dht;
float humidity;
float temperature;

int buzzer = 23;
int led = 2;
int lampu = 27;
int motor = 26;

const int buttonPin = 25;
int buttonState = 0;

const int analogInPin = 33;
int sensorValue = 0;
int outputValue = 0;

int flag = 0;

int state = LOW;
unsigned long previousMillis = 0;
const long interval = 500;

int timers = 0;
int timer_set = 0;

void setup()
```

```
{
  Serial.begin(115200);

  dht.setup(DHTpin, DHTesp::DHT11);

  pinMode(buzzer, OUTPUT);
  pinMode(led, OUTPUT);
  pinMode(lampu, OUTPUT);
  pinMode(motor, OUTPUT);

  pinMode(buttonPin, INPUT_PULLUP);

  lcd.init();
  lcd.backlight();

  lcd.clear();

  lcd.setCursor(0,0);
  lcd.print("Connecting Wifi");
  lcd.setCursor(0,1);
  lcd.print("----------------");

  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);

  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print(" Wifi Connected");
  lcd.setCursor(0,1);
  lcd.print("----------------");

  digitalWrite(buzzer,HIGH);
  delay(50);
  digitalWrite(buzzer,LOW);
  delay(50);
  digitalWrite(buzzer,HIGH);
  delay(50);
  digitalWrite(buzzer,LOW);
  delay(3000);
  lcd.clear();
}

void loop()
{
  Blynk.run();
  read_function();
}

void read_function()
```

```
{
  unsigned long currentMillis = millis();
  if (currentMillis - previousMillis >= interval)
  {
    previousMillis = currentMillis;
    if (state == LOW)
    {
      state = HIGH;
      humidity = dht.getHumidity();
      temperature = dht.getTemperature();

      if(flag == 1)
      {
        timer_set--;
        Serial.println(timer_set);

        if(timer_set <= 5)
        {
          digitalWrite(motor,HIGH);
        }

        if(timer_set == 0)
        {
          digitalWrite(motor,LOW);
          timer_set = timers;
        }
      }
    }
    else
    {
      state = LOW;
    }
  }

  buttonState = digitalRead(buttonPin);

  if (buttonState == LOW)
  {
    digitalWrite(buzzer, HIGH);
    delay(250);
    digitalWrite(buzzer, LOW);
    flag = !flag;
  }

  lcd.setCursor(0,0);
  lcd.print("T:");
  lcd.print(temperature);
  lcd.print("  ");
```

```
  lcd.setCursor(0,1);
  lcd.print("H:");
  lcd.print(humidity);
  lcd.print("  ");

  lcd.setCursor(10,0);
  lcd.print("S:");
  lcd.print(outputValue);
  lcd.print("   ");

  Blynk.virtualWrite(V0,temperature);
  Blynk.virtualWrite(V1,humidity);

  if(flag == 1)
  {
    digitalWrite(led, HIGH);
    lcd.setCursor(9,1);
    lcd.print(" start   ");
    if(temperature >= outputValue)
    {
      digitalWrite(lampu, LOW);
    }
    else
    {
      digitalWrite(lampu, HIGH);
    }
  }
  else
  {
    timer_set = timers;
    sensorValue = analogRead(analogInPin);
    outputValue = map(sensorValue, 0, 4095, 0, 99);
    lcd.setCursor(9,1);
    lcd.print(" Stop   ");
    digitalWrite(led, LOW);
    digitalWrite(lampu, LOW);
  }
}

BLYNK_WRITE(V2)
{
  timers = param.asInt();
  timer_set = timers;
}

BLYNK_WRITE(V3)
{
```

```
  int limit_temp = param.asInt();
  outputValue = limit_temp;

}
```

APPENDIX B GANN CHART PSM 2